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Preferences for Bundled Index-Based Livestock Insurance: Evidence From Northern Kenya

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ABSTRACT

Considerable attention has been placed on bundled index insurance to enhance climate resilience, address multiple risks simultaneously, and increase the adoption of agricultural technologies. We conducted an *endow-and-exchange* choice experiment with 1,828 female and male livestock keepers in northern Kenya to elicit their preferences for bundled index-based livestock insurance (IBLI). We measured relative willingness to pay (WTP) as the maximum amount of money that an individual is willing to pay to switch from one bundle to another. We found that livestock keepers were willing to pay 19%–33%, 100%–153%, and 148%–232% more for *IBLI + animal nutrition*, *IBLI + animal health*, and *IBLI + flexible package*, respectively, relative to *IBLI + animal breed*. Relative to the average WTP to switch from other bundles to *IBLI + animal breed*, women had 36%–45%, 54%–64%, and 76%–84% higher WTP than men for *IBLI + animal nutrition*, *IBLI + animal health*, and *IBLI + flexible package*, respectively. Providing information about bundled products and seasonal vegetation forecasts reduced the relative WTP for *IBLI + animal nutrition*. Our findings highlight the importance of considering the differential preferences of women and men when designing and promoting bundled IBLI products.

JEL Classification: G52, O33, Q54

1 | Introduction

Intensifying extreme weather events have attracted considerable attention to the role of agricultural index insurance in climate risk management. The index-based livestock insurance (IBLI) was developed to cushion pastoralists against severe drought. IBLI uses the normalized difference vegetation index (NDVI) to monitor forage availability during the rainy season. Based on the NDVI values, payouts are triggered early in the dry season in anticipation of a severe drought. IBLI has been implemented widely in East Africa as a stand-alone innovation. Studies have shown its beneficial impacts in protecting vulnerable pastoralist populations from climate-induced poverty traps, reducing downside income risk, improving food security, spurring investment in productivity-enhancing inputs, and mitigating resource-based conflicts (Chantarat et al. 2017; Jensen et al. 2017; Bertram-Huemmer and Kraehnert 2018; Janzen and Carter 2019; Gehring and Schaudt 2024; Shikuku and Ochenje 2025; Sakketa et al. 2025). To optimize the welfare benefits, studies have suggested innovative approaches to minimizing basis risk through product quality improvement, increasing affordability, reducing information constraints, and addressing supply-side barriers to uptake (Estefania-Salazar et al. 2024; Arteaga et al. 2024a; Jensen et al. 2024).

Under rapidly changing contexts characterized by more frequent, prolonged, and intense climate extremes, compounded by other production risks such as pests and diseases, focus has been placed on the potential of bundled socio-technical and financial innovations for agri-food systems transformation and achievement of the 2030 agenda for sustainable development (Barrett et al. 2020). Bundling involves the deliberate combination of different complementary and proven interventions with the express intention of solving a human need (Lybbert and Carter 2015; Barrett et al. 2020). Interest is growing in bundling agricultural index insurance with other services, both financial and non-financial (Carter et al. 2017; Mukherjee et al. 2017). Several reasons motivate this growing interest. While stand-alone index insurance covers only a fraction of risks when considering the various layers of risk exposure (Kramer et al. 2022), bundling insurance with other services can help address multiple constraints simultaneously (Deutschmann et al. 2025), generate complementarities necessary for enhancing the ability to cost-effectively address climatic shocks (Lybbert and Carter 2015; Boucher et al. 2024), and reduce barriers to agricultural technology adoption (Farrin and Miranda 2015; Bulte et al. 2020; Mishra et al. 2023; DePaula 2023). However, while studies have assessed uptake and the effects of bundled crop insurance, empirical knowledge about livestock keepers' preferences for bundled IBLI in the rangelands is limited, and the role that information plays in influencing such preferences is not well understood. Such knowledge is crucial for the design and implementation of appropriate bundled IBLI products for climate risk management and resilience building in the face of unpredictable, recurrent, and intense climate shocks.

We conducted an *endow-and-exchange* choice experiment with female and male livestock keepers from pastoralist households in northern Kenya with the objectives to: (1) elicit their preferences for bundled IBLI, (2) examine heterogeneity of preferences between women and men, and (3) assess the effect of information (training about bundling and providing seasonal vegetation forecast) on the relative willingness to pay (WTP) for bundled IBLI. We studied four bundled IBLI products. The first bundle, *IBLI + animal health*, comprised IBLI and inputs relating to livestock medicines, vaccines, and clinical services. The second bundle, *IBLI + animal nutrition*, comprised IBLI and livestock feed, including fodder, pellets, and other commercial feeds. The third bundle was *IBLI + animal breed*. This bundle comprised IBLI and artificial insemination services. The fourth bundle, *IBLI + flexible package*, allowed participants to obtain an input of their choice (health, nutrition, artificial insemination) based on their most pressing need. We targeted 119 villages. Eight men and eight women were randomly sampled from livestock-keeping households in every village. Separate meetings were organized with the selected men (as a group) and women (as another group) in each village. We had a total of 238 groups, comprising 119 groups of men and 119 groups of women.

In our experiment, one product was randomly selected as the default option for a group. Using the Becker-DeGroot-Marschak (BDM) method (Becker et al. 1964), the remaining bundles were presented one at a time, and participants were asked to indicate their individual WTP to exchange their endowment for another bundle. Therefore, WTP measures the amount of money an individual participant was willing to pay to switch out of their default option and obtain a more preferred bundle. At the end of the bidding exercise, each participant received a non-transferable discount coupon for either their default bundle or the one that they switched to (depending on the outcome of the BDM). Participants were only allowed to redeem the coupon at the selling point of the input and upon providing valid proof of an active IBLI contract.

Our main results are as follows. Relative WTP was the lowest for *IBLI + animal breed*: livestock keepers were willing to pay 19%–33%, 100%–153%, and 148%–232% higher for *IBLI + animal nutrition*, *IBLI + animal health*, and *IBLI + flexible package*, respectively, relative to the *IBLI + animal breed* bundle. Relative WTP for the *IBLI + animal breed* bundle was significantly lower among women than among men. Relative to the average WTP to switch from other bundles to the *IBLI + animal breed* bundle, women had 36%–45%, 54%–64%, and 76%–84% higher WTP than men for *IBLI + animal nutrition*, *IBLI + animal health*, and *IBLI + flexible package*, respectively. We find that providing information about bundling and seasonal vegetation forecast significantly reduced the relative WTP for the *IBLI + animal nutrition* bundle. We find no evidence of heterogeneous effects of the information treatment on the relative WTP for bundled IBLI between women and men.

Our study contributes to the literature in three ways. First, we contribute to the growing literature on bundled agricultural insurance. This literature focuses on crop insurance and has assessed uptake (Karlan et al. 2011; Giné and Yang 2009; Mishra et al. 2021), evaluated impacts on productivity, welfare, and resilience (Awondo et al. 2020; Boucher et al. 2024; Deutschmann et al. 2025), and investigated effects on the adoption of agricultural technologies (Bulte et al. 2020; Mishra et al. 2023). But only a few studies have assessed WTP for bundled crop insurance (Gallenstein et al. 2019; Ward et al. 2020). We contribute to this literature by assessing differential preferences for bundled agricultural index insurance with a focus on livestock keepers in the rangelands.

Second, we contribute to the literature on gender and agricultural insurance, specifically for contexts where women face differential impacts of climate shocks like drought by bearing a substantial burden of risk in their households. For instance, evidence suggests that women often reduce their consumption and sell their own assets to meet household needs (Chantarat et al. 2010; Arteaga et al. 2024a). Yet gendered capacities and preferences for financial solutions like insurance remain less well understood. Not only is there a knowledge gap around the role of agricultural insurance in supporting women's empowerment through enhanced decision-making agency and any transformative impacts on societal norms and relations, but existing agricultural insurance products are designed and delivered in ways that often limit women's uptake of the products and their ability to benefit from them (Timu and Kramer 2023). Male-dominated information channels and women's low education and financial literacy may act as barriers to gender equitable access to information on insurance products and their benefits (Tavenner et al. 2025). Previous research has shown heterogeneous welfare impacts of index insurance by gender (Timu et al. 2023) and that gendered differences in socioeconomic factors can influence farmers' preferences for insurance (Akter et al. 2016). Gender, however, may not operate alone. Specifically, in northern Kenya, for instance, decision-making around uptake of IBLI can be influenced by the intersection of gender, ethnicity, and household structure (Tavenner et al. 2025). Understanding household dynamics could, therefore, become critical in this context, as acknowledged through efforts like family-framed insurance that insures "family units" rather than tropical livestock units (Arteaga et al. 2024b). Recognizing the need to examine gendered capacities and preferences that may vary within the same household, our work contributes to and extends the existing understanding by further probing heterogeneity in preferences for bundled IBLI between women and men from livestock-keeping households in pastoral Kenya.

Third, our work is also related to literature examining the role of information in the choice of climate risk management strategies by smallholder farmers and livestock keepers. We contribute to this body of literature by assessing the effect of combined information on bundled products and seasonal vegetation forecast on the relative WTP for bundled IBLI. The provision and use of location-specific, accurate, and timely weather and climate forecasts can help reduce weather risks and uncertainty in decision-making by smallholder farmers and livestock keepers (Surminski et al. 2022; Paparrizos et al. 2024). Studies have shown a link between access to weather and climate information services (CIS) and adoption of climate-smart agricultural practices (Djido et al. 2021; Mabhaudhi et al. 2025). For instance, Carriquiry and Osgood (2012) showed that, in theory, forecast information can induce farmers to increase their use of agricultural inputs and crowd-in demand for stand-alone insurance. Similarly, Surminski et al. (2022) showed that climate risk information can support adaptation decision-making by insurance policyholders. Our study underscores the need to consider information about bundling and CIS when designing bundled IBLI as a risk management solution.

The rest of the paper is structured as follows. Section 2 describes the context. In Section 3, we review the literature and provide a more detailed description of the bundled IBLI products. Section 4 explains the research design. Subsequently, Section 5 discusses data collection and presents summary statistics and balance. Section 6 explains the empirical estimation strategy, followed by the presentation of the results in Section 7. In Section 8, we discuss the results, while Section 9 concludes and draws implications for policy and future research.

2 | Context

The study was conducted in Isiolo county, which is in the arid and semi-arid lands (ASALs) of Kenya, and is representative of the drylands of East Africa. Livestock keeping is the main source of livelihood in this setting, with the majority of the population practicing (agro)pastoralism. Drought is responsible for more than 50% of livestock losses (Jensen et al. 2017). Pastoralists face multiple constraints, the most severe being limited access to animal feed: 63% of our respondents indicate that they faced forage scarcity. IBLI has been implemented in the county as a stand-alone innovation since 2012, including the Kenya Livestock Insurance Program (KLIP) and more recently the De-Risking, Inclusion, and Value Enhancement of Pastoral Economies in the Horn of Africa (DRIVE) program. However, the adoption of IBLI remains low (10% in our sample). As an asset protection policy, IBLI was developed to cushion pastoralists against drought-related risks by making payouts early in the dry season to enable households to purchase fodder, water, and veterinary services to prevent loss of their livestock. At the time of the experiment, there was no bundled IBLI product in the market. Therefore, all the bundles studied in our experiment include insurance and an additional component (i.e., the input).

As part of its climate risk management and livelihood improvement interventions, the World Food Programme of the United Nations (WFP) supports communities and county governments in Kenya to anticipate, respond and adapt to climate and environmental shocks by implementing interventions aimed at improving food security, livelihoods and market linkages for pastoralists living in the ASAL counties. Under its pastoral livelihoods programming, WFP undertakes financial inclusion and productivity support through access to IBLI, financial literacy and savings among pastoralist households in Isiolo County. Additionally, WFP collaborates with the Isiolo County Government's veterinary services department, along with designated community-based veterinary service agents, to facilitate last-mile delivery of livestock products and services, including feeds, livestock medicine, vaccinations, artificial insemination, as well as training of community animal health volunteers on disease surveillance and reporting. It emerged from our focus group discussions with the service providers that demand for their products was low, mainly because of alternative, cheap but low-quality imported products. Therefore, bundling IBLI with high-quality productivity-enhancing inputs offers an opportunity to increase demand for the quality inputs while helping livestock keepers address climate and other production risks simultaneously. In our context, a further justification for bundling index insurance with productivity-enhancing inputs is that for micro-index insurance products to be offered on a wide scale, investment in efficient delivery mechanisms is required, including the development and maintenance of physical points of purchase and indemnity collection. These costs can be reduced by using established agricultural input suppliers as aggregators to serve as the vehicles of delivery, either by bundling index insurance with inputs or making it available for purchase in conjunction with the inputs (Miranda and Farrin 2012). In addition, bundling IBLI with productivity-enhancing inputs can help address discouragement effects that arise when insurance payouts are not triggered. This is typically the case, for example, when NDVI values are low (i.e., there is drought) but above the trigger point (i.e., the drought is not severe). In that case, livestock keepers can still access inputs to protect their animals and enhance productivity.

3 | Literature and Motivation for Bundling Agricultural Insurance

Literature on bundled agricultural insurance is vast. A common feature is that bundled products are proposed based on synergy between the products. This literature can be broadly categorized into two. The first category comprises studies using either randomized control trials (RCT) or choice experiments to assess demand for bundled insurance. Evidence from this literature is mixed. Giné and Yang (2009) conducted an RCT that offered farmers in Malawi credit to purchase high-yielding crop varieties and required them to buy index insurance that partially or fully forgave the loan in the event of poor rainfall. They found a low uptake of the loan bundled with insurance for which a premium must be paid. The low demand was attributed to the limited liability in the uninsured loan contract because it provided enough implicit insurance. Experimental evidence by Karlan et al. (2011) also showed that bundling credit with price risk insurance did not increase loan uptake among crop farmers in Ghana. Mishra et al. (2021) conducted an RCT in Ghana comparing bundled insurance at the micro level, whereby the farmers were the direct beneficiaries, and a meso-level product with the lender as a beneficiary, conditional on the payout being used to retire the farmer's debt obligation. Bundling loans with insurance increased the likelihood of farmers receiving credit by between 15 and 21 percentage points because lenders were more likely to approve applications. The considerable attention that has been given to the topic of bundling index insurance with credit is mainly because banks are seen as being able to manage basis risk better than individual policyholders and the insurance may enable banks to increase their loan portfolio (Miranda and Farrin 2012; Miranda and Gonzalez-Vega 2011).

Notable examples of studies that have used WTP experiments to understand demand for bundled insurance include Gallenstein et al. (2019) and Ward et al. (2020). Gallenstein et al. (2019) assessed farmers' WTP for loans bundled with micro-level insurance (micro-insured loans) and loans bundled with meso-level insurance (meso-insured loans) in Ghana. They showed that although farmers were willing to pay more for insured loans compared to uninsured loans, the proportion of farmers was significantly lower for the insured loans than for the uninsured loans. If the full price of the insurance premium is passed on to the borrower and interest rates are held constant, insured loans will experience lower demand than the uninsured loan (Gallenstein et al. 2019). However, Ward et al. (2020) found greater WTP among rice farmers in Bangladesh for bundled drought-tolerant varieties with weather index insurance compared to when the financial and technological risk management tools were offered separately.

The second category of studies has generated experimental evidence on the impact of bundled insurance. For example, Bulte et al. (2020) provided free multi-peril crop insurance conditional on farmers using improved seeds. They found evidence of factor-deepening in the use of certified seeds and increased investment in complementary inputs. However, Mishra et al. (2023) showed that providing farmer groups with agricultural loans that were insured with an index insurance policy improved the adoption of fertilizer but did not influence the use of other inputs. In an experiment that compared the effect of unconditional input subsidy with that of subsidized insurance bundled with input vouchers, Wong et al. (2020) found that while the former intervention increased the purchase and use of seeds and fertilizers by about 40%–50% of the voucher value, bundled insurance produced weak effects on technology adoption.

Several studies have evaluated the impacts of bundled agricultural insurance on productivity, welfare, and resilience. Awondo et al. (2020) and Boucher et al. (2024) evaluated a bundle including drought-tolerant maize varieties and index insurance. While Awondo et al. (2020) showed highly variable welfare effects attributed to the heterogeneity in performance of the varieties across different environments and the chosen trigger level, Boucher et al. (2024) found a 60% increase in yield in the year following a shock. Deutschmann et al. (2025) evaluated a program that bundled loans for improved seeds and fertilizer, training on modern agricultural techniques, and input insurance. They found that participation in the program increased maize yield by 26%.

3.1 | Motivation for Bundling IBLI With Productivity-Enhancing Inputs

Our study focuses on bundling IBLI with livestock productivity-enhancing inputs. Livestock keepers in the drylands of Africa face both idiosyncratic and covariate risks. In the pastoral context, for example, idiosyncratic risks could be losses driven by a livestock disease that is specific to a household and uncorrelated across households. Livestock keepers typically manage idiosyncratic risks through animal husbandry practices, including feeding, breeding, and health care. However, such practices are limited in their ability to address covariate risks, which can be thought of as livestock mortality driven by a drought or another common event affecting many households over large geographical areas at once. While IBLI offers protection against covariate risk, it is not designed to (directly) manage idiosyncratic risk. Therefore, bundling index insurance with solutions that manage idiosyncratic risk offers an opportunity to create comprehensive products with greater resilience benefits than when offered in isolation.

A few studies have demonstrated important complementarities between insurance and genetic improvement (Ward et al. 2020; Boucher et al. 2024). The synergy in the *IBLI + animal breed* bundle emerges because, first, the complementarity of the two products can enable livestock keepers to acquire insurance at a lower cost and, second, the two products combined can provide nearly comprehensive covariate drought risk management. Both Ward et al. (2020) and Boucher et al. (2024) evaluate a bundle in which the insurance was designed to complement drought-tolerant seeds. The seeds managed moderate drought conditions but not early-season droughts (that thwarted germination) and severe droughts. The insurance was specifically designed to complement the shortfalls of the seeds by offering protection against severe drought, but uptake tends to be low, and basis risk is problematic. In our experiment, the cost of IBLI was about KES5727 for one tropical livestock unit. Artificial insemination service for cattle was provided at the cost of KES2000–KES10,000. In our context, where a network of animal health service providers has been established as aggregators, bundling IBLI with animal health (*IBLI + animal health*) can improve the demand for insurance by reducing the cost of last-mile delivery of insurance, hence increasing affordability (Miranda and Farrin 2012). Further, diseases such as *foot and mouth*, *contagious bovine pleuropneumonia*, and *peste des petits ruminants* tend to be common during the dry season mainly because livestock come together in grazing and watering areas. Animal health interventions in the form of vaccination and treatment can help protect the livestock during periods of mild drought, while insurance provides cover against severe drought. At the same time, investment in livestock health is expected to improve productivity and the quality of the livestock sold. This can increase income among pastoralists, which can help generate effective demand for insurance. At the time of the experiment, the cost of vaccination was KES15 per goat/sheep and KES200 per cow. The cost of medicine and clinical services varies widely depending on the type of medicine or service. Treatment for the contagious bovine pleuropneumonia (CBPP) and East Coast fever costs a maximum of KES3000. Studies carried out after major IBLI payouts indicated that animal health services were among the top five priorities for the use of payouts (Taye et al. 2019).

Our third bundle comprises *IBLI + animal nutrition*. Proper livestock nutrition, particularly during dry seasons, lowers vulnerability to diseases and mortality (Vrieling et al. 2016). Because of good nutrition and low exposure to diseases, expenditure on animal health has reduced. This can boost both productivity and farm incomes (Polizel et al. 2018). IBLI payouts are triggered by severe drought; that is also the time when fodder is required the most (Taye et al. 2019). In most cases, demand is very high during drought. There have been efforts to promote fodder production to address the problem of feed scarcity. However, such efforts are challenged by a lack of a sustainable business model for fodder producers due to a lack of demand when drought is not severe, as pastoralists then rely on extensive grazing in open fields. This has led to a very thin market for fodder, consequently reducing feed availability during drought. Bundling IBLI with animal nutrition offers an opportunity to crowd-in production of fodder by creating demand early in the dry season. At the time of the experiment, a bale of dry grass hay (15–20 kg) cost KES300–KES500 while range cubes for goats were selling at KES3000 for a 50 kg bag.

Our last bundle, *IBLI + flexible package*, allows livestock keepers to access an input of their choice (artificial insemination, health services, and feed) when the need arises. Different from the rest of the bundles, which are "fixed," the flexible package is proposed in recognition of variation in the idiosyncratic risk faced by the pastoralists. The flexible product might be attractive to consumers insofar as rational choice theory would suggest that more choice is always weakly preferred to less choice. Like the "fixed" bundled products described above, the flexible product proposed in our study is also likely to capitalize on natural synergies between the products. This is different from the case of bundling insurance with credit, where flexibility is less desirable, especially on the supply side. For example, a bank would not appreciate a bundled insurance product in which the consumer could choose whether to bundle that insurance with a loan. If the consumer can choose not to allocate the insurance payout towards loan repayment, the bank will be unlikely to issue the loan. In our case, IBLI is still bundled with any of the three inputs, except that the policyholder is allowed the flexibility to obtain the type of input that they require as and when the need arises. The flexible bundle has the potential to address multiple risks often faced in the rangelands because of the compounding effects of shocks, giving the livestock keepers the opportunity to respond to different needs at any given time.

The motivation for a flexible IBLI bundle further draws from evidence that farmers' (risk) preferences are not static (Wuepper et al. 2023), that farmers have high preference for contracts that adapt to changing needs (Belissa et al. 2025), and that there exist wide differences in farmers' ability to adopt new technologies (Dercon and Christiaensen 2011). These factors complicate efforts to scale and sustain IBLI uptake. While designing contracts that fully account for farmer heterogeneity is costly and data-intensive (Jørgensen et al. 2020), flexible bundles can help address this challenge. For example, farmers' tolerance for risk can either increase or decrease after experiencing a shock (see e.g., Di Falco and Vieider 2022), which can translate into higher or lower uptake of productivity-enhancing or risk-reducing inputs. Because preferences are context-dependent, farmers may also become more risk-averse in specific domains and therefore choose not to use certain inputs that could, if adopted, reduce their overall risk exposure and ultimately address their specific bottlenecks to adoption; evidence has shown that households' capacity to adopt varies from household to household (Dercon and Christiaensen 2011). In such situations characterized by unstable preferences and given that risk preferences are key determinants of technology adoption, a flexible bundle can serve as a form of "soft commitment," encouraging farmers to use productivity-enhancing or risk-reducing inputs when needed. This benefits farmers, insurers, and input suppliers alike (McIntosh et al. 2013). Such soft commitment devices are also valuable in the presence of procrastination, a behavioral bias frequently observed among farmers when it comes to the timely use of productivity-enhancing inputs (Duflo et al. 2011). Empirical evidence further shows that farmers prefer flexibility in insurance contracts and often choose portfolios that align with their specific risk profiles (Ceballos and Robles 2020). By contrast, offering a single standardized product that ignores the substantial heterogeneity in agricultural risk profiles reduces the product's value for many farmers who deviate from the "average" risk profile (Ceballos and Robles 2020).

At the same time, pastoralists differ markedly in their capacity to use specific productivity-enhancing inputs, for example, due to variation in skills, access to service providers, herd composition, cash flow, decision-making dynamics, and household responsibilities. A fixed bundle that prescribes a single input risks allocating a service that some households cannot effectively use, which can depress both welfare gains and demand. By allowing insured livestock keepers to choose among feed, health, or breeding services at the time when a need arises, the flexible bundle both aligns more closely with dynamic risk preferences and makes the product more inclusive across households with different adoption capacities, helping crowd in the use of quality inputs among otherwise constrained users and enabling them to respond to whichever layer of risk (nutrition, health, or breeding) becomes most pressing in a given season, while IBLI still insuring against drought related risks.

However, introducing flexibility may create new difficulties (see e.g., Belissa et al. 2025), such as higher administrative costs and greater product complexity. These can be mitigated through supply-side innovations, including partnerships with vetted local input suppliers to deliver bundle components, and leveraging agent networks, cooperatives, or producer groups to reduce transaction and training costs while building trust in remote pastoral areas. Equally important is the framing of the bundled insurance: pastoralists should perceive it as a single, integrated product, such that the value derived from accessing preferred inputs when needed is attributed to the bundle itself rather than to the individual inputs.

In practice, implementation of the flexible bundle would require that insurance companies work with specific service providers.[1]

One possible model could require that the livestock keeper contact the insurance company when the specific need arises. The insurance company then provides a list and contact details of available pre-listed service providers within a reasonable proximity to the location of the livestock keeper. Details of the pre-listed service providers could also be provided on the back of their policy document. The livestock keeper would identify a preferred service provider and contact them to arrange the delivery of the service. The flexibility allowed would need to be communicated at the time of purchasing the insurance. This will be determined by the cost of the different inputs and the purchasing power of the livestock keeper. For example, such a product could specify the percentage of the cost that the policy allows and the maximum coverage that can be provided for each input being offered. Although the cost of the inputs will vary, they are not substitutes. The insurance company should determine that the total amount of cover allowed for each input is the same. This means that for some of the services, such as artificial insemination, the cost will be partially offset, whereas for others, such as bales of hay, the cost would be fully offset for a maximum number of bales.

The flexible component operates as a voucher-like entitlement issued alongside IBLI and redeemable through pre-contracted local providers (feed suppliers, animal health agents, and breeding services). While the product is owned and underwritten by the insurance company, the pastoralist (or receiver of the bundle) interacts primarily with familiar last-mile actors rather than multiple new institutions, which reduces the perceived complexity for semi-nomadic households. Data from a qualitative assessment show that pastoralists who received a voucher of KES2000 for the flexible bundle option topped up to around KES3000 to access the specific inputs they needed. This behavior suggests that households perceive the risk-prevention benefits of the bundle, particularly for animal health and nutrition in the face of multifaceted drought, disease and feed risks, as sufficiently high to justify paying more than the face value of the entitlement. Therefore, the perceived value of a flexible package that can help prevent losses to animals appears to outweigh its monetary cost for many respondents. This also suggests that a flexible insurance–input bundle can still be attractive if implemented in a way that minimizes client-side complexity and if it credibly helps pastoralists mitigate multiple risks simultaneously. More policies sold might reduce the (operational) cost per policy, offsetting the high transaction costs the reviewer is foreseeing.

4 | Experimental Design

We implemented an *endow-and-exchange* choice experiment with men and women livestock keepers in northern Kenya in August 2024. The study period was chosen to coincide with the August–September sales window for IBLI. Eight men and eight women were recruited from livestock-keeping households in each of 119 villages. Women and men in our sample were intentionally recruited from different households, with no women and men in the sample belonging to the same household. Though individual women and men were recruited from each household in our sample, the purpose of the study was clearly communicated to the household members, especially spouses of the participants, at the time of invitation, to adhere to the principle of "do no harm" and reduce risks of potential backlash. In each village, we organized separate meetings with the eight men (as a group) and the eight women (as another group). Therefore, in total, we had 238 groups randomized into either the *information intervention* arm (treatment) or the *no information* arm (control). Out of the 1904 participants who were invited, 1828 attended our meetings. Upon arrival at the meeting location—which was clearly communicated at the time of invitation—participants were engaged in a short activity involving sorting of colored beads and earning KES500 (USD4) each. We used this exercise to reduce the "house money effect," that is, the tendency for unexpected cash to inflate bids. Participants were allowed to use this money in the bidding exercise.

Next, we conducted a short survey to collect demographic information about the participants. We used data from this survey to check whether covariates are balanced between the information treatment and control arms and to construct variables used as additional controls in our analysis. The survey was followed by an information session that was only implemented in the treatment arm. Specifically, the information session explained to the participants what it means to bundle products, discussed the potential benefits that could be obtained by bundling insurance with other products, and provided guidance about some of the factors to consider when selecting bundled products (e.g., the most problematic risks faced and the opportunity to access other services that would otherwise be challenging). In addition, participants in the treatment arm received seasonal forecasts about vegetation availability (a proxy for animal feed availability). The seasonal forecast was visualized on maps, which were explained carefully to the participants. The vegetation condition maps were obtained from the Regional Centre for Mapping of Resources for Development (RCMRD) and the National Drought Management Authority (NDMA). The maps showed trends in the vegetation condition every 10 days starting July 31st, 2024 until October 19th, 2024. Specifically, the forecast showed a declining trend in vegetation conditions, but by the end of the dry season in September, pasture conditions were expected to be above average. We organized the information session before the choice (bidding) session. Participants in the control arm were neither informed about bundled products nor provided with the seasonal vegetation forecast. Because the information session combined both bundling and seasonal forecast, we can only assess the effect of this combined package of information on the relative WTP as opposed to "bundling" and "forecast" separately.

In the choice session, one of the four bundled insurance products was randomly selected as the default option. Selection of the default option was done by the research team and provided to the enumerators prior to the bead sorting exercise. All participants in the group were endowed with the default product for the purchase of an input at a discount from a local service provider. In this study, we collaborated with 18 service providers to ensure the availability of the inputs for purchase by the livestock keepers. We then introduced the remaining three bundled IBLI products, one at a time, and provided each participant, individually, with an opportunity to exchange their endowment with another product, if they wished to do so. To reduce bias due to order effects, we randomized the order in which the bundled IBLI products were presented. The randomized order was held constant at the group level. While randomizing the default option and the presentation order of the remaining products can help minimize concerns related to the endowment effect, we cannot completely rule out the possibility of this effect occurring. We, therefore, control for the default option effect in our empirical analysis and explain the implications of our approach in Section 8.

All four options (*IBLI + animal health, IBLI + animal nutrition, IBLI + animal breed, IBLI + flexible package*) include insurance, and all four options include an additional component. This means that insurance is held constant and we are unable to tell how respondents value insurance. Instead, we can compare preferences for the bundled component, holding insurance fixed. We revisit the implications of our approach in Section 8. Each of the experiment participants was asked to indicate the maximum amount of money he or she was willing to pay to exchange their endowment for another bundled IBLI product. Therefore, bids were submitted individually and not as a group. Everyone was provided with a recording sheet, and sitting positions were arranged to prevent individuals from discussing or observing each other's bids. The enumerators helped to record the bids for those individuals who were unable to write. We considered the product with the highest bid as the one most preferred by an individual. Whether or not participants were allowed to exchange their endowment was determined using a BDM auction mechanism. In a BDM auction, participants state their bid, which is compared to an unknown strike price. If WTP meets or exceeds the strike price, the participant obtains the item and pays the strike price. BDM auctions are incentive-compatible and reveal true preferences if subjects maximize expected utility. The strike price is revealed by opening a sealed envelope containing a randomly drawn number from a uniform price distribution. In our case, the strike price was randomly drawn from a distribution of possible values that were generated during a pilot study, which was conducted before the actual experiment. This amount was KES200 (≈ USD1.6). Our approach is similar to that used by Magnan et al. (2015) in the context of demand for a resource-conserving agricultural technology. A clear explanation was provided to participants about this process before the bidding began. Livestock keepers were very understanding of the process and did not have any issue with how the strike price was selected. Because our experiment was implemented at the village level and ensured that both the men and women groups in a village participated on the same day, the possibility of information about the strike price spreading widely was minimized. A further strategy was to work with a large team of enumerators (18) to ensure that the experiment was completed within the shortest time possible. In our experiment, we randomly selected one bundle as the binding product among the three alternative bundles. Participants paid the strike price if their WTP for that randomly drawn bundle met or exceeded the strike price. In that case, they exchanged their endowment for the binding bundle. If the WTP for the binding bundle was below the strike price, participants kept their default bundle.

Prior to the actual bidding session, all subjects participated in a trial BDM auction, which was clearly explained with trial runs to reduce the risk of game form recognition failure (Cason and Plott 2014). The practice round was conducted with four types of soap with easily differentiable attributes. The literature recommends conducting practice rounds with products that are different from the final product being auctioned (Okello et al. 2023). In the practice round, although we used actual bars of soap, this exercise was for demonstration purposes only, and participants did not walk home with any bar of soap. This was clearly explained at the start of the practice round. To ensure that participants fully understood the instructions, we asked a few follow-up questions. We continued to the next step only after the participants answered all the follow-up questions correctly, otherwise the instructions were repeated. In multiple-product round auctions, purchasing a product in one session may decrease WTP in subsequent sessions since the participant subsequently has less to spend (Dillaway et al. 2011). This issue is particularly problematic if a participant has already purchased the same or a very similar product in a previous session. Our design avoids this problem arising between alternative types of bundled IBLI products, as only the outcome for one of the products was implemented. Since soap and bundled IBLI are very different products, WTP for bundled IBLI is unlikely to be affected by the warm-up exercise.

At the end of the bidding and after the exchange was effectuated, we put 10 numbered chips in a bag, shook it, and asked a participant to draw a chip without looking. An individual drawing a number 1–5 received a discount coupon of KES1000 (USD8) and an individual drawing a number 6–10 got a discount coupon of KES2000 (USD 16) on the productivity enhancing input that was bundled with IBLI for their preferred bundle (i.e., either their default bundle in case relative WTP for the randomly drawn bundle is lower than the strike price or the randomly drawn bundle in case relative WTP for that bundle meets or exceeds the strike price). During the warm-up exercise, participants were informed that they would receive a coupon for their preferred input product. However, the exact amount was random and unknown to the participants until the bidding exercise was complete. We used the subsidy coupon to encourage experimentation with the quality products that were being sold by the service providers, and because in-person conversations with a few insurance companies had shown that they were thinking along the lines of providing discount coupons for inputs upon purchase of IBLI. The coupon size used in our study was determined to be sufficient to subsidize at least 50% of the cost of the inputs for any input chosen by the participant. Provision of one-off subsidies can lead to long-term sustained adoption of innovations (Bensch and Peters 2020). Finally, contact details of the service providers for the inputs chosen were shared. Participants were informed that they were allowed to redeem the discount coupon at the point of sale of the input upon providing valid proof of an active IBLI contract. The discount coupon was not transferable and was provided in the form of a booklet with a unique serial number and in denominations of KES50 (USD0.4) to allow for small purchases.

Before conducting the experiment, the research project was approved by the Institutional Research Ethics Committee (IREC) of the International Livestock Research Institute, and a complete pre-analysis plan (PAP) describing the experimental setup and the identification strategy was registered in the American Economic Association's registry for randomized controlled trials—AEARCTR-0014229.

5 | Data, Summary Statistics, and Balance Test

Data about individuals' relative WTP for bundled IBLI comes from the bids submitted in the choice experiment. Demographic data of the study participants comes from the survey that was conducted before the bidding exercise and included age, sex, education, household size, livestock ownership, access to information and training, purchase of IBLI, trust in service providers, livestock-related expenditure, access to credit, and membership to a producer or marketing association. We used this information to construct variables for the covariates balance test and as additional controls. Table 1 shows that the differences between the information treatment and control arm are small in magnitude. The F-test of joint orthogonality (p value = 0.189) indicates that treatment assignment is statistically independent from baseline characteristics. However, we acknowledge that our treatment and control arms are not perfectly balanced: out of 26 variables, one is significant at the 1% level, another one at the 5% level, and three are significant at the 10% level. In our analysis, we control for all the variables that showed imbalance.

Our main outcome variable was the relative bids submitted. The bids indicated the amount of money a participant was willing to pay to exchange their endowment for each of the other bundled IBLI products. An amount of zero meant that the participant did not want to switch from the default option. Although our *endow-and-exchange* approach is useful to understand the relative WTP for the bundles, we acknowledge that it provides a lower bound estimate of the difference in demand between products. For example, it is possible that a participant endowed with something of greater value would be willing to accept compensation (i.e., a negative bid instead of zero) to give up their endowment rather than pay some money. We come back to this issue in the Section 8. The average relative WTP was KES150 for *IBLI + animal breed*, KES209 for *IBLI + animal nutrition*, KES381 for *IBLI + animal health*, and KES532 for *IBLI + flexible package* (Table 2). Our second outcome variable is knowledge. We administered a knowledge module (Appendix 1) to participants in both the information treatment and control arms before implementing the choice experiment. The questions assessed participants' knowledge about bundling and bundled products. At the end of the information session, the same questions were asked to participants in the treatment arm. Participants in the control arm were not asked the knowledge questions again. In other words, we consider the control arm participants' responses to the knowledge questions to remain the same because they were not provided with training. The knowledge variable is a composite of the sum of all the questions answered correctly by the participant. The change in knowledge is the difference in scores before and after the information intervention. This change equals zero for control arm participants. We used the knowledge variable to conduct causal mediation analysis because we expected that the information treatment would influence relative WTP through knowledge improvement.

Descriptive summary statistics from the data show that the average age of a participant was 42 years, and that four-fifths of our sample respondents are married. Islam is the dominant religion. More than half (55%) of the participants have attained some level of formal education, and about one-fifth have a secondary-level education or higher. The main economic activity is livestock keeping, with a household owning an average of five tropical livestock units (TLUs) and earning KES39,000 (USD300) per year from livestock sales, on average. However, livestock mortality is high: a household has, on average, lost four TLUs over the past 5 years preceding the survey. The proportion of households with IBLI coverage is low (10%). Only 18% of the households have received climate advisories, and one-third have obtained information about livestock diseases. On a scale of 1 (no trust at all) to 10 (complete trust), participants seem to trust service providers for livestock medicine, feed, and clinical services; the average score is 7. Trust in service providers for improved breeds is low (trust score: 4 out of 10), while trust in sellers of insurance is average. More than three-fifths of the sample respondents indicated that the shortage of feed was the main constraint to livestock production.

Attrition is very low in our sample and, therefore, not a major concern for our analysis: only 4% of the individuals we invited to participate in the study did not attend the meetings. A formal test of attrition showed that attrition is random (Table A1).

6 | Empirical Specification

We began our analysis by conducting non-parametric tests of equality of the relative bid distributions using the Kolmogorov–Smirnov test. We then estimated Equation (1) to determine relative WTP for the bundled IBLI products.

$$y_{ijv} = \alpha + \sum_{j=1}^{3} \beta_j bundle_{ij} + \omega_i \mathbf{x}_{ivc} + \tau_i \mathbf{w}_{ivc} + C_c + \varepsilon_{ij} \quad (1)$$

where y_{ijv} measures individual i's relative bid for the bundled IBLI product j and $bundle_{ij}$ is a vector of dummy variables for the bundled IBLI products with the *IBLI + animal breed* bundle as the comparison (base) group. Vector $\mathbf{x}_{ivc}$ captures demographic characteristics: sex, age, marital status, religion, livestock mortality, and IBLI policy holding. Vector $\mathbf{w}_{ivc}$ represents dummy variables for the default options, while C_c captures the sub-county fixed effects. Here, the intercept measures the average WTP to switch from other bundles to *IBLI + animal breed*. The parameter β_j, therefore, measures the additional amount of money that participants are willing to pay to switch from their default endowments to *IBLI + animal nutrition, IBLI + animal health*, and *IBLI + flexible package* above the relative WTP for *IBLI + animal breed*. We estimated Equation (1) with and without the additional controls using a mixed effects model (Raudenbush and Bryk 2002) to allow for interdependence of the relative bids arising from each participant providing one relative bid per product, for the three bundled IBLI products. Further, because order was held constant at the group level and information treatment was also assigned at the group level, we control for order effects and cluster standard errors at the group level.

Next, we assessed the effect of the information treatment (combined training on bundling and providing seasonal vegetation forecast) on pastoralists' relative WTP for bundled IBLI (i.e., the willingness to switch from one bundled IBLI product to another) using Equation (2).

$$y_{ivc} = \alpha + \gamma \text{Information}_{ivc} + \boldsymbol{\delta}_i \mathbf{x}_{ivc} + \theta_i \mathbf{w}_{ivc} + \mathbf{C_c} + \varepsilon_{ivc} \quad (2)$$

TABLE 1 | Summary statistics by treatment arm.

Variable	Overall (1)	No information (2)	With information (3)	Difference (4)	*p* value (5)
Age of respondent (years)	42.30	42.10	42.48	0.38	0.573
	(14.65)	(14.86)	(14.44)		
Respondent is male	0.49	0.48	0.50	0.02	0.553
	(0.50)	(0.50)	(0.50)		
Respondent is married	0.81	0.82	0.80	0.02	0.275
	(0.39)	(0.39)	(0.40)		
Main religion is Islam	0.80	0.83	0.77	0.06	0.002
	(0.40)	(0.37)	(0.42)		
Respondent has no formal education	0.45	0.46	0.44	0.02	0.335
	(0.50)	(0.50)	(0.50)		
Respondent has primary level education	0.37	0.37	0.36	0.01	0.468
	(0.48)	(0.48)	(0.48)		
Respondent has secondary level education	0.14	0.13	0.16	0.03	0.057
	(0.35)	(0.33)	(0.36)		
Respondent has post-secondary level education	0.04	0.04	0.05	0.01	0.412
	(0.20)	(0.20)	(0.21)		
Household size	6.21	6.28	6.14	0.14	0.223
	(2.49)	(2.58)	(2.40)		
Main occupation is livestock keeping	0.64	0.65	0.64	0.01	0.874
	(0.48)	(0.48)	(0.48)		
Herd size (TLU)	5.12	5.31	4.93	0.38	0.194
	(6.22)	(6.43)	(6.01)		
Livestock expenditure (KES)	20,582.00	21,055.00	20,119.00	936.00	0.369
	(22,252.00)	(22,425.00)	(22,083.00)		
Livestock mortality (TLU)	4.38	4.72	4.05	0.67	0.099
	(8.65)	(9.04)	(8.25)		
Livestock sale income (KES)	39,208.00	39,214.00	39,203.00	2299.00	0.996
	(49,147.00)	(49,357.00)	(48,967.00)		
Household has livestock insurance coverage	0.10	0.08	0.12	0.04	0.012
	(0.30)	(0.27)	(0.32)		
Household has received climate advisories	0.18	0.16	0.19	0.03	0.091
	(0.38)	(0.37)	(0.39)		
Household has received livestock disease information	0.31	0.31	0.31	0.00	0.967
	(0.46)	(0.46)	(0.46)		
Respondent perception about pasture condition	2.98	2.98	2.98	0.00	0.918
	(1.04)	(1.00)	(1.08)		
Received training in livestock disease management	0.13	0.12	0.13	0.01	0.458
	(0.33)	(0.33)	(0.34)		
Received financial training	0.25	0.24	0.26	0.02	0.324
	(0.43)	(0.43)	(0.44)		
Received training in climate risk management	0.11	0.11	0.11	0.00	0.605
	(0.31)	(0.31)	(0.32)		

(Continues)

Variable	Overall (1)	No information (2)	With information (3)	Difference (4)	p value (5)
Trust in service providers for livestock medicine	7.12	7.17	7.07	0.10	0.387
	(2.52)	(2.50)	(2.54)		
Trust in in service providers for livestock feed	6.61	6.64	6.58	0.06	0.622
	(2.73)	(2.72)	(2.74)		
Trust in providers of clinical services	6.84	6.83	6.84	0.01	0.904
	(2.73)	(2.70)	(2.76)		
Trust in providers of breeding services	3.98	4.00	3.96	0.04	0.760
	(3.03)	(3.00)	(3.05)		
Trust in sellers of livestock insurance	5.36	5.27	5.44	0.17	0.246
	(2.97)	(2.95)	(2.98)		
Observations	1,829	905	924	1,829	
p value of joint orthogonality test					0.189

Note: Standard deviations are in parentheses. The *p* value of the joint orthogonality test is obtained from a logit regression of the information treatment on the variables with robust standard errors clustered at the village level.

TABLE 2 | Summary of relative bids for bundled IBLI.

Bundle type	Mean relative WTP (KES)	Standard deviation	Observations
IBLI + animal breed	150.00	432.61	1140
IBLI + animal nutrition	209.00	454.42	1510
IBLI + animal health	381.00	665.51	1352
IBLI + flexible package	532.00	1003.49	1479

where y_{ivc} measures the relative bid of an individual i in village v and sub-county c. The variable $Information_{ivc}$ denotes the treatment dummy (access to vegetation forecast and training on bundling), with the no-information arm as the comparison group. The rest of the variables are as defined in Equation (1). We are interested in seeing the overall effect of the information treatment and if the difference in the impact of the information treatment between products is statistically significant. Therefore, we first estimated Equation (2) with pooled data (i.e., without differentiating between bundles). We then ran the model again with interaction terms between each bundle and the information treatment variable. Throughout, we use a mixed effects model and cluster standard errors at the group level (i.e., unit of randomization).

To assess heterogeneous effects between women and men, we split our sample and estimated Equation (2), with interaction terms between each bundle and the information treatment variable, separately for men and women using a mixed effects model. Our large sample size allows us to conduct this analysis.

We were further interested in analyzing whether the effect of the information treatment on the relative WTP for bundled IBLI is mediated by its causal effect on knowledge of the livestock keepers. To analyze the mediation of the information treatment through this pathway, we followed the approach proposed by Imai et al. (2011). Specifically, we estimated causal mediation effects by decomposing the total treatment effect into indirect-mediated and direct effects. Imai et al. (2011) formalize the assumption necessary to identify the causal mediation effect and the direct effect, which is known as the "sequential ignorability" assumption. Let IT_i be the treatment indicator (information treatment), K_i the mediator indicator (knowledge), and X_i be a vector of the observed pre-treatment confounders for the individual i. The ignorability assumption is formulated as follows:

$$\{y_i(it,k), K_i(it)\} \perp\!\!\!\perp IT_i | X_i = x, \tag{3}$$

$$y_i(it,k) \perp\!\!\!\perp K_i(it) | IT_i = it, X_i = x, \tag{4}$$

Where $0 < \Pr(IT_i = it | X_i = x)$ and $0 < \Pr(K_i = k | IT_i = it, X_i = x)$ for $it = 0, 1$ and all x and k in the support for X_i and K_i, respectively.

The assumption is called sequential ignorability because two ignorability assumptions are made sequentially. First, given the observed pre-treatment confounders, the treatment assignment is assumed to be statistically independent of potential outcomes and potential mediators (Equation 3). The second part of the assumption (Equation 4) implies that there are no unmeasured pre-treatment or post-treatment covariates that confound the relationship between the outcome indicators and the mediators. Based on these two assumptions, the average direct causal effect and the mediation effect can be estimated through the following set of linear equations:

$$\text{Mediator}_{ivc} = \alpha + \eta \text{Information}_{ivc} + \boldsymbol{\delta}_i \mathbf{x}_{ivc} + C_c + \xi_{ivc} \quad (5)$$

$$y_{ivc} = \alpha + \omega_1 \text{Information}_{ivc} + \omega_2 \text{Mediator}_{ivc} + \boldsymbol{\delta}_i \mathbf{x}_{ivc} + C_c + \varsigma_{ivc} \quad (6)$$

In this setup, the total effect of the information treatment $\hat{\gamma}$ from Equation (2) comprises a direct effect and a mediation effect. The direct effect is estimated as $\hat{\omega}_1$ from Equation (6). This is the partial causal effect of the information treatment on the relative WTP, controlling for the mediator variable as well as a set of confounders. The mediation effect is estimated as $\hat{\eta} * \hat{\omega}_2$. This is the effect of the information treatment on the mediator ($\hat{\eta}$ from Equation (5)) multiplied by the partial effect of the mediator on the relative WTP ($\hat{\omega}_2$ from Equation (6)) controlling for the information treatment and the same set of confounders.

7 | Results

7.1 | Preferences for Bundled Index-Based Livestock Insurance

We start by looking at pastoralists' preferences for bundled IBLI products. Figure 1 shows the distributions of the relative bid amounts for the four bundled IBLI products. At low amounts of relative WTP, the graph for the *IBLI + animal breed* bundle is above those of all other bundles, whereas the graph for *IBLI + flexible package* is below the rest. The reverse is observed at high relative WTP values, with the *IBLI + flexible package* being above the graphs of all other bundles. These findings indicate that pastoralists ranked the bundled IBLI products starting with *IBLI + flexible package* as the most preferred, followed by *IBLI + animal health* (second most preferred), *IBLI + animal nutrition* (third most preferred), and *IBLI + animal breed* (least prioritized). Results of the Kolmogorov–Smirnov test for equality of distributions indicate a significant difference ($p < 0.01$) in the bid distribution between the bundled IBLI products.

Table 3 presents the results of a mixed effects model regressing the relative bid amounts (KES) on the bundled IBLI products (dummy variables), with the *IBLI + animal breed* bundle as the base category. Results are consistent with those in Figure 1. WTP is the lowest for the *IBLI + animal breed* bundle. Specifically, we find that relative to the WTP to switch from other bundles to *IBLI + animal breed*, participants were willing to pay 19%–33% more for *IBLI + animal nutrition*, 100%–153% more for *IBLI + animal health*, and 148%–232% more for *IBLI + flexible package* (Columns 1–2). Tests comparing coefficients between the bundled IBLI products in the mixed effects model indicate statistically significant differences (p value < 0.01) in the relative WTP for all the bundles.

We checked for the presence of differential preferences for bundled IBLI products between women and men. Results of the mixed effects model assessing heterogeneity of preferences between women and men are presented in Columns (3)–(6) of

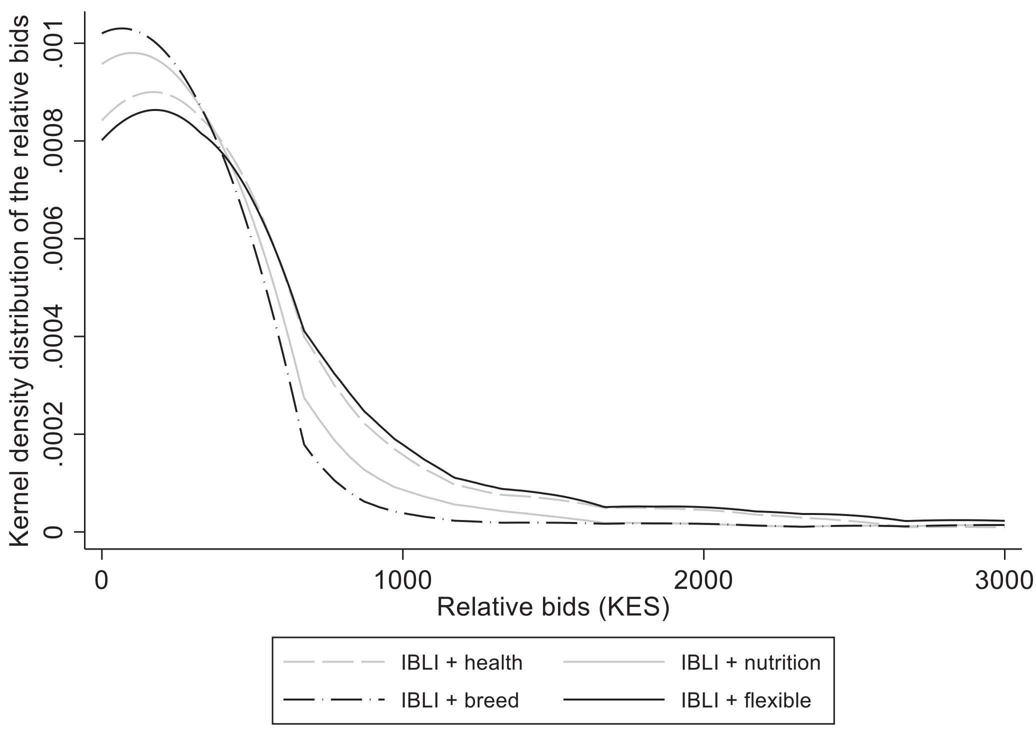

FIGURE 1 | Relative willingness to pay (WTP) kernel density distributions. Kolmogorov–Smirnov test for equality of distribution: IBLI + Health = IBLI + Nutrition (p value = 0.000). IBLI + Health = IBLI + Breed (p value = 0.000). IBLI + Health = IBLI + Flexible (p value = 0.000). IBLI + Nutrition = IBLI + Breed (p value = 0.000). IBLI + Nutrition = IBLI + Flexible (p value = 0.000). IBLI + Breed = IBLI + Flexible (p value = 0.000). IBLI, index-based livestock insurance.

TABLE 3 | Relative willingness to pay estimates for bundled IBLI products.

Variable	Dependent variable: Relative bids					
	Whole sample		Women		Men	
	(1)	(2)	(3)	(4)	(5)	(6)
Constant (Base: IBLI + Breed)	156.12***	238.61**	131.31***	168.48	178.99***	258.87
	(11.89)	(113.08)	(23.84)	(116.65)	(29.26)	(185.51)
IBLI + Animal nutrition	50.86***	45.20***	81.41***	72.12***	20.94	16.70
	(13.11)	(14.87)	(17.61)	(19.00)	(21.34)	(22.73)
IBLI + Animal health	238.82***	238.89***	252.75***	243.30***	229.63***	234.25***
	(18.34)	(27.99)	(39.97)	(39.84)	(40.74)	(39.51)
IBLI + Flexible package	361.92***	353.07***	371.29***	356.24***	355.55***	350.43***
	(22.70)	(34.24)	(53.11)	(51.30)	(45.22)	(45.44)
Additional controls	No	Yes	No	Yes	No	Yes
Sub-county fixed effects	No	Yes	No	Yes	No	Yes
Order effects	No	Yes	No	Yes	No	Yes
Default product effect	No	Yes	No	Yes	No	Yes
Number of observations	5481	5481	2796	2796	2685	2685
Number of respondents	1828	1828	932	932	896	896
Wald χ^2	414.12***	231.98***	86.84***	177.47***	89.54***	127.11***
Health = Nutrition (p value)	0.000	0.000	0.000	0.000	0.000	0.000
Health = Flexible (p value)	0.000	0.000	0.004	0.003	0.000	0.000
Nutrition = Flexible (p value)	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Mixed effects model estimates. Robust standard errors are reported in parentheses. Other controls include sex, age, marital status, religion is Islam, livestock mortality, IBLI policy holding, and group membership.
Abbreviation: IBLI, index-based livestock insurance.
***$p < 0.01$. **$p < 0.05$.

Table 3. We find that relative to the average WTP to switch from other bundles to the *IBLI + animal breed* bundle, women pastoralists were willing to pay 36%–45%, 54%–64%, and 76%–84% more than men for *IBLI + animal nutrition*, *IBLI + animal health*, and *IBLI + flexible package*, respectively.

7.2 | Effect of Information on the Relative Willingness to Pay for Bundled Index Insurance

We now turn to the role of the information treatment in influencing livestock keepers' preferences for bunded IBLI. Table 4 presents mixed effects model regression estimates of the effect of the information treatment on the relative WTP for bundled IBLI. Overall, we find that providing information about bundling and seasonal vegetation forecast had no effect on the relative WTP for the bundled IBLI products (Column 1). However, we find evidence (at the 10% level) that the information treatment reduced the relative WTP for the *IBLI + animal nutrition* bundle (Column 2).

Is the effect of the information treatment on preferences for bundled IBLI heterogeneous between women and men? Mixed effects model regression estimates are presented in Columns (3) and (4) of Table 4. We do not find evidence of heterogeneous effects of the information treatment on the relative WTP for bundled IBLI between men and women livestock keepers.

7.3 | Mechanism

We tested whether access to information improved the knowledge of pastoralists by regressing the knowledge variable on the information treatment variable. Table 5 presents OLS regression estimates and shows that the information treatment significantly improved knowledge scores by 1.7 points. This highlights the key role of information in increasing awareness of innovations, confirming that the information treatment enabled pastoralists to make more informed choices when selecting the bundles. Table 6 presents the results of the causal mediation analysis on the relative WTP for *IBLI + animal nutrition* with knowledge as the mediator. We focused only on *IBLI + animal nutrition* because of the statistically significant effect of the information treatment on the relative WTP for this bundle and because the intervention targeted nutrition. Looking at the relative WTP for *IBLI + animal nutrition*, the results show that the total effect of the information treatment is −66.09. Most of the total effect is due to the direct effect of the information treatment, with the effect due to increased knowledge representing 29% of the total effect.

7.4 | Robustness Analysis

We performed a placebo test by regressing training round bids on the information treatment dummy. If the coefficients on the infor-

TABLE 4 | Effect of information on relative willingness to pay for bundled IBLI products.

	Dependent variable: Relative bids			
	Whole sample		Women	Men
Variable	(1)	(2)	(3)	(4)
Information treatment	−43.71 (31.14)	−19.51 (34.66)	−46.42 (43.71)	−10.49 (50.95)
IBLI + Animal nutrition (Nutrition)		69.24*** (19.90)	90.08*** (27.35)	39.47 (28.76)
IBLI + Animal health (Health)		260.41*** (38.57)	268.22*** (56.47)	241.85*** (52.43)
IBLI + Flexible package (Flexible)		314.28*** (43.22)	315.22*** (55.38)	305.63*** (66.80)
Information × Nutrition		−51.07* (27.04)	−39.88 (35.45)	−46.14 (40.77)
Information × Health		−44.05 (56.19)	−50.18 (78.75)	−15.43 (79.44)
Information × Flexible		72.05 (67.64)	77.22 (102.88)	83.77 (89.92)
Additional controls	Yes	Yes	Yes	Yes
Sub-county fixed effects	Yes	Yes	Yes	Yes
Default product effect	Yes	Yes	Yes	Yes
Constant	337.83*** (78.22)	252.72** (116.07)	203.45* (120.15)	263.53 (187.73)
Number of observations	5481	5481	2796	2685
Number of respondents	1828	1828	932	896
Wald χ^2	470.53***	234.50***	175.40***	131.04***

Notes: Mixed effects model estimates. Robust standard errors are reported in parentheses. Other controls include sex, age, marital status, religion is Islam, livestock mortality, IBLI policy holding, and group membership.
Abbreviation: IBLI, index-based livestock insurance.
***$p < 0.01$. **$p < 0.05$. *$p < 0.1$.

mation treatment dummy are significantly positive or negative, it would indicate the presence of unobserved heterogeneity, which could introduce bias. Results inTable A2 indicate no statistically significant effect of the information treatment on training round bids, suggesting that our estimates are not affected by such bias.

In addition to the four treatments (bundles), our experiment further assesses the effect of information and social differentiation (between men and women). This raises questions of multiple hypothesis testing, as some of the significant results may be due to chance rather than actual treatment effects. Therefore, we calculated Romano–Wolf adjusted p values following Clarke et al. (2019) to correct for the familywise error rate (FWER), the probability of making at least one false discovery among a family of comparisons. We also calculated sharpened q-values as in Anderson (2008) to correct for the false discovery rate (FDR), the probability of making at least one false discovery among the discoveries already made. Results presented in Tables A3 and A4 are comparable to those of our main estimation, indicating robustness to the controlling for multiple hypothesis testing.

8 | Discussion

Preferences of livestock keepers for bundled IBLI, with the estimated relative WTP (KES156–KES592), are economically relevant. Pastoralists seem to prefer a flexible bundle that allows them to purchase an input of their choice depending on the prevailing or the most pressing need, unlike conventional bundles that are usually limited to specific inputs. This could imply that pastoralists, being risk-averse (Schrieks et al. 2024), have a strong preference for the IBLI bundle, which minimizes uncertainty in their choices. The result is plausible given the increasing uncertainty about the occurrence of multiple shocks at a given time (in this case, a season). While the flexible product might be attractive to consumers insofar as rational choice theory would suggest that more choice is always weakly preferred to less choice, it raises questions about whether such a product is likely to capitalize on natural synergies between the individual products. We believe that it is likely to be the case for productivity-enhancing inputs used in this study. Unlike the case of bundled insurance with credit, whereby a bank will be unlikely to issue

TABLE 5 | Effect of information treatment on knowledge.

Variable	Dependent variable Δ in knowledge score (1)	(2)
Information treatment	1.72***	1.71***
	(0.08)	(0.08)
Additional controls	No	Yes
Sub-county effects	Yes	Yes
Control group mean	0.03	0.03
R-squared	0.29	0.29
Observations	1829	1829

Notes: Ordinary least squares (OLS) regression estimates. Robust standard errors in parentheses. Other controls include sex, age, marital status, religion is Islam, livestock mortality, IBLI policy holding, and group membership.
Abbreviation: IBLI, index-based livestock insurance.
***$p < 0.01$.

TABLE 6 | Causal mediation analysis on WTP for *IBLI + animal nutrition*. Mediator: Knowledge.

Variable	Knowledge (1)	Relative WTP for *IBLI + animal nutrition* (2)
Knowledge		−11.48*
		(6.38)
Information treatment	1.70***	−46.05*
	(0.07)	(26.90)
Additional controls	Yes	Yes
Sub-county effects	Yes	Yes
Constant	−0.02	34.61
	(0.19)	(55.60)
R-squared	0.285	0.035
Observations	1510	1510
Mediation effect		−19.44
Direct effect		−46.64
Total effect		−66.09
Share of total effect (%)		29.17

Notes: Robust standard errors in parentheses. Other controls include sex, age, marital status, religion is Islam, livestock mortality, IBLI policy holding, and group membership.
Abbreviation: IBLI, index-based livestock insurance.
***$p < 0.01$. *$p < 0.1$.

the loan if the consumer can choose not to allocate the insurance payout toward loan repayment, in the case of the productivity-enhancing inputs, the flexibility that the livestock keeper is provided is to choose the input according to the need at the time. The pricing would, for instance, include the input except that the livestock keeper is allowed to choose the input rather than the insurer fixing it. Therefore, on the supply side, the insurer is not affected by the livestock keeper's decision to buy the input or not.

Looking at the specific inputs, pastoralists indicated higher relative WTP for bundled IBLI with animal health than with *IBLI + animal nutrition* and *IBLI + animal breed*. The experiment was implemented when forage conditions were good. This possibly explains why *IBLI + animal nutrition* was ranked lower than *IBLI + animal health*. The finding that *IBLI + animal breed* was the least prioritized bundle possibly reflects the thin market (demand and supply) for artificial insemination services in pastoral communities or insufficient information and capacity to avail the services. Adoption rate for artificial insemination is much lower in the pastoralist settings compared with intensive and semi-intensive systems. This result possibly suggests the need for increased knowledge diffusion on the benefits of artificial insemination services among the pastoralist communities. Furthermore, focus group discussions with the service providers showed that the cost of artificial insemination was very high. Therefore, some pastoralists may value breeding services, but affordability could be a constraint.

Our finding of differential preferences for bundled IBLI between men and women is consistent with Akter et al. (2016), who assessed a stand-alone insurance product and attributed preference heterogeneity by gender to differences in farmers' level of trust in insurance institutions and financial literacy. In our study, the level of trust in insurance service providers is not significantly different between men and women (Table A5). However, women have higher trust scores in animal health and animal nutrition service providers than men. The higher trust scores of women for animal health and nutrition can be attributed to the fact that women often are responsible for taking care of sick and lactating animals and are responsible for their feed. A complementary study to the choice experiment showed that animal health and feed were among the top five expenses women would prioritize, especially during times of shocks such as drought (DuttaGupta et al. 2024).

However, both Mishra and Gallenstein (2022) and Timu et al. (2024), who show that women tend to have a lower WTP compared to men for risk-contingent credit, attributed differential preferences among men and women to the existence of gender inequities in the use and distribution of potential benefits from the bundled innovation. While our study was conducted with individuals, we recognize that they are part of diverse households, though each of them belongs to a household unit, and that women and men in these households have differential access to resources and opportunities as well as agency to make decisions.

We showed that information on bundled products combined with seasonal vegetation forecast information influenced the participants' choice for *IBLI + animal nutrition*, by pushing them away from the bundle. Carriquiry and Osgood (2012) documented synergies between forecasts and insurance and effective input use if contracts are appropriately designed. They explained that "insurance allows the farmer to map a probabilistic forecast into a much more deterministic payout, allowing the farmer to commit to production choices that take advantage of forecast information that is too noisy to utilize without risk protection." In our case, the forecast showed a declining trend in vegetation conditions, but by the end of the long dry season, pasture conditions were expected to be above average. Therefore, it is possible that information helped the pastoralists to update their beliefs and to expect that the season was not a bad one, and they were able to anticipate less need for pasture, consequently prioritizing *IBLI + animal nutrition* less. During focus group discussions with the service providers for inputs, they indicated that demand for livestock feed tends to fall drastically during good seasons as pastoralists rely on open grasslands for feed.

The finding that there is no heterogeneous effect of the information treatment on the relative WTP for bundled IBLI between women and men is supported by Timu et al. (2024). The heterogeneous effect might arise not only from gender differences in accessing, processing, and understanding information, but also subsequent decision-making (Timu et al. 2024), which is beyond the scope of the current analysis. It is also important to note that gender may not operate alone. Diverse needs, preferences, and capacities of pastoralists can be shaped by social differences based on gender, location, household structure and other factors (DuttaGupta et al. 2024) that interact with each other to determine whether women make decisions around insurance uptake independently (Tavenner et al. 2025). Going beyond relative WTP to examine actual decision-making within pastoral households can be an avenue for future research that further integrates how gendered dynamics of pastoral mobility, with men typically moving with the herds, and women staying back, especially when it is a good period, and pasture is available, may affect decision-making around uptake and use of bundled IBLI.

Overall, our findings highlight the need to understand the different risks faced by livestock keepers. There is growing evidence about the role of compound risk aversion and basis risk on uptake of index insurance (e.g., Elabed and Carter 2015; Harrison et al. 2025). At the same time, designing contracts that fully account for farmer heterogeneity is costly and data-intensive (Jørgensen et al. 2020). Our findings suggest the potential role that bundling IBLI with other services, and allowing flexibility, can have on uptake when livestock keepers are faced with multiple risks with unknown probabilities.

Finally, although we generated useful information about preferences for bundled IBLI, our study has a few limitations. First, our experiment held insurance constant and introduced an additional component (i.e., the inputs). It is, therefore, not possible to learn about how respondents value insurance alone. Instead, we can compare preferences for the bundled component, holding insurance fixed. The decision to omit the standalone insurance product in the valuation was because IBLI is not new in the study site: its premium is known, and the product has been previously promoted through KLIP and DRIVE projects. However, we acknowledge that in a practical sense, insurance companies should sell a bundled product, and the price should be included, for example, in the premium calculation. Omitting the standalone IBLI from the experiment design limits our ability to discuss total WTP for the bundled products and instead permits a discussion of the value ranking and incremental WTP for the different add-on inputs. Although the motivation for omitting the standalone IBLI was that its market value is known, we acknowledge that demand is low even when livestock keepers are aware of the product. It is also plausible that the risk profile might vary depending on what add-on is being bundled with the insurance, and consequently, the insurance products themselves could vary in terms of structure and payouts. Second, the endow-and-exchange approach, while helpful in understanding the extent to which some bundles are ranked relative to others, would seem to provide a lower bound estimate of the difference in demand between products. This is because if a respondent is endowed with something of greater value, they would conceivably be willing to accept something (i.e., a negative bid) for the trade rather than pay something. But those bids appear in the data as zero, instead of a negative bid. This might bias downward the estimated spread across options. It is also possible that because of the likely elevation of the value of the default product that an individual participant was endowed with, the WTP for all the other products will be elevated too. List (2003) showed that the endowment effect tends to fade with experience (learning) about a product. In our context, although the products used in the experiment are well known to the livestock keepers, adoption is not yet widespread. This means that a substantial proportion of our participants have not experienced the products. Furthermore, bundled IBLI is a new concept among most of the livestock keepers. Therefore, our experimental design attempts to address this concern by randomizing the order of the products, hence spreading out the possible inflation of the WTP across the products and preserving the viability of any comparison across products. We also control for the default option in our empirical estimation. However, we cannot completely rule out the presence of endowment effects. For example, there is a possibility that the value of the default bundle possessed by the participants falls, for example, the case of *IBLI + animal breed* among women participants, when it becomes salient to them that the product they have is inferior compared to another bundle that is available. We believe that future designs can mitigate this concern by using *full bidding*. Third, some of the inputs we consider in our experiment have significantly different prices in the market. Breeding, for example, is more expensive than nutrition. Although we made the value of the coupon equal across the products so that for each purchase, 50% of the cost was subsidized, the coupon might still make it more affordable to buy some inputs (e.g., feed) than others (e.g., artificial insemination). Unfortunately, due to data limitations, we are unable to adjust for input price differences in our analysis. We, therefore, acknowledge that the significant variation in the market prices of the bundled inputs may still affect WTP independently of preferences. Fourth, our study combined information about bundling and seasonal vegetation forecasts. While this allowed us to assess the effect of this combination of information, we cannot disentangle the effect of information on bundling from that of the seasonal forecast. In addition, future research can perhaps include climate information services (CIS) as a component in bundled index insurance to further understand if there is demand for the information and assess if there might be differential access to and use of CIS. These limitations, which we hope that future research can address, should be taken into consideration when interpreting our results. In addition, further research is needed to shed more light on ways to make the implementation of a flexible bundle more cost-effective.

9 | Conclusion

Livestock keepers in the rangelands face multiple shocks, including droughts, floods, conflicts, and livestock diseases. The effects of these shocks are not confined to their immediate duration but often linger and potentially deepen existing inequalities and disproportionately affect certain social groups. Standalone services, while addressing specific needs, often fail to account for the cumulative effects of these shocks. For instance, a severe drought can deplete water and pasture resources, weaken livestock health, and result in communal conflicts over shared resources, creating cascading impacts on food security and household income.

We studied the preferences of livestock keepers for bundled index-based livestock insurance (IBLI) and assessed the effect of information on the relative willingness to pay (WTP) for the bundles. We have shown that pastoralists' WTP is highest for *IBLI + flexible package* that allows them to buy an input of their choice when a shock occurs. This is followed by *IBLI + animal health* and *IBLI + animal nutrition*, while *IBLI + breeding* was the least prioritized. Preferences for bundled IBLI products also differed between women and men. Compared to men, women demonstrated relatively higher WTP for *IBLI + animal nutrition*, *IBLI + animal health* and *IBLI + flexible package*. Providing information about bundling and seasonal vegetation forecast reduced *WTP for IBLI + animal nutrition*. Additionally, information treatment reduced the relative WTP among women more than among men.

Our findings generate important implications for policy and future research. Designing bundled products that can last the duration of the time of an insurance policy, with policy coverage that allows livestock keepers flexibility in their expenditure on inputs of choice in anticipation of or during shocks would likely be preferred than options that are specific to a particular input. There is an opportunity to leverage ongoing research to co-design bundled solutions with local actors, including communities and private sector partners, ensuring they are sensitive, well-targeted and responsive to diverse needs, priorities and differential capacities of women and men in pastoral communities. Providing contextual information is important in supporting decision-making by livestock keepers.

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Conflicts of Interest

The authors declare no conflict of interest.

Endnotes

[1] The flexible IBLI bundle and all the other bundles are conceptualized as products that are owned and underwritten by the insurance company but delivered through existing high-demand touchpoints and last-mile structures that already mediate interactions between pastoralists and IBLI (e.g., WFP programs, county veterinary services, community-based animal health workers, producer groups, and input suppliers acting as agents). This is consistent with how IBLI has historically been offered through government and development partners and local agents, rather than solely through insurer branches. In practice, because insurance companies do not have licenses for selling the inputs, they would contract and pre-list local service providers (feed suppliers, veterinary service agents, and cooperatives) as delivery partners.

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Appendix

TABLE A1 | Test for attrition.

Variable	Attrition
Information treatment	−0.09
	(0.10)
Constant	−1.69***
	(0.07)
Observations	1908

Note: Robust standard errors in parentheses. *** $p < 0.01$.

TABLE A2 | Placebo test: Effect of forecast information on training round bids.

	Dependent variables are continuous and measure the bids			
Variable	**Blue soap (1)**	**Yellow soap (2)**	**Green soap (3)**	**Brown soap (4)**
Information	−22.93**	−16.44	−15.29	1.79
	(19.43)	(17.68)	(20.40)	(3.23)
Constant	56.20***	50.06***	57.75***	28.89***
	(19.33)	(17.32)	(19.82)	(2.40)
Observations	1401	1123	1435	1326

Note: Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$.

TABLE A3 | Results of multiple hypothesis testing: Relative willingness to pay for bundled IBLI.

	Dependent variable: Relative bids					
	Whole sample		Women		Men	
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
IBLI + Animal nutrition	0.001	0.008	0.001	0.002	0.270	0.539
	[0.001]	[0.058]	[0.001]	[0.015]	[0.735]	[0.831]
IBLI + Animal health	0.001	0.001	0.001	0.001	0.001	0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
IBLI + Flexible package	0.001	0.001	0.001	0.001	0.001	0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Additional controls	No	Yes	No	Yes	No	Yes
Sub-county fixed effects	No	Yes	No	Yes	No	Yes
Order effects	No	Yes	No	Yes	No	Yes
Default product effect	No	Yes	No	Yes	No	Yes
Number of observations	5,481	5,481	2,796	2,796	2,685	2,685
Number of respondents	1,828	1,828	932	932	896	896

Notes: Romano–Wolf adjusted p values are reported and control for familywise error rate (FWER) following Clarke et al. (2019). Sharpened q-values are in [brackets] and correct for the false discovery rate (FDR) following Anderson (2008). Other controls include sex, age, marital status, religion is Islam, livestock mortality, IBLI policy holding, and group membership.
Abbreviation: IBLI, index-based livestock insurance.

TABLE A4 | Results of multiple hypothesis testing: Effect of information on relative willingness to pay for bundled IBLI products.

	Dependent variable: Relative bids			
	Whole sample		Women	Men
Variable	(1)	(2)	(3)	(4)
Information treatment	0.043 [0.761]	0.356 [0.807]	0.115 [0.573]	0.795 [0.831]
IBLI + Animal nutrition (Nutrition)		0.001 [0.003]	0.001 [0.004]	0.146 [0.501]
IBLI + Animal health (Health)		0.001 [0.001]	0.001 [0.001]	0.001 [0.001]
IBLI + Flexible package (Flexible)		0.001 [0.001]	0.001 [0.050]	0.001 [0.001]
Information × Nutrition		0.001 [0.050]	0.101 [0.400]	0.161 [0.516]
Information × Health		0.166 [0.691]	0.281 [0.772]	0.622 [0.831]
Information × Flexible		0.087 [0.545]	0.169 [0.761]	0.222 [0.761]
Additional controls	Yes	Yes	Yes	Yes
Sub-county fixed effects	Yes	Yes	Yes	Yes
Default product effect	Yes	Yes	Yes	Yes
Number of observations	5,481	5,481	2,796	2,685
Number of respondents	1,828	1,828	932	896
Wald χ^2	470.53***	234.50***	175.40***	131.04***

Notes: Romano–Wolf adjusted p values are reported and control for familywise error rate (FWER) following Clarke et al. (2019). Sharpened q-values are in [brackets] and correct for the false discovery rate (FDR) following Anderson (2008). Other controls include sex, age, marital status, religion is Islam, livestock mortality, IBLI policy holding, and group membership.
Abbreviation: IBLI, index-based livestock insurance.

TABLE A5 | *t*-Test of differences in trust scores between men and women.

Variable	Men	Women	Difference	*p* value
Trust in livestock medicine service providers	6.96 (2.57)	7.28 (2.47)	0.32	0.008
Trust in livestock clinical service providers	6.72 (2.76)	6.94 (2.71)	0.22	0.086
Trust in animal nutrition service providers	6.45 (2.74)	6.76 (2.72)	0.31	0.015
Trust in animal breeding service providers	4.03 (3.10)	3.92 (2.96)	0.11	0.435
Trust in livestock insurance agents and companies	5.28 (2.97)	5.43 (2.97)	0.15	0.288

Note: Standard deviations are in parentheses.

Appendix: Knowledge questions

Now I will ask you a few questions, more specific to bundling. The goal of these questions is for us to have a sense of your understanding of the concept of bundling. Please note that how you answer these questions will not affect your participation in this study in any way. Consider this a learning exercise.

1. Bundling can increase customer satisfaction more than a standalone product (true/false/I don't know).
2. Bundled products are more expensive than standalone products (true/false/I don't know).
3. When choosing bundled products, you should pick the cheapest (true/false/I don't know).
4. Bundled products are always of an inferior quality compared to standalone products (true/false/I don't know).
5. When choosing bundled products, you should pick the one that generates the greatest satisfaction (true/false/I don't know).
6. When choosing bundled products, you should pick the one that effectively addresses the most problematic challenges to you (true/false/I don't know).