Rangeland Ecology & Management 103 (2025) 153–162

Contents lists available at ScienceDirect

Rangeland Ecology & Management

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

Original Research

Uninsured Pastoralists - Adoption and Attitudes towards Index-Based Livestock Insurance in Four Kenyan Counties

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ARTICLE INFO

Article history:
Received 25 March 2025
Revised 8 August 2025
Accepted 11 August 2025

Key Words:
Basis risk
Customary adaptation strategies
Drylands
Index-based livestock insurance
Pastoralism
Kenya

ABSTRACT

Index-based livestock insurance (IBLI) is promoted as a proactive measure to protect against climate-related risks. Despite initial efforts to introduce the insurance, its adoption has generally been low in most developing countries. This paper compares adopters and nonadopters of IBLI in four arid or semi-arid counties in Kenya, focusing specifically on household demographics, climate effects, land tenure arrangements, and the interaction between other coping strategies and the decision to adopt livestock insurance. The household survey was conducted in 12 counties, whereby 491 respondents were interviewed, of which about 4.5% had insurance. The results showed that IBLI adoption was influenced by the socioeconomic, environmental, and existing adoption strategies. Lack of awareness was the most common reason (44.2% of respondents) for not adopting insurance, showing the need for simplifying information, because the respondents with more schooling were likely to purchase insurance. High precipitation reduced the need for livestock insurance due to low drought risk. Active fodder management positively influenced insurance uptake, likely due to the use of the indemnity for investment in other adaptive strategies. Otherwise, pastoralists were more likely to purchase insurance if they had to travel a long distance to the alternative grazing grounds. Likewise, insurance premiums limited insurance uptake due to the imperfect correlation between drought and indemnity payments (basis risk). Generally, insurance alone is not a panacea for pastoralists. Presently, they seem to be too expensive compared to the value they provide. Either the prediction accuracy of IBLIs must be increased, or premiums more heavily subsidized, for insurance to be a genuine alternative for pastoralists.

Introduction

Pastoralism is often associated with cultural backwardness, conflicts, and insecurity, and sometimes perceived as static (Bonfoh et al. 2016). However, in contrast with this perceived static life, pastoralists have a range of coping strategies against climatic and economic shocks, such as changing herd composition, migrating further in case of drought, livelihood diversification, and active management of the fodder resource (Oba 2001; Opiyo et al. 2015; Bostedt et al. 2023). In fact, pastoralists across the world are often successful in their adaptation to major exogenous shocks, i.e., somewhat of a model for resilience (e.g., Nori and Scoones 2019; Scoones 2021). However, this resilience has its limits, due to major structural changes like climate change and population increase, which are becoming especially evident in East Africa. Coping strategies may not be sufficient in the future, given that climate change is increasingly affecting the lives of pastoralists in East Africa. These customary adaptation strategies must therefore be renewed or supplemented. Climate change has led to more frequent extreme weather events like droughts, which are more intense than usual, irregular and unpredictable rainfall, flooding, and increasing temperatures, making already existing challenges with water and food security even more difficult (Ministry of Foreign Affairs of the Netherlands 2018; Haile et al. 2020).

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https://doi.org/10.1016/j.rama.2025.08.005

Given these challenges, index-based livestock insurance (IBLI) has been promoted in Kenya and Ethiopia since 2010, as an innovation that could aid to protect against climate-related risks that livestock keepers face (Jensen et al. 2015), particularly, among pastoralists with low asset base and who lack access to commercial insurance products. The IBLI are tailored using exogenous and easily observed/available remote-sensed imagery data to determine when and whether payments should be made. This has several advantages, including eliminating the need for claim verification, and reducing familiar problems with moral hazard[1] and adverse selection[2] that normally are an inherent part of almost all insurance markets (cf. Barnett et al. 2008; Jensen et al. 2018). IBLI also has a pre-emptive goal in the sense that payments can be used to improve herd health and nutritional products and services if a drought persists, e.g., to purchase fodder. However, despite initial efforts channeled toward this type of insurance the uptake has generally been low in most countries where it has been introduced (Smith and Watts 2019).

Academic writing about index-based insurance dates back from as early as 1920 in India (Chakravarti 1920). However, the first IBLI program targeted at pastoralists facing climate-related livestock deaths started in 2005 by the Government of Mongolia (cf. Mahul et al. 2009). Globally, as of 2018 IBLI has facilitated more than 1.8 million contracts, covering approximately 8 million people (Jensen et al. 2018). As an example of how IBLI works in practice, in Borana County, Kenya, IBLI contracts are available during two sales periods: January to February and August to September, which precede the short and long rainy seasons. These contracts provide coverage for a full 12-mo period. At the end of each season, index readings are announced, and if the specified strike rate is met, indemnity payments are made to policyholders (Amare et al. 2019). The final contract designed for any given location will depend not only on its own remote-sensed imagery data observations, but also on those from neighboring areas (Woodard et al. 2016).

Studies that analyses local preferences for, and differences in, the uptake of IBLI in East Africa are limited. The only other large-scale survey that has tried to estimate preferences toward IBLI programs among pastoralists in Kenya, including both adopters and nonadopters, is the study by Jensen et al. (2018), which used a dataset from 2009, and focused exclusively on Marsabit County. Their analysis provides evidence that in addition to price and household characteristics, IBLI product characteristics play significant roles in determining demand, and they argue that household-level data should be collected and used to improve the performance of the index. Survey-based, demand analyses have also been made across Kenya's northern border in southern Ethiopia, where IBLI was introduced in 2012, as reported in the study by Takahashi et al. (2016) and Takahashi et al. (2019), which allow for interesting comparisons.

The objective of this paper is to make a comparative analysis of adopters and nonadopters of IBLI in four ASAL (arid and semi-arid land)-dominated counties in Kenya, Isiolo, Laikipia, Baringo, and West Pokot. It focuses specifically on household demographics, climate effects, land tenure arrangements, and the interaction between the choice of other coping strategies and the choice to adopt or not adopt livestock insurance. Furthermore, it focuses on both areas where respondents are more accustomed to IBLI, as well as areas where this is a new phenomenon.

The first aim of this paper is to contribute to addressing the overall question why—despite the potential of insurance as a policy instrument to protect pastoralists against climate-related risks—the uptake remains low. In the literature, several factors have been suggested as explanation, such as insurance product quality and design, affordability, information and education, and behavioral and sociocultural factors such as tenure security (e.g., Nshakira-Rukundo et al. 2021). Building on this, one hypothesis investigated in the paper is therefore that lack of awareness and low education are important contributing factors to the low uptake.

A second aim is to address the potential of insurance in bridging the gap between secure and flexible land rights. The paradox of pastoralists is that they need both secure and flexible land rights (Turner et al. 2016)—where the need for grazing flexibility is increasingly driven by climate change. This is an increasing challenge in the context of the ongoing land adjudication in Kenyan pastoral lands, which increases security (for some groups) while reducing grazing flexibility. However, one factor that has been largely overlooked is how insurance relates to and interacts with these changes in terms of land use and access to grazing land that is ongoing in Kenya. Building on this, the second hypothesis is that tenure security increases uptake, for two reasons—one being that more secure land rights is to a certain extent a proxy for wealth among pastoralists (e.g., Lesorogol 2003), and the other being that tenure security also restricts the possibilities to migrate, an alternative coping strategy.

Another aim is to investigate to what extent other coping strategies could be complements or substitutes to IBLI. Are customary adaptation strategies renewed or supplemented through the introduction of IBLI? Thus, the third hypothesis is that other coping strategies are determinants for insurance uptake.

The approach used in this paper, a systematic and uniform questionnaire and statistical analysis, fills a gap in the literature on pastoralist adoption of livestock insurance by focusing on relative importance of a set of key factors within a specific dryland region to analyze how other coping strategies interact with the choice to adopt livestock insurance in this area. Because Kenya was the first country in subSaharan Africa to implement IBLI and almost all studies are on Kenya, and because other East African countries are in the process of implementing, or are considering similar insurance arrangements, we can learn a lot from Kenya.

Background—Livestock Insurance in Kenya

IBLI in Kenya started in 2010 on the initiative of the International Livestock Research Institute (ILRI) in Nairobi. ILRI collaborated with a team of development economists at Cornell University, University of California, Davis, and Syracuse University, all in the United States, with the design and initial implementation (Johnson et al. 2019). The ILRI program was launched in Marsabit County, on the border with Ethiopia in January 2010. ILRI collaborated with a Kenyan insurance agency and one of the few commercial banks operating in Marsabit. Note that the IBLI product in Marsabit County was calibrated to three different production environments: Lowland Marsabit South, Lowland Marsabit North, and Highland Marsabit Central. Contracts and payoffs were calibrated to each of those production zones and payoffs were triggered in one area based on conditions at a given point in time but potentially not in another.

As IBLI is designed in Kenya and Ethiopia, the insured party makes premium payments twice annually, and receive indemnity payments[3] based on realizations of some objectively measured

[1] In economics, *moral hazard* refers to a situation where an economic actor has an incentive to increase its exposure to risk because it does not bear the full costs associated with that risk, should things go wrong. For example, when individuals are insured, they may take on higher risk knowing that the insurance will pay the associated costs.

[2] In insurance *adverse selection* refers to the higher tendency of high-risk individuals to obtain insurance than low-risk individuals.

[3] An *indemnity payment* is a payment as a result of a contractual obligation of an insurance company to compensate the loss incurred by the insured party.

climate index variable, relative to some predetermined threshold (Chantarat et al. 2017). One advantage with IBLI over traditional insurance is that payments are not triggered by individual claims, but by the value of the remote-sensed signal. This has the potential to both reduce transaction costs and minimize problems with adverse selection and moral hazards. However, one disadvantage with this design is that the IBLI may either overpredict or underpredict actual losses for an individual pastoralist. Overprediction occurs if actual drought losses are smaller, or nonexistent, compared with the predictions of the climate index. Conversely, underprediction occurs if the contract holder experiences a loss even though no indemnity payments are triggered by the index. This imperfect correlation between drought and indemnity payments is referred to as "basis risk" (Chantarat et al. 2017). A study based on data on IBLI in Marsabit County between 2010 and 2012 showed that policy holders are left with an average of 69% of their original risk due to high loss events (Jensen et al. 2016). Unrealized expectations of immediate payouts—forage conditions had been too good to trigger payouts—on the part of the pastoralists, and absent representatives of the insurance agency, led to a deteriorating reputation and declining sales in 2011.

In 2012, ILRI revised the insurance program, it collaborated with a new insurance agency, and in 2013 expanded the insurance program to Wajir and Isiolo County. By 2016, this ILRI program had expanded further to include the counties of Turkana, Marsabit, Mandera, Garissa, and Tana River, all north or east of our study region. Considerable effort was now put into explaining what IBLI was and how it worked (Johnson et al. 2019). As the basis risk is a challenge to this kind of insurance, a lot of effort is needed to explain how the insurance product works.

The number of insured pastoralists nearly tripled within a year, with total contracts sold rising from 462 in 2013 to 1 323 in 2014. By 2015, overall sales surged to 6 106. However, during the 2015/2016 period, growth slowed, resulting in 2 445 contracts sold overall (Johnson et al. 2019). Additionally, in 2014, the Government of Kenya, in collaboration with the World Bank, launched the Kenya Livestock Insurance Program (KLIP).

KLIP is run by the Ministry of Agriculture, Livestock, Fisheries, and Irrigation, and supported by ILRI, the World Bank, and the international insurance company Swiss Re. ILRI is currently the calculating agent that designed the index and make payout calculations. As an IBLI KLIP uses Normalized Difference Vegetation Index (NDVI), often referred to as "greenness maps," assessments from satellite remote sensing (Miller et al. 2020). The insurance triggers, or decision points, which determine whether payout should be made, are identified by the response of observed NDVI. The insurance contract's rationale is that drought causes forage depletion, which is strongly linked to livestock mortality, and this forage depletion is evident through observable changes in NDVI. The index is derived from the standard score of the spatially averaged vegetation conditions over a Unit Area of Insurance. Payouts based on the index could potentially be provided to the insured pastoralist twice a year, corresponding to the long and short rainy seasons: once in midAugust and once in midFebruary. These insurance payouts allow pastoralists to purchase food and water to sustain livestock, or replace lost livestock. Households have to decide to join KLIP by insuring a minimum number of animals set by the scheme.[4] By so doing, the whole herd is covered from risk of loss from drought.

By early 2018, the program had reached 32 000 pastoral households (Mohtasin 2021), and as of 2020 KLIP covers all of the abovementioned counties, plus West Pokot, northern Baringo and northern Laikipia (Miller et al. 2020). However, as demonstrated by Jensen et al. (2024) in an analysis of sales data from 2010 to 2020, heterogeneous supply has constrained purchases so that purchases are not exclusively a function of demand.

Average premium rates paid by a KLIP-insured pastoralist are roughly 8.5% of the value of the insured amount, which translates to an annual premium of about 1 200 KES (9.29 USD[5]) for one cattle, 120 KES (0.93 USD) for a goat or sheep, and 1 750 KES (13.55 USD) for a camel. There is also a fully subsidized component for vulnerable households, where the national and county governments had set up selection criteria to ensure that only sufficiently vulnerable households benefit from the fully subsidized component.

Some of the previous research on IBLI programs in Kenya has focused mainly on understanding of the quality of the existing insurance products that are offered. Jensen et al. (2016) argue that index insurance product quality remains largely unexplored, and consumers can only begin to estimate the design risk once they have observed a number of periods of product coverage. They argue that consequently, basis risk remains an Achilles heel of index insurance. Other research studies have been based on simulations of pastoralist household wealth dynamics based on stylized models, such as the study by Chantarat et al. (2017), who find that IBLI will be less valuable to the poorest whose assets are too small to prevent herd collapse in the event of drought. Finally, there are overviews of the competing expectations held by actors such as (re)insurers, researchers, donors, NGOs, and pastoralists, such as in the study by Johnson et al. (2019). Their analysis suggests that early demand and subsequent backlash were not results of systematic mis-selling, but rather stemmed from unfulfilled expectations by the pastoralists, as well as patron-like relationships with insurance partners.

Finally, it must be emphasized that IBLI programs do not enter in a vacuum—rather there are various forms of informal insurance systems that have existed across African societies for centuries. Among them can be mentioned *ekone* among the Karomojong of northeast Uganda, *dabare* among the Gabra people of northern Kenya, and *osotua* among the Maasai of Kenya, (cf. Takahashi et al. 2019; Muchema et al., 2025). Social networks can be based on socioeconomic, cultural, and personality attributes, and friendships can be forged and maintained through gifts, provision of livestock fodder, livestock transfers, and financial assistance from informal group-based savings organizations (cf. Bostedt et al. 2021).

The study by Muchema et al. (2025) is arguably the most recent study of IBLI in Kenya. Based on in-person interviews with pastoralists, a focus group discussion, and key informant interviews, the authors found that although social networks enhance resource sharing, climate change is strangling traditional risk-management structures of pastoralism. However, the study concludes that the low IBLI uptake was due to low awareness levels, a slowed premium sale supply, and a plausible product trust deficit. The study recommends establishing a framework that integrates both the traditional and modern approaches to risk sharing.

Study Area

This study focuses on the Kenyan rangelands, covering slightly over 83% of the country (Ministry of Agriculture, Livestock, Fisheries and Cooperatives, 2021), and home for millions of pastoralists and agropastoralists practicing mainly extensive livestock grazing in open rangelands. The study is one part of the research project "Escaping the pastoralist paradox in the face of climate change," funded by the Swedish Research Council. The four Kenyan counties chosen as case study areas, West Pokot, Baringo, Laikipia, and

[4] The minimum number is five Tropical Livestock Units (TLU), where a cow equals one TLU, while a sheep is 0.1 TLU, and a camel is 1.25 TLU.

[5] Exchange rate in May 2025.

Table 1
Demographic and climate characteristics of the studied counties.

Variable	West Pokot County	Baringo County	Laikipia County	Isiolo County
Population[1]	621 135	666 730	518 532	267 966
Population density (inh./km^2)[1]	68	61	55	11
Percent urban population[1]	5.1	11.3	24.6	46.9
Average annual rainfall (mm/yr)[2]	1 025–1 039	729–921	647–797	453–587
Average air temperature (°C)[3]	~21	23–26	18–19	22–26
Altitude range (meters above sea level)[4]	750–3 370	726–3 000	1 500–2 611	200–1 104

[1] Government of Kenya (2020).
[2] Kenya National Drought Management Authority, average 1960–1999.
[3] NASA, GES-DISC Interactive Online Visualization And Analysis Infrastructure (Giovanni).
[4] County statistical abstracts for the respective counties.

Isiolo, are all dominated by semi-arid land where pastoralism is or has been the dominating livelihood (cf. Table 1). Within and in a comparison between the counties, the transition toward a more sedentary, privatized, and commercialized agropastoralism land use practices is in different phases and has taken different forms. The four counties were chosen to study IBLI and a broad range of issues relating to the effects of climate change on pastoralists in Kenya. The study area does not include the northernmost counties in Kenya, which were the pilot counties for IBLI. Rather, these counties represent a later stage (2013 onward) in the expansion of IBLI insurance and areas where it could be expanded to in the future.

West Pokot County

West Pokot County is mainly inhabited by the Pokot people. Pastoralism, in the form of agro-pastoralism and transhumance pastoralism, supports over 90% of the county's population (Muricho et al. 2019). Although one of the least urbanized counties in Kenya, it has the highest population density of the four studied counties. In terms of topography, the northern and northeastern parts are dry plains, with a lower altitude, whereas the southeastern part rises to an altitude of 3 370 m above sea level. Within the county, Chepareria Ward has seen extensive implementation of private rangeland enclosures to alleviate pasture scarcity and enable proper management of formerly degraded areas–a process that has been thoroughly described in the literature (e.g., Nyberg et al. 2015; Wairore et al. 2015a,b,c).

Baringo County

Baringo County is situated in the Rift Valley region, and the main ethnic communities are the Tugen, Pokot, and 'Il Chamus. As in West Pokot, the absolute majority of the population reside in the rural areas. According to Vehrs (2018), among the East Pokot north of Lake Baringo—which the study ward of Loiyamorok is part of—livestock numbers per km^2 have increased tremendously during the twentieth century. The eastern part of the county is in the floor of the Rift Valley. Here Lake Baringo is one of the fresh water lakes in the Rift Valley floor, and provides an abundant source of fresh water. The studied wards all lie in the center of the county.

Laikipia County

Laikipia County encompasses a vast highland plateau, which is naturally bordered by the Great Rift Valley to the west, the Aberdares mountain ridge to the south, and Mount Kenya to the east. Current land use and tenure arrangements have been shaped by an especially dramatic history (Hughes 2006), and today around 40% of the county is owned by a small, non-pastoralist, minority (Letai 2011). Thus, competition for land is high, and the majority of the pastoralists are members of group ranches, surrounded by large privately owned estates. One effect of this is that pastoralist livestock herds are more or less stationary, where seasonal migration in accordance with grazing conditions was previously the norm (Huho et al. 2010; Boles et al. 2019). Ethnically there are about 23 communities, comprising Maasai, Samburu, Rendile, Somali, Pokots, Kalenjins, Meru, Kikuyu, and Turkana, among others (The Ministry of Agriculture, Livestock and Fisheries 2017a).

Isiolo County

Most of the Isiolo County is a flat low lying plain, which is hot and dry most of the year. This county has the lowest population and the lowest population density of the four studied counties, but the highest level of urbanization. Annual average rainfall is lower than in the other three counties. Most of the land is communally owned, under the trustship of the county government (Boye and Kaarhus 2011). The main ethnic groups in Isiolo are Borana, Meru, Samburu, Somali, and Turkana (The Ministry of Agriculture, Livestock and Fisheries 2017b).

Fig. 1 shows the location of the wards included in the survey.

Methods

The survey

This paper uses data from a unique survey study of pastoralists in four counties in Kenya, conducted in March and April 2020, covering 520 respondents in 12 wards in West Pokot, Baringo, Laikipia, and Isiolo counties, using personal interviews. This means that the survey was conducted just before the rainy season, and was completed just before the COVID-19 pandemic resulted in severe travel restrictions across Kenya.

Purposive and multistage cluster sampling approaches were used in this study to select first counties, then wards within the selected counties, and finally households within the selected wards. In the first stage, sampling was purposive to West Pokot, Baringo, Laikipia, and Isiolo because of the different land use changes occurring in the four counties. This was motivated by the fact that the survey as a whole had the broader purpose of making a comparative study of the relationship between land tenure and capacity for climate adaption in pastoralist regions in Kenya. Thus, the questions focusing on livestock insurance were only one part of the questionnaire, and given the information from other sources (e.g., Smith and Watts 2019) that the livestock insurance uptake was low it was expected that a minority would be holders of an insurance contract.

A multistage sampling approach was used in the second stage. Within the four counties, three wards per county were purposively selected taking into account the different land uses within the counties, conditional on there being a largely pastoralist community living in the ward. These were the primary sampling units for the survey, making a total of 12 sampling units.

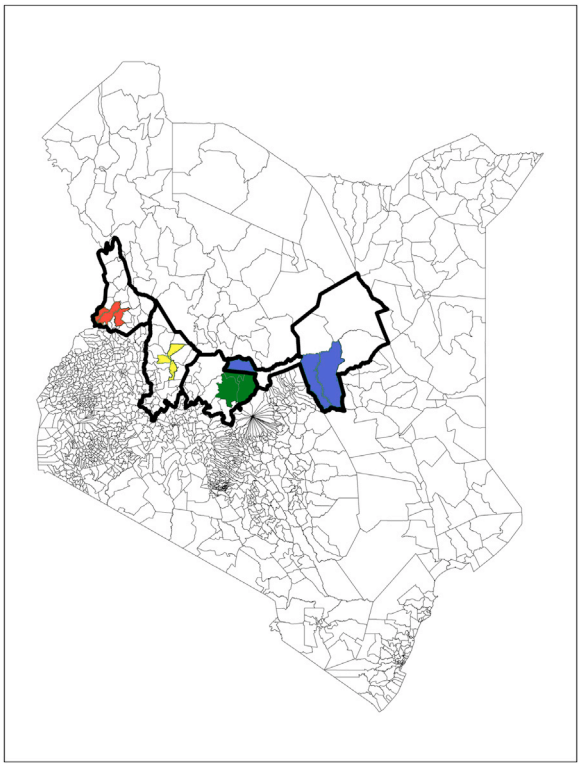

Figure 1. Locations of counties and wards in the study. Red wards—Suam, Chepareria, and Riwo—are in West Pokot County. Yellow wards—Loiyamorok, Ilchamus, and Saimo/Soi—are in Baringo County. Green wards—Mukogodo West, Mukogodo East, and Segera—are in Laikipia County. Blue wards—Oldonyiro, Garbatulla, and Kinna—are in Isiolo County.

Systematic random sampling was used to select the individual household respondent. This was achieved by selecting every fourth household (manyatta) on either side of the road or path (Mugenda and Mugenda 2003; Kothari 2010). Data were collected at the household level using semistructured questionnaires that were administered through a face-to-face interview by trained local enumerators, and encoded on tablets. We wanted to make sure that the respondents could understand the questions and express their answers in their mother tongue. Although many pastoralists understand Swahili, the lingua franca of East Africa, many do not. For this reason, we recruited enumerators—four for each county—who were university students from the University of Nairobi from the same ethnic group as the respondents, and who were fluent in the local languages. A total of 520 respondents were interviewed across the four counties, resulting in 491 usable[6] responses, of which 22 had livestock insurance. The distribution of respondents across the counties was fairly even with 125 respondents from West Pokot, 123 from Baringo, 122 from Laikipia, and 121 respondents from Isiolo.

The whole survey tool consisted of 70 questions, with several different sections. The focus here, however, is on the questions about livestock insurance, namely the question: "*I have joined a livestock insurance program,*" where the response alternatives were yes or no, and the follow-up question: "*If you have NOT joined a livestock insurance program, why*", with the following response alternatives:

- It is not available where I live (henceforth denoted *Availability*).
- I was not aware that livestock insurance existed (denoted *Awareness*).
- It is too expensive (denoted *Expense*).
- I don't think I need an insurance (denoted *Need*).
- Other, please state reason.

Furthermore, another of the questions in the survey reads: "*What is your strategy to cope with changes in livelihood conditions? More than one alternative is possible,*" with eight preset alternatives, where the most commonly chosen were:

- Reduce herds.
- Change composition of herd.
- Migrate further distances.
- Diversifying livelihoods, e.g., taking up other activities/jobs.
- Active management of fodder resources.

These coping choices were used to address the third hypothesis—to what extent other coping strategies are determinants for insurance uptake.

Statistical approach

Initially, probit models of the decision to purchase insurance were estimated for the whole sample. However, it should be borne in mind that no respondents in Baringo and only a few in West Pokot have purchased an insurance contract, resulting in an inflated number of zeroes in the dependent variable. For this reason, a restricted model, with only the Isiolo and Laikipia observations, was also estimated. Specifically, we assume that the probit model takes the form:

$$P(Y = 1|X) = \Phi\left(X^T\beta\right) \quad (1)$$

where P is the probability and Φ is the cumulative distribution function of the standard normal distribution. The parameters β were estimated by maximum likelihood in Limdep/Nlogit.

Explanatory variables used in the vector X were first a set of climate/geographic variables, which included annual average precipitation and temperature on the ward level, as well as distance to alternative grazing grounds (in km). These are averages over the period 2009–2019, and for rainfall, the data come from the Kenya National Drought Management Authority, whereas for temperature, it comes from NASA's GES-DISC Interactive Online Visualization And Analysis Infrastructure (Giovanni). The distance to alternative grazing grounds was one of the questions in our survey. We also used dummies for the wards, with West Pokot County as baseline when the full sample is used, whereas Laikipia is used in the geographically restricted model, and dummies for whether the respondent had a group or private title deed (denoted *Anydeed* in the following). The county level dummies are motivated by our interest in analyzing possible geographical differences, whereas the deed dummy was selected to investigate whether ownership security made it more or less likely to make the decision to get insurance. In the study by Promsopha (2017), it is argued that customary tenure and communal property perform key informal risk-coping functions, and that further research on risk coping would benefit from examining property regimes. This dummy variable is therefore one way to address the effect of property regimes on insurance adoption as a risk-coping choice.

To these independent variables, socioeconomic variables such as gender of household head, age and years of schooling of household head, and household size were added. Household income was one of the questions in the survey—but extensive item nonresponse rendered this variable unusable in the probit models, although descriptive statistics are presented.

[6] Usable in the sense that the questions focused in this paper were answered.

Table 2
Descriptive statistics—some demographic variables. Means and 95% confidence intervals within parenthesis. The values within brackets for all rows are the lower and upper limits of 95% confidence intervals around the sample mean.

Variable	West Pokot	Baringo	Laikipia	Isiolo
Household head (share male)	0.82 (0.75–0.89)	0.80 (0.73–0.87)	0.53 (0.44–0.62)	0.59 (0.50–0.68)
Household head (share male), insured			0.75 (0.43–1.07)	0.36 (0.062–0.66)
Household head, mean age (yr)	44.4 (43.0–45.9)	52.5 (50.4–54.8)	39.4 (36.7–42.2)	39.9 (37.3–42.6)
Household head, mean age (yr), insured			47.1 (38.9–55.3)	35.6 (30.4–40.8)
Schooling of household head (yr)	6.8 (5.8–7.8)	6.5 (5.8–7.3)	7.5 (6.5–8.5)	8.4 (7.3–9.5)
Schooling of household head (yr), insured			7.8 (4.1–11.4)	8.2 (5.7–10.7)
No. of household members	8.2 (7.4–8.9)	8.9 (8.0–9.9)	6.1 (5.6–6.6)	6.1 (5.5–6.7)
No. of household members, insured			8.6 (5.9–11.4)	7.8 (6.1–9.5)
County average, no. of household members (2019)[1]	4.6	5.0	3.4	4.6
Share of households with IBLI (%)	1.6	0.8	6.6	9.0
No. of observations[2]	125	123	122	121

[1] Kenya Bureau of Statistics (2020).
[2] Excluding item nonresponse.

Results

Pastoralists' sociocultural characteristics and IBLI uptake/purchase

Table 2 shows some descriptive statistics on the county level, together with 95% confidence intervals.[7]

Notable is that West Pokot and Baringo counties have significantly higher share of male headed households in the sample, compared with Laikipia and Isiolo, as shown by the confidence intervals. Baringo also has significantly older aged household heads than the other three counties, again as shown by the confidence intervals. Household heads in Isiolo County have somewhat more years of schooling than the other counties, but here the differences are smaller. As shown by the confidence intervals, the mean number of household members is significantly higher in West Pokot and Baringo (with the typical household being two parents and six children) compared with Laikipia and Isiolo (where the typical household consists of two parents and four children). Overall, the sample mean household sizes are larger in the sample compared with the county averages, which is unsurprising because pastoralist households generally are larger. The demographic means for the respondents with IBLI were not significant from the means for the overall sample for Laikipia and Isiolo. The share of households with IBLI in the sample was very low in West Pokot and Baringo counties, which meant that it was not meaningful to calculate demographic means for these subgroups, but clearly higher in Laikipia and Isiolo counties.

Although the government ambition is to provide insurance access to pastoralists in all of Kenya, our dataset provides some insight into the level of adoption in our four study counties (see Fig. 2).

Of the 22 respondents who had purchased a livestock insurance contract, 2 lived in West Pokot, 1 in Baringo, 8 in Laikipia, and 11 in Isiolo. In Isiolo, the main reason for not purchasing is that the respondent felt they did not need it—which can be seen as an informed choice. This is unsurprising, given that livestock insurance has been around since 2013. In Laikipia, Baringo, and West Pokot, the main reason for not purchasing was reported to be lack of awareness, or a belief that it is not available.

The drivers of IBLI adoption/purchase

Table 3 shows the results of the probit models. The first model includes dummies for the counties, with West Pokot County as the baseline. In the second model, the counties dummies are omitted for reasons described below. The third model is based only on the data from Laikipia and Isiolo. This model has a dummy for Isiolo County, with the baseline being Laikipia County

Focusing first on the climate variables in Model 1 in Table 3, both precipitation and temperature are significant, but with unintuitive signs in the sense that the expectation is that higher precipitation would decrease, whereas higher temperature would increase, the likelihood of obtaining insurance, whereas the signs of these coefficients are reversed in the model. This effect could be caused by multicollinearity because precipitation and temperature are significantly negatively correlated. For the county dummies, results show that respondents from Isiolo and Laikipia counties are significantly more likely to purchase an insurance contract compared with the baseline county West Pokot. None of the dummies for alternative coping strategies are significant in Model 1, which means that the third hypothesis, that other coping strategies are determinants for insurance uptake, is not supported. The tenure dummy was insignificant, which means that the second hypothesis, that tenure security increases uptake, is also not supported. This could also be caused by multicollinearity because the tenure security dummy is positively correlated with precipitation and negatively correlated with temperature—which is reasonable because it makes more sense to have title deed where intense production is possible. Of the demographic variables, results show that older household heads with more schooling are significantly more likely to purchase insurance, which strengthens the hypothesis that low education is an important contributing factor to the low uptake, which supports the third hypothesis.

The unintuitive signs lead to the suspicion of covariance with county dummies. Therefore, in the second model the county dum-

[7] The confidence interval is based on the sample mean, $\bar{X}$, and the sample standard deviation, s. The equation is then: $\bar{X} \pm Z * \frac{s}{\sqrt{n}}$, where Z is the Z-value for the chosen confidence level drawn from the Student's t-distribution, $\bar{X}$ is the sample mean, s is the sample standard deviation, and n is the sample size.

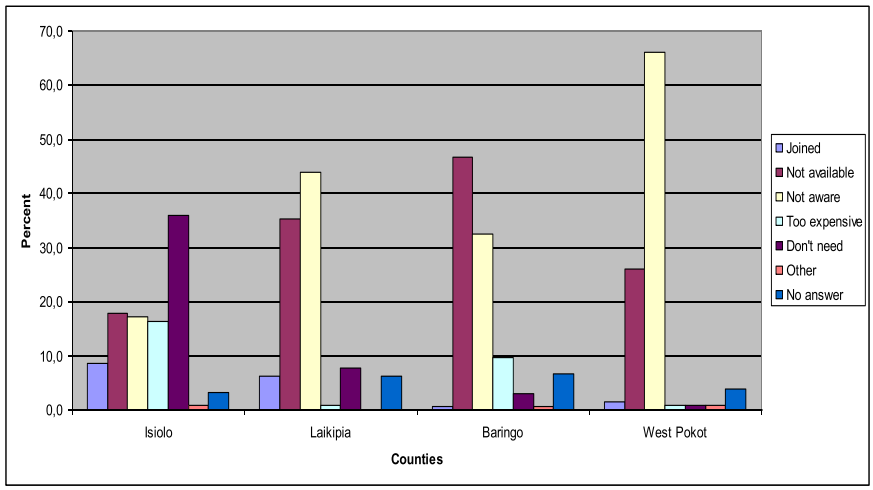

Figure 2. Adoption of livestock insurance and stated reasons for not joining on the county level ($n = 479$).

Table 3
Binomial probit models of the decision to join index-based livestock insurance.

Variable	Model 1 (Baseline county: West Pokot)	Model 2	Model 3 (Baseline county: Laikipia County)
Constant	−5.8941	2.0413	−1.5125
	(−1.277)	(1.258)	(−0.305)
Geographical/climate variables			
Distance to alternative grazing	0.000009	0.000009	0.0051
grounds (km)	(0.259)	(0.325)	(1.879)[2]
Precipitation (mm, annual average)	0.0077	−0.0023	0.0047
	(2.327)[1]	(−2.374)[1]	(1.302)
Temperature (°C, annual average)	−0.2775	−0.1406	−0.2845
	(−2.139)[1]	(−2.255)[1]	(−1.543)
Alternative coping strategies (dummies)			
Reduce herd	0.5163	0.1832	0.0003
	(1.377)	(0.605)	(0.0)
Change composition of herd	0.3706	0.1058	0.4513
	(0.931)	(0.310)	(0.870)
Migrate further	−0.6410	−0.4108	−7.5036
	(−1.088)	(−0.786)	(0.0)
Diversify livelihood	0.4254	0.2091	0.3966
	(1.158)	(0.661)	(0.748)
Active fodder management	0.5238	0.6219	0.1276
	(1.524)	(2.014)[1]	(0.268)
County dummies			
Baringo	−5.1611		
	(0.0)		
Laikipia	2.0284		
	(1.819)[2]		
Isiolo	5.4587		3.0962
	(3.317)[3]		(3.001)[3]
Demographic variables			
Any title deed	−0.3120	0.0028	0.0886
	(−0.776)	(0.008)	(0.171)
Male hh head	−0.1505	−0.2394	0.0029
	(−0.498)	(−0.914)	(0.008)
Age of hh head (yr)	0.0159	0.0046	0.0013
	(1.420)	(0.466)	(0.088)
School years hh head	0.0411	0.0362	0.0172
	(2.576)[1]	(2.428)[1]	(0.643)
Hh size (persons)	0.0360	0.0243	0.1210
	(1.140)	(0.764)	(1.595)
McFadden R^2	0.315	0.165	0.327
No. of observations	447	447	211

T-values are within parenthesis.
[1] Significant at the 5% level.
[2] Significant at the 10% level.
[3] Significant at the 1% level.

mies were omitted. Then both the variable for precipitation and the variable for temperature were significant and negative. This suggests that in wards where natural precipitation is high the incentive to purchase a livestock insurance contract is low. This is intuitive, where the risk of drought is lower the motivation to sign an insurance will also be low. The negative sign of the temperature variable is harder to explain, but could be influenced by the fact that Oldonyiro Ward where insurance uptake is high is slightly mild climate wise. Furthermore, and very interesting, the dummy for active fodder management is significant and positive. Because respondents with insurance are largely found in Laikipia and Isiolo—the counties with the lowest share of respondents doing active fodder management—these respondents must consider that acquiring insurance is a complementary strategy to active fodder management. Of the demographic variables only school years is significant in this model.

In the more restrictive "Isiolo/Laikipia model," based only on the Isiolo and Laikipia data, the distance to alternative grazing grounds is significant, suggesting that respondents with long migration distances are more likely to purchase an insurance contract. The precipitation variable is insignificant, whereas the Isiolo County dummy is highly significant.

Overall, it is also interesting to note which variables that are *not* significant in either of the models. Clearly, having a title deed (group or private) is not relevant for the decision to purchase livestock insurance, and neither are the gender of the household head.

Explanatory variables for IBLI nonadopters or uninsured pastoralists

We now focus on the stated reasons for not joining, i.e., *Availability*, *Awareness*, *Expense*, and *Need*—ignoring the "*Other*" and "*No answer*" alternatives, partly because very few respondents checked these alternatives, and partly because they have no natural interpretation. Probit regressions were made for each of the above reasons with county level dummies. The results can be found in Table 4.

Looking first at the distance and climate variables, it seems like respondents with long migration distances were less likely to state that they were not aware of the insurance alternative, or that they did not need it. Respondents in areas with high precipitation were more likely to state that they did not need insurance, which is intuitively reasonable. Note that precipitation is positively correlated with elevation. Traveling to higher elevations in these counties not only means that rainfall increases, but the coefficient of variation of annual rainfall decreases. That make pastoralists less prone to the type of shocks that the insurance is meant to address.

Respondents with title deeds were less likely to state that insurance was not available, but significantly more likely to state that they were simply not aware of the insurance alternative. The response that the respondents were not aware of the existence of livestock insurance is significantly less likely in Isiolo County, which natural given that it has been in existence there since 2013. The stated reason that the insurance is too expensive or that they do not need insurance is significantly more common in Baringo, Laikipia, and Isiolo counties, compared with the baseline West Pokot. Finally, the stated reason that insurance is too expensive is significantly more common among better-educated respondents, suggesting a more informed decision process.

Discussion

The focus in this paper has been local preferences among pastoralists for IBLI and differences in the uptake of IBLI in four counties in Kenya. We argue that the preferences toward and the low uptake of insurance must be understood in relation to the ongoing major changes in terms of land use and access to grazing land. Here IBIL comes in—could it be a "third way" out of the pastoralist paradox by reducing uninsured, drought-related risk, thereby avoiding the route of either increasing tenure security (for some groups) while reducing grazing flexibility, or vice versa.

The findings showed that IBLI uptake among pastoralists was very low in the study sites, as was also reported by Lung (2021), despite over 10 yr of scheme implementation. The low uptake also aligns with Oduniyi et al. (2020), who found a low willingness to pay (WTP) for IBLI in South Africa. However, the signs of the coefficients in the regression results also demonstrate that the trend toward reduced migration, more intensive animal husbandry with the help of active fodder management, and more education has the potential to increase the demand for insurance. Reduced migration is not so much driven by the right to grazing land during the wet season, but by the reduced access to grazing land to migrate to during the dry season due to the proliferation of private ownership.

The awareness response demonstrates that information about the possibility of purchasing IBIL is something that has grown organically, likely through word of mouth, from east to west across the study region. One key limiting factor for adoption of insurance has previously been availability and awareness. As shown earlier, the introduction of the KLIP insurance product to the more westerly located counties of Baringo and West Pokot is fairly recent. However, even in the parts of the study region where it was introduced earliest, it has not really gained widespread popularity. The question is why.

The results provide some explanations that are expected and predictable, such as the fact that respondents with more schooling are significantly more likely to be insured. That education increases demand for insurance is in contrast with the Ethiopian survey results in Takahashi et al. (2016), where the education level was negatively correlated with IBLI uptake, as well as the South African contingent valuation study by Oduniyi et al. (2020), which showed that education was negatively correlated with WTP. Insurance products are notoriously difficult to understand, and simplifying the information that is presented to the pastoralists is a challenge, but one that the organizations behind the insurance products must rise up to if adoption is to spread further. It also points to the importance of education in marginalized pastoral areas, i.e., one can see low insurance uptake as indirect evidence of marginalization. However, it is somewhat promising for future insurance uptake that insurance and active fodder management seem to be complementary strategies, because Baringo and West Pokot are counties where active fodder management is much more common. As mentioned in Hurst et al. (2012), effective fodder management opens up opportunities for income generation that can be used to invest in insurance coverage. However, it can also lower risk exposure, leading to reduced insurance premiums and payouts.

Furthermore, in wards where natural precipitation is high the incentive to purchase a livestock insurance contract is low. This suggests that there are likely natural barriers and enablers for the adoption of livestock insurance, given by the natural precipitation distribution across Northern and Central Kenya—e.g., if the dry spells are not severe, then pastoralists do not need IBLI.

Another source of explanation is the cost of livestock insurance, which is mainly advanced by respondents in Isiolo County, where awareness is relatively high, and insurance products have been available the longest of the surveyed counties. These pastoralists—with more experience with livestock insurance—seem to feel that the premiums are too high in comparison to what the product gives. Indeed, as shown by Jensen et al. (2016), the basis risk suffered by the insured pastoralists due to underprediction is high, a fact that seems to be known where these insurance products have been around longer. High basis risk will always reduce demand, as demonstrated by Jensen et al. (2018), although the quality in the remote sensing data are likely to improve over time. As noted

Table 4
Binomial probit models of the stated reason for not joining index-based livestock insurance.

Variable	Not available	Not aware	Too expensive	Don't need
Constant	1.8645	–0.4571	–7.2754	–7.5516
	(–0.650)[1]	(–0.159)	(–2.397)[3]	(–2.567)[3]
Geographical/climate/tenure variables				
Distance to alternative grazing grounds	0.0005	–0.00003	–0.00001	–0.0049
(km)	(0.835)	(–3.998)[2]	(–0.308)	(–2.544)[3]
Precipitation (mm, annual average)	–0.0020	–0.0014	0.0059	0.0046
	(–1.570)	(–1.052)	(3.451)[2]	(2.752)[2]
Temperature (°C, annual average)	0.0076	0.0979	–0.1242	0.0136
	(0.089)	(1.124)	(–1.440)	(0.166)
County dummies				
Baringo	–0.0084	–1.3971	2.3878	1.4248
	(–0.030)	(–4.441)[2]	(4.706)[2]	(2.523)[3]
Laikipia	–0.3896	–0.6162	1.5653	2.6293
	(–0.638)	(–1.016)	(1.970)[3]	(3.335)[2]
Isiolo	–1.4270	–2.269	5.0303	4.6611
	(–2.601)[2]	(–3.842)[2]	(6.019)[2]	(5.144)[2]
Demographic variables				
Any title deed	–0.4383	0.3360	–0.0001	0.4238
	(–2.600)[2]	(1.973)[3]	(0.0)	(1.381)
Male hh head	–0.3317	0.2417	0.5746	–0.0033
	(–2.243)[3]	(1.625)	(1.835[1]	(–0.016)
Age of hh head	–0.0086	0.0058	0.0151	–0.0017
	(–1.620)	(1.066)	(1.547)	(–0.241)
School years hh head	0.0106	–0.0139	0.0317	–0.0088
	(0.948)	(–1.139)	(2.665)[2]	(–0.490)
Hh size	0.0252	–0.0325	0.0001	0.0262
	(1.550)	(–1.997)[3]	(0.005)	(1.428)
McFadden R^2	0.083	0.135	0.295	0.302
No. of observations	431			

T-values are within parenthesis.
[1] Significant at the 10% level.
[2] Significant at the 1% level.
[3] Significant at the 5% level.

by Bulte and Haagsma (2021), substantial subsidies will likely continue to be required in the near term—and possibly well into the future—to support the widespread adoption of index-based drought insurance. However, as noted by these authors, increased subsidies can have the downside of raising short-term stocking rates.

Conclusion

The first aim of this paper was to contribute to addressing the overall question why the uptake remains low. Related to this, the first hypotheses stated in this study were accepted because education increases uptake and low awareness about IBLI is an important explanation behind the low uptake, which highlights the need to simplify information for pastoralists, whereas the second hypothesis was rejected because tenure security does not have a significant effect. This relates to the second aim—to address the potential of insurance in bridging the gap between secure and flexible land rights.

Concerning the third aim, to what extent other coping strategies could be complements or substitutes to IBLI, that insurance can be considered a complementary strategy to active fodder management livestock confirms the third hypothesis, a fact that should be highlighted and used more extensively in the promotion of IBLI.

However, insurance alone is not the panacea to the pastoralist paradox. Presently, they seem to be too expensive compared to the value they provide. Either the prediction accuracy of IBLIs must be increased, or premiums more heavily subsidized, for insurance to be a genuine alternative for pastoralists.

Data Availability

The survey data are available upon request from the corresponding author.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

Göran Bostedt: Writing – review & editing, Writing – original draft, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Per Knutsson:** Writing – original draft, Investigation, Funding acquisition, Conceptualization. **Deborah Muricho:** Investigation, Data curation. **Stephen Mureithi:** Writing – original draft, Supervision, Resources, Project administration, Investigation, Funding acquisition, Conceptualization. **Ewa Wredle:** Writing – original draft, Project administration, Investigation, Funding acquisition.

Acknowledgements

The authors also wish to thank the research network Triple L's research project "Escaping the pastoralist paradox in the face of climate change", funded by the Swedish Research Council for financial support. We also thank the data enumerators for their committed effort to collect reliable data during fieldwork and all the respondents who took their time to answer the survey. Finally we would like to thank the anonymous reviewer for constructive comments.

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