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Influence of Institutional Arrangements on the Demand for Agricultural Insurance in a Developing Country Context.

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Abstract

Agricultural insurance is essential for risk management, yet farmers often do not embrace it without appropriate institutional arrangements. Drawing on New Institutional Economics (NIE) theory, this study examines how institutional arrangements influence demand for agricultural insurance using data from 365 randomly chosen farmers from northern Uganda's Nwoya, Zombo, Amuru, and Kotido districts through self-administered questionnaires. Data were analysed using logit models. Findings reveal that farmers are more willing to pay when index insurance is offered through suitable institutional arrangements like input suppliers (IS) and non-governmental organisations (NGOs). The study found that offering insurance through IS and NGOs at sub-county and parish levels was crucial for enhancing DII. Demand is also driven by age, income, risk attitude, education, and farmer experience. The Agriculture Insurance Consortium (AIC) should leverage institutional arrangements trusted by farmers to improve index insurance demand. Government actions to integrate agricultural insurance with IS and NGOs' operations can enhance farmers' access to insurance and achieve inclusive agricultural insurance, improving demand.

Keywords: Institutional Arrangements, Demand for agricultural insurance, Index Insurance, Farmers

Introduction

Agriculture is a key source of livelihood for African populations, providing employment, food security, and foreign exchange earnings (Food and Agriculture Organization (FAO), 2024). It employs over 70% of the population, accounts for most of Uganda's export revenue, and contributes over 24% of the GDP (UBOS, 2022). Climate change and extreme weather events cause crop failures for Ugandan farmers, as in other African nations (Oyebola et al., 2021). These factors jeopardise targets for Sustainable Development Goals (SDGs) 1 (no poverty) and 2 (zero hunger) (World Bank 2016). Agricultural insurance becomes essential to help farmers deal with these unfavourable natural disasters (Xie, Zhang, Li, Xia, & Chen, 2024). It helps protect income, ensure food security, and maintain stability in the sector, vital for economic growth. In Uganda, agricultural insurance is provided with government support for farmers. Index-based insurance is prominent, particularly weather index insurance, which offers payouts based on weather parameters (Adeyinka et al., 2022). Crop weather insurance covers drought and excess rainfall, while livestock insurance covers disease outbreaks and extreme weather events (Bulte & Haagsma, 2021).

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Crop production forms Uganda's agricultural sector foundation, and crop weather index insurance protects against agricultural uncertainties (Masiza, Chirima, Hamandawana, Kalumba, & Magagula, 2022). These are sold to farmers at the sub-county level by the Agricultural Insurance Consortium, Uganda (AICU), a coalition of 13 local insurance companies, or through brokers and risk aggregators like banks and Micro Finance Institutions (MFIs) (World Bank, 2019). However, demand for index insurance (DII) remains low among Uganda's farmers (Adeyinka et al., 2022). After the 2016 program revival, only 316,496 farmers were insured by 2023 (Insurance Regulatory Authority, Uganda (IRAU), 2022). This falls short of the National Financial Inclusion Strategy 2017-2022 target of 7% (1.8 million) individuals using insurance products. Moreover, uptake was lowest among smallholder farmers, who are the majority farmers. Increasing DII has significant effects on economic growth, financial resilience to weather shocks, and poverty reduction. Supply- and demand-side factors explain low DII (Platteau et al., 2017). Most studies have focused on demand-side determinants to explain low DII (Oyebola et al., 2021; Xie et al., 2024). Limited attention has been given to supply-side factors, despite their crucial influence on DII in developing countries (Jensen et al., 2017). This study suggests that low DII may be linked to supply-side factors, particularly unsuitable institutional arrangements, in contexts where agricultural index insurance is relatively new, and smallholder farmers predominantly dominate agriculture. Understanding the role of institutional arrangements could offer insights into low insurance uptake. Neoclassical theory has provided significant insights into DII. However, since agricultural index insurance markets are less developed in developing countries, DII's nature and its institutional interaction require a different approach. Using New Institutional Economics (NIE) theory by Williamson (1975), which emphasizes the institutional environment and arrangements' role in economic decisions, a framework can be established to explain DII.

Few studies have examined the influence of institutional arrangements (banks, MFIs, and input suppliers) on the DII (Marr et al., 2016; Farrin & Miranda, 2015; Carter et al., 2017). And less attention has also been given to farmers' preferences for institutional arrangements based on trust (Rukundo et al., 2021), which could improve DII in a context like Uganda, where insurance delivery channels (banks, MFIs) have had limited success. This study examines how institutional arrangements influence DII backed by sub-county or parish-level agricultural index insurance coverage. NGOs, Village Savings Loan Associations (VSLAs), and IS have been identified as key last mile delivery channels that can influence DII (Bulte, Cecchi, Lensink, Marr, & Van Asseldonk, 2020; Carter et al.,2017; Lagu, 2023). These institutions, positioned within communities with outreach to farmers, can foster trust and influence farmers' DII decisions. Uganda offers ground for this research as agriculture is vulnerable to weather risks (Kolliesuah, Olum, & Ongeng, 2023), but the literature on agricultural insurance is scarce. Northern Uganda remains the most susceptible region (IFAD,2021). As Uganda is agriculturally based, with smallholder farmers cultivating food crops while pursuing commercialisation, it warrants DII research. This study examines the effect of institutional arrangements on willingness to pay (WTP) for index insurance while considering farmers' socioeconomic attributes. It analyzes how farmers' institutional preferences affect their WTP, which previous studies have ignored (Carter et al.,2016). Second, this study extends Hazell et al.'s (2021) discussion of innovations in agricultural insurance by comparing institutional arrangements associated with WTP at different coverage levels. It has policy implications where governments cannot persistently provide farmer

subsidies. These insights could help inform policies that strengthen key institutional arrangements, enabling farmers to adopt insurance products effectively.

Theoretical and Empirical Literature Review

The New Institutional Economics (NIE) theory by Williamson (1975) anchors this study. The theory focuses on institutions' role in economic decisions at micro and macro levels (Kherallah & Kirsten, 2002) and suggests that institutional arrangements shape demands by aligning strategies with needs for mutual benefits. As agricultural insurance arrangements in developing countries evolve, more attention needs to be paid to the relationships created. Since agricultural insurance is intended for farmers, their perspective on institutional arrangements for agricultural index insurance delivery is vital. Trust acts as a governance tool, enhancing cooperation and influencing the choice of institutional arrangements (Organisations) (Nooteboom,1996; Ritcher,2005). Trust shapes preferences and beliefs about what Organizations are appropriate and acceptable. Nooteboom (1996,1999) acknowledges that trust in organisation's leadership influences behavior. As trust affects relationships that improve DII, understanding farmers' preferences for organisations based on trust is important, especially where farmers lack experience with index insurance. Applying NIE theory to DII offers a lens to examine institutional arrangements and address farmers' accessibility challenges. Assessing insurance demand requires either hypothetical or constructed market approaches. The latter applies in developed markets (Wang et al.,2019), while the former suits nascent markets (Kumar et al.,2020). This study uses a hypothetical market, as Uganda's agricultural index market remains thin. Despite low insurance demand, Ugandan farmers face climate risks and inefficient insurance access (Madaki et al., 2023). Creating relationships with organizations enables resource access (Ngetich et al., 2021), influencing demand. NGOs, VSLAs, and IS could be key intermediaries between insurance companies and farmers to increase DII (Carter et al.,2017; Bulte et al.,2020).

NGOs and Demand for Index Insurance

The social mobilisation of NGOs and their experience in service delivery offer insurers an opportunity to exploit agricultural insurance. NGOs help empower smallholder farmers by ensuring affordable coverage (Sheikhnor 2024). Their trust within local communities is essential for accepting insurance products and motivating DII (Sheikhnor,2024; Ly et al., 2022). Hill et al. (2019) found that providing weather index insurance through a local NGO to smallholders in northwestern Bangladesh was successful. However, Cole et al.'s (2013) experiment among Indian farmers found that marketing insurance through SEWA, an NGO serving women, did not significantly affect demand for rainfall index insurance. This suggests women are generally risk averse and have limited involvement in financial decisions due to social gender roles (Akter et al., 2016). Despite limited evidence on NGOs' influence on DII, literature from Africa, India, and Bangladesh shows that NGO partnerships have succeeded in providing index insurance to smallholders (Pereira et al., 2015). Basri (2021) found a positive relationship between NGOs and demand for Micro Health Insurance. Additionally, Sanadgol, Doshmangir, Majdzadeh, and Gordeev (2021) found that NGOs positively influence Universal Health Insurance demand. Consequently, we hypothesize:

H1: Farmers' demand for agricultural insurance is expected to be higher when insurance is provided through NGOs.

VSLAs and Demand for Index Insurance

VSLAs are major providers of rural financial services in Uganda (Uganda National Household Survey (UNHS), 2020) and can provide agricultural insurance. It is easier to trust index insurance through VSLAs due to their informal risk-sharing networks and operational frameworks. Few studies examine informal institutions (VSLAs) on DII. This study responds to Carter et al. (2017) who suggest that delivering index insurance through VSLAs can address low uptake. According to Fred (2023), VSLAs are potential delivery channels for agricultural insurance, being member-based informal institutions that farmers trust (Dawuni, Mabe, & Tahidu, 2021). Lagu (2023) argues that VSLAs provide trusted insights for rural communities to engage in insurance services. Gebre et al. (2023) suggested that providing insurance through VSLAs can overcome barriers that hinder insurance uptake, such as lack of trust, and low awareness. In Ethiopia, Berg, Blake, and Morsink (2022) noted that marketing index-based rainfall insurance through informal risk-sharing groups increases farmer demand. The study found insurance demand increased significantly (27%) compared to 18% among untrained leaders. A randomized control trial by Belissa, Bulte, Cecchi, Gangopadhyay, & Lensink (2019) found that demand for index-based insurance doubled to 15% when marketed through trusted informal group leaders, versus 8% when marketed by companies. Mobarak and Rosenzweig (2013) found that offering formal index-based rainfall insurance through informal farmer groups positively influences DII. Based on the literature review, we hypothesize:

H2: *Farmers' demand for agricultural insurance is expected to be higher when insurance is provided through VSLAs.*

Input Suppliers (IS) and Demand for Index Insurance

According to Bulte et al. (2020) and Binswanger (2012), IS can attract farmers to insurance by bundling it with agricultural inputs to increase value and enhance demand. With its ability to provide quality inputs that improve productivity, IS are positioned to promote insurance. Furthermore, incorporating insurance into supplies may increase farmer participation (Lagu, 2023; Pienaah & Luginaah, 2024). Despite its potential to improve DII, few studies have examined DII when linked with IS, like drought-tolerant seeds. The Kilimo Salama scheme in Kenya combines seed and fertiliser sales with index insurance through agro-input dealers, positively affecting insurance demand (Madaki et al., 2023). In Zambia, satellite rainfall index-based insurance is marketed by agro-dealers who bundle it with seed sales. NWK Agro-Services has offered insurance with input credit to cotton farmers since 2013, insuring 52,000 farmers between 2014 and 2015 (Hess & Hazell, 2016). Additionally, over one million farmers have participated in Zambia's Farmer Input Support Program, combining index insurance with input credit between 2020 and 2022, 2017. Providing insurance through IS ensures farmers are protected against risks while accessing quality inputs to improve yields, increasing DII. Based on this, it is expected that;

H3: Farmers' demand for agricultural insurance is expected to be higher when insurance is provided through input suppliers.

Socio-economic Attributes of Farmers

Studies show that age, gender, marital status, income, education, risk attitude, and farming experience influence agricultural insurance demand. Younger farmers are more willing to pay for

agricultural insurance (Danso-Abbeam et al., 2014; Dercon et al., 2014), and male farmers show higher willingness to purchase weather index insurance (Ankrah et al., 2021; Okoffo et al., 2016; Akter et al., 2016). While some studies indicate that marital status positively affects WTP (e.g., Ellis, 2017), others find no significant difference in DII. Literature shows varying effects of farmers' income levels. Abugri et al. (2017) and Danso-Abbeam (2014) show high-income farmers are more willing to take insurance, while Jin et al. (2016) report negative relationships in rural China. These contradictions may stem from varying crop varieties and farming contexts. Higher education levels positively influence farmers' WTP for insurance (Senapati, 2020; Fonta et al., 2018; Aditya et al., 2018). Regarding farming experience, Jin et al. (2016) show an increased likelihood of insurance purchase, while Senapati (2020) finds no significant effect. Studies (Ali et al., 2021; Cole et al., 2013) show both positive and negative effects of risk aversion on DII, possibly due to basis risk in index insurance products affecting trust (Clarke, 2016). Therefore, farmers' WTP for crop insurance is expected to correlate with age, gender, marital status, income, education, farming experience, and risk attitude.

Methodology

Study Setting

This study examines Uganda, where agriculture drives economic growth. Agriculture is rain-fed and dominated by smallholder farmers with low productivity (UBOS,2022), making them vulnerable to adverse weather. The study sample was from northern Uganda, selected for its high vulnerability to disasters (Katongole, 2020) and poverty, with 35.9% in severe poverty (Galema et al., 2024). Few farmers have insurance (IFAD, 2021). Farmers are smallholders with less than five acres or seasonal income under 20 million, growing food crops mainly maize, cassava, soya beans, rice, and groundnuts, with some growing beans, simsim, sunflower, millet, onions, and tomatoes (UBOS, 2022). Farming is their main income. The study included 365 (91.3%) farmers in northern Uganda. Using AICU information, data were collected from the West Nile, Acholi, and Karamoja subregions spanning Amuru, Kotido, Nwoya, and Zombo districts. Using a farmer list from District Agricultural officers (DAO), researchers and agricultural extension officers randomly selected farmer groups to participate. Extension officers contacted lead farmers to invite members to agricultural insurance sessions, requiring participants to make decisions about DII. Lead farmers informed members of selection times and locations. Working with extension officers, researchers assembled groups of about 30 farmers centrally from various villages. These were pre-existing groups following AICU's procedure. Six groups of 30 farmers from Nwoya, four groups of 25 from Amuru, three groups of 30 from Zombo, and two groups of 25 from Karamoja, totaling 420 farmers, were selected through proportionate random sampling. However, only 400 were surveyed. Data collection occurred with DAO permission. Two sessions run daily, with groups assigned based on availability. To avoid bias, respondents were assured privacy. The respondents were farmers growing insurable crops because they are the ones who make agricultural insurance decisions.

Primary data were collected using a structured questionnaire. Given the novelty of weather index insurance, a basic explanation was provided before the questionnaire, as Jensen and Barrett (2017) recommend. The sessions explained farmers' transition from subsistence to commercial farming and the need for protection from financial losses due to natural disasters. The researchers explained agricultural index insurance benefits, premiums, payouts, and coverage levels. Information provision enables informed choices in hypothetical markets (Fonta et al., 2018;

Tadesse et al., 2017). The questionnaire included three sections: socioeconomic information, institutional arrangements assessment (NGOs, VSLAs, and IS), and WTP for index insurance. For institutional arrangements, farmers rated trust perceptions as high (three), moderate (two), or low (one). Due to high WTP figures, a follow-up question was included. As in Ishengoma et al. (2021) and Hill et al. (2019), farmers indicated their WTP at sub-county or parish levels at different prices. Cronbach's alpha measured internal consistency (Cronbach, 1951). Three insurance specialists validated the questionnaires (Saunders et al., 2012). A pilot study with 50 northern Uganda farmers was conducted (Hair et al., 2010).

The dependent variable, DII, was measured by WTP (Kumar et al., 2020). WTP was captured using two variables: WTP at sub-county and parish levels. The first variable was a dummy for farmers preferring insurance at the sub-county level, zero otherwise. The second was a dummy for farmers' WTP at parish level, zero otherwise. The independent variable, institutional arrangements, included VSLAs, NGOs, and IS, measured by farmers' trust preferences (reputation, reliability, competence, commitment, and integrity), rated as follows: 3 high trust, 2 moderate, and 1 low. Age was measured continuously, and gender was a dummy: 1 if male. Marital status was measured as 1 if married. Income was measured as natural logarithm of seasonal income. Education was captured by four dummy variables: no formal education, primary, secondary, and higher education. Farming experience was captured using four dummies: less than five years, 5-10 years, 10-15 years, and over 15 years. Risk attitude was measured as a dummy: 1 if risk-averse.

Logistic regression analysis was used to analyse the data. The binary logistic model expressed the likelihood of a farmer purchasing index insurance given institutional arrangements and socioeconomic attributes. The model is as follows.

$$Y_n = \alpha_n + \beta_1 \text{VSLAs} + \beta_2 \text{Input suppliers} + \beta_3 \text{NGOs} + \beta_n Z_n + \varepsilon_n \ldots (3)$$

where α is a constant, n indicates a farmer, and ε is an error term. The dependent variable y denotes the DII (WTP), with 1 if farmer n is willing to pay for insurance and 0 if otherwise. β1, β2, and β3 are parameters of institutional arrangements, while βn is the parameter for control variables, and Zn represents socioeconomic factors.

Results

Descriptive Results

Table 1 shows that the sample size of the data is 365. However, the sample size for income is 334 because not all farmers were growing crops for sale. Overall, the sample is large enough to achieve a good logistic model fit for the data as recommended by Hair et al. (2010). Table 1 shows that the respondents' average age was 40 years, indicating mostly middle-aged farmers. 56% were male and 44% female, reflecting socio-cultural norms where men manage resources. 83% of farmers were married. Crop farming generates seasonal incomes of Ug. Shs 847, 234. 59% completed primary education, 33.7% lacked formal education, and 7.4% completed secondary school.

Table 1: Descriptive Statistics

Variables	No.	Percent (%)	Mean	Std. Dev.	Min	Max
Age (years)	365		39.764	11.149	20	66
Gender (male)	365		0.556	0.498	0	1
Marital status (married)	365					
Income (Ug.shs)	334		847,233.8	1,226,581	21,000	8,960,000
Ln income	334		12.7859	1.4012	9.9523	16.0083
Education level						
No formal education	123	33.7				
Primary	215	58.9				
Secondary	17	4.7				
Higher education	10	2.7				
Farming experience (years)						
Less than 5	74	20.3				
5 -9	87	23.8				
10-15	144	39.5				
Above 15	60	16.4				
Risk attitude (risk averse)	359		0.732	0.443	0	1
Demand						
WTP for Parish level	365		0.30	0.461	0	1
WTP for Sub-County level	365		0.70	0.461	0	1

Source: Field Data (2024)

This low education level may affect understanding of index insurance. For farming experience, 20.3% had less than five years, 23.8% had five–ten years, 39.5% had 10–15 years, and 18.4% had over 15 years. Only farmers with minimum three years' experience were analysed, as per Massawe et al. (2024). Results showed 73% were risk-averse, which may explain the high WTP for index insurance. The mean WTP was 0.7 at sub-county and 0.30 at parish level, suggesting diverse DII perceptions. Farmers' preferences for organizations based on the level of trust were examined using a three-point Likert scale (1 = low trust, 2 = moderate trust, 3 = high trust). The results are shown below.

Table 2: Farmers' Preferences for Institutional Arrangements

Institutional arrangement		Preference
VSLAs	124	Moderate trust
Input suppliers (IS)	155	High trust
NGOs	86	Low trust

Source: Field Data (2024)

The results above rank IS first, followed by VSLAs and NGOs, showing differing trust levels. Since VSLAs are member-based organisations (Patt et al., 2009), it is surprising they do not rank highest. This is because VSLAs are informal institutions whose leadership may be less trusted, unlike formally established IS. IS may be valued more for providing quality inputs like drought-resistant seeds and technical advice on smart practices. Nonetheless, VSLAs are likely more trustworthy and adaptable than NGOs.

Diagnostic Tests

Following Tabachnick and Fidell (2013) and Hair et al. (2010), data were tested before regression analysis, wherein tolerance (TOL) and variance inflation factors (VIF) were calculated to explore multicollinearity among independent variables (Gujarati, 2004). The results are as follows.

Table 3: Variation Inflation Factor (VIF)

Variable	VIF	Tolerance (TOL)
Age	1.06	0.9462
Gender	1.02	0.9794
Marital status	1.05	0.9491
Ln Income	1.03	0.9680
Education	1.05	0.9558
Farming experience	1.11	0.8998
Risk attitude	1.02	0.9795
Institutional arrangements	1.02	0.9794
Mean VIF	1.05	

Source: Field Data (2024)

The results show that the smallest TOL exceeds 0.8, and the largest VIF is less than 2, within ranges by Hair et al. (2010), indicating no multicollinearity between variables. Reliability, measured by Cronbach's alpha, ranged from 0.70 to 0.790, exceeding the 0.700 threshold (Kennedy, 2022), showing internal consistency. Data distribution was evaluated using kernel density (Cameron & Trivedi, 2005). Residuals were normally distributed with a mean of 0 and a variance (σ). To check extreme outliers, multivariate data were examined using leverage against residuals. Observations showed high leverage and residual value, but values were not significantly above average to be influential, indicating no outliers. These statistics demonstrate adherence to logistic regression assumptions, strengthening the model's reliability (Hair et al., 2010).

Logit Regression Results

Table 4 shows the results of the relationship between institutional arrangements and DII. Demand was addressed in terms of WTP for index insurance, either at the sub-county level (model 1) or parish level (model 2). Premium rates of 5% and 10% were considered for index insurance at sub-county and parish levels, respectively. The results are presented below.

Table 4: Logistic Regression Results

Variables	Index insurance at the sub county level			Index insurance at the parish level		
	Coef. (Robust Std. Err)	dy/dx (Std.Err)	*p*>z	Coef. (Robust Std. Err)	dy/dx (Std.Err)	*p*>z
Institutional arrangements						
VSLAs	0.3081	0.0589	0.597	-0.3669	-0.0704	
	(0.5832)	(0.1149)		(0.5663)	(0.1114)	0.517
Input suppliers	0.5589***	0.1048*	**0.039**	-0.5230	-0.0988	
	(0.2708)	(0.0492)		(0.6940)	(0.1155)	0.451
NGOs	-1.0770*	-0.2256*	**0.005**	1.0892*	0.2306*	
	(0.3817)	(0.0559)		(0.4438)	(0.0718)	**0.014**
Age	0.3343*	0.0649*	**0.049**	-0.3330	-0.0599*	
	(0.1699)	(0.0311)		(0.1315)	(0.0267)	**0.011**
Gender	-0.2725	-0.0529	0.466	0.0941	0.0408	
	(0.3736)	(0.0647)		(0.2637)	(0.0488)	0.721
Marital status	0.1803	0.0350	0.6	-0.1180	-0.0230	
	(0.3435)	(0.0613)		(0.3771)	(0.0703)	0.754
Ln Income	-0.1268*	-0.0246*	**0.022**	0.1628	0.0318	
	(0.1050)	(0.0231)		(0.1311)	(0.0283)	0.214
Education						
No formal	-0.3415	-0.0678	0.377	0.3616	0.0722	
education	(0.3868)	(0.0739)		(0.4157)	(0.0816)	0.384
Primary	0.7323***	0.1433*	**0.005**	-0.7200***	-0.1419*	
	(0.2624)	(0.0513)		(0.1726)	(0.0237)	**0.000**
Secondary	-0.2993	-0.0585	0.266	0.3071	0.0607	
	(0.2693)	(0.0609)		(0.2883)	(0.0636)	0.287
Higher	-2.0199*	-0.4442**	**0.000**	2.0331*	0.4485**	
	(0.4824)	(0.0899)		(0.5091)	(0.0954)	**0.000**
Farming Experience						
Less than 5yrs	-0.2965*	-0.0597*	**0.005**	0.2085	0.0418	
	(0.4443)	(0.0967)		(0.4402)	(0.0920)	0.636
5-10yrs	0.1316	0.0247	0.669	-0.2255*	-0.0422*	
	(0.3079)	(0.0569)		(0.1144)	(0.0228)	**0.049**
10-15yrs	0.4197	0.0774	0.158	-0.2633	-0.0492	
	(0.2973)	(0.0520)		(0.2585)	(0.0447)	0.308
Above15 yrs	-0.2576	-0.0507	0.271	0.2168	0.0427	
	(0.2340)	(0.0427		(0.2115)	(0.0358)	0.305
Risk attitude	0.6550**	0.1272*	**0.001**	-0.6019**	-0.1176*	
	(0.2033)	(0.0191)		(0.2898)	(0.0355)	**0.038**
Cons	1.6309			-2.6627		
Wald chi2	28.18			26.97		
Prob > chi2	0.0052			0.0082		

Pseudo R^2	0.0932			0.0905		
AIC	384.996			386.0601		
BIC	434.2655			435.3296		
Observations	328			328		
Hat	0.8112***		0.000	0.8629***		
	(0.2278)			(0.2343)		0.000
Hat sq.	0.1682		0.244	-0.1196		
	(0.1443)			(0.1441)		0.406
Marginal effects after logit		0.706			0.294	

****, **, and * denote significance level of <0.01, <0.05 and <0.10 respectively*

Results show that institutional arrangements and farmers' socio-economic attributes explain 9.3% and 9% of WTP for index insurance at sub-county and parish levels, respectively. Based on marginal effect models, average probabilities of WTP for index insurance at sub-county and parish levels were 71% and 29%, respectively. These probabilities indicate that even if index insurance is available at parish level, many farmers are ready to pay for insurance at sub-county level. The model specifications were tested using link tests. Results indicated both models were well specified. Model 1 shows IS has a significant positive relationship with WTP ($\beta = 0.559$, $p<0.01$), NGOs have a negative relationship with WTP ($\beta = -1.077$, $p<0.1$), and VSLAs have an insignificant effect on WTP. This indicates farmers are likely to purchase index insurance at the sub-county level through input suppliers. The negative relationship with NGOs suggests farmers are less likely to purchase index insurance when provided by NGOs. The results confirm hypothesis H3: Farmers are likely to demand agricultural insurance through input suppliers. This supports the model's statistical significance at the 1% level. Model 2 shows an insignificant effect of VSLAs and input suppliers on WTP. However, NGOs have a positive significant effect on WTP ($\beta =1.089$, $p<0.1$), implying farmers are likely to purchase index insurance when provided through NGOs. The results confirm hypothesis H1: Farmers are likely to demand agricultural insurance through NGOs. This supports the model's significance at the 10% level.

For control variables, age has a significant effect on WTP in Model 1 ($\beta = 0.3343$, $p<0.1$) but not in Model 2. The positive relationship in Model 1 suggests older farmers are more likely to purchase index insurance at the sub-county level. The findings are supported by Aditya et al. (2020), who argued that in India, older farmers are more reluctant to participate in insurance. Gender and marital status had no significant effect on WTP at either sub-county or parish level. Income shows a negative significant effect on WTP in Model 1 ($\beta = - 0.127$, $p<0.1$) and an insignificant effect in Model 2, suggesting lower farming income increases the probability of purchasing insurance at sub-county level. The education variables for no formal education and secondary education were insignificant in both models. Model 1 shows a positive significant effect of primary education on WTP ($\beta = 0.7323$, $p<0.01$) and a negative significant effect of higher education ($\beta = -2.0199$, $p<0.1$). Model 2 indicates a negative significant relationship between primary education and WTP ($\beta = -0.720$, $p<0.01$) and a positive significant relationship with higher education ($\beta = 2.0331$, $p<0.1$). These results show that less-educated farmers are more likely to purchase insurance at sub-county level, while more educated farmers prefer parish level. The findings suggest that low education level of farmers could limit their ability to evaluate benefits of index insurance at parish level. Farmers also appeared to be conservative and thus

hesitant to immediately respond to changes in the insurance sector. Results reveal a negative significant effect of farming experience less than five years on WTP in Model 1(β = -0.2965, p<0.1) and five to ten years in Model 2 (β = -0.2255, p<0.1), indicating farmers with less than 10 years of experience are less likely to purchase insurance at both levels. Risk-averse farmers are 13% more likely to purchase insurance at sub-county level and 12% less likely at parish level than risk-taking farmers.

Robust Check

To check robustness, the specifications of the logit regression model were varied. Risk attitude interacted with farming experience to establish the stability of the coefficients and any significant changes in the estimated models, as shown below.

Table 5: Robustness Check

	Index insurance at the sub-county level			**Index insurance at the parish level**		
Variables	**Coef. (Robust Std. Err)**	**dy/dx (Std.Err)**	***p*>z**	**Coef. (Robust Std. Err)**	**dy/dx (Std.Err)**	***p*>z**
Institutional arrangements						
VSLAs	0.3094 (0.5805)	0.0591 (0.1144)	0.594	-0.3674 (0.5645)	-0.0704 (0.1111)	0.515
Input supplies	0.5665*** (0.2725)	0.1060* (0.0493)	**0.038**	-0.5176 (0.6848)	-0.0977 (0.1140)	0.450
NGOs	-1.0777* (0.3868)	-0.2258* (0.0567)	**0.005**	1.0875* (0.4482)	0.2302* (0.0732)	**0.015**
Age	0.3309* (0.1667)	0.0642* (0.0308)	**0.047**	-0.3048* (0.1282)	-0.0595* (0.0266)	**0.017**
Gender	-0.2900 (0.3962)	-0.0562 (0.0679)	0.464	0.2174 (0.2977)	0.0424 (0.0516)	0.465
Ln Income	-0.1256 (0.1084)	-0.0244 (0.0239)	0.247	0.1622 (0.1335)	0.0317 (0.0289)	0.224
Marital status	0.1771 (0.3356)	0.0343 (0.0596)	0.598	-0.1164 (0.3714)	-0.0227 (0.0692)	0.754
Education						
No formal education	-0.3454 (0.3885)	-0.0685 (0.0737)	0.374	0.3631 (0.4174)	0.0725 (0.0816)	0.384
Primary	0.7457*** (0.2643)	-0.1446* (0.0309)	**0.005**	-0.7377** (0.2017)	-0.1453* (0.0248)	**0.000**
Secondary	-0.3017 (0.2668)	-0.0590 (0.0597)	0.258	0.2996 (0.2851)	0.0592 (0.0620)	0.293
Higher Education	-2.0340* (0.9023)	-0.4469** (0.1709)	**0.024**	1.9923* (0.5586)	0.4405** (0.1053)	**0.000**

Farming Experience (years)						
	0.5178	0.0531		-0.3216	-0.0384	
Less than 5	(0.4834)	(0.0907)	0.284	(0.4346)	(0.0900)	0.459
	-0.4551	-0.0409		0.3796	0.0411*	
5 – 10	(0.5980)	(0.0273)	0.447	(0.4528)	(0.0259)	**0.033**
	-0.4569	-0.0785		0.1419	0.0496	
10 – 15	(0.5879)	(0.0533)	0.437	(0.4987)	(0.0459	0.776
	0.3470	0.0501		0.0626	-0.0379	
Above 10	(0.6231)	(0.0651)	0.578	(0.5690)	(0.0368)	0.912
	0.9288***	0.1324*		-0.7415	-0.1226*	
Risk attitude	(0.7444)	(0.0236)	**0.000**	(0.7755)	**(**0.0410)	**0.000**
Risk attitude & less than 5	-0.3566 (0.6918)		0.606	0.1814 (0.6242)		0.771
Risk attitude & 5-10	0.4724 (0.6904)		0.494	-0.2401 (0.5286)		0.650
Risk attitude&10 – 15	0.0543 (0.5328)		0.919	0.1766 (0.5207)		0.735
Risk attitude & Above 10	-0.1241 (0.7190)		0.863	-0.3807 (0.5252)		0.469
Cons	1.6304			-2.1459		
Wald chi2	23.61			22.7		
Prob > chi2	0.0145			0.0195		
Pseudo R^2	0.0911			0.0902		
AIC	391.5088			392.6154		
BIC	437.0249			438.1316		
Observations	328			328		

These results appear robust, even when there is an interaction between risk attitude and farming experience. The coefficients of the explanatory variables remain slightly the same.

Discussion of the Findings

The results suggest that farmers are generally interested in purchasing index insurance at the sub-county level, at a premium rate (5%), similar to what is offered under UAIS. This finding suggests that farmers have low sensitivity to basis risk and are willing to trade off basis risk for lower premiums, such that as the cost of insurance rises, uptake becomes cost sensitive. The analysis demonstrates that both theoretical and empirical literature provide a comprehensive understanding of how institutional arrangements affect DII. Hypothesis (H1) tested the effect of NGOs on DII. The results show that 22.5% of farmers were less willing to purchase index insurance at the sub-county level, and 23% were more willing to buy index insurance at the parish level. This aligns with evidence from countries such as India and Bangladesh, which reveals the success of NGO partnerships in delivering insurance to smallholder farmers. While these studies differ in context, they reinforce the current study's findings by emphasizing the role of NGOs in

shaping the DII in Uganda. Thus, we argue that index insurance at the parish level is appealing because NGOs can offer a cushion on insurance premiums for farmers. Furthermore, NGOs may be more reputable and credible to the people due to their active community-level involvement in northern Uganda and dedication to long-term societal betterment.

Hypothesis (H3) examined the effect of IS on DII. Accordingly, IS positively influence WTP for index insurance at the sub-county level ($\beta = 0.559$, $p<0.01$). This is similar to the findings in Kenya and Zambia, where the provision of index insurance through local input dealers has a positive influence on demand (Hazell et al.,2021; Bulte et al., 2020). This may be explained by IS's capacity to offer incentives to smallholders, who are typically cash-constrained, as well as higher-quality inputs and technical guidance on excellent agricultural techniques. Consequently, farmers are likely to find IS valuable and are more inclined to buy index-based insurance at the sub-county level. The results further indicate an insignificant effect of VSLAs on WTP for index insurance at both the sub-county and parish levels. This finding is rather surprising and contrary to similar studies (Gebre, Rahut, Aryal, and Mawia, 2023; Berg, Blake, and Morsink, 2022; Belissa, Bulte, Cecchi, Gangopadhyay, & Lensink, 2019) in Tanzania and Ethiopia that found a positive effect. As previously highlighted, the informal nature of VSLAs may pose doubts about their competence in delivering index insurance. At the same time, VSLAs in Uganda have been proven to target mostly female farmers (IFAD, 2020), and the loans they access from VSLAs are small and may be inadequate to purchase insurance. Additionally, farmers' varying perceptions of VSLAs could explain the insignificant results.

Moreover, age has a significantly positive effect on WTP for index insurance at the subcounty level. This finding is consistent with Okoffo et al. (2016), who found a positive relationship between age and WTP of cocoa farmers in Ghana. This may be because older farmers tend to be more averse to risk (Kouame & Komenan, 2012); hence, they are more likely to choose index insurance at the sub-county level, which attracts a lower premium (5%). The results further show that gender and marital status have insignificant effects on WTP for index insurance at the sub-county and parish levels. The insignificant results for gender are consistent with the findings of Adjabui and Gray (2019) and Senapati (2020) for farmers in Ghana and India. This surprising result can be attributed to differences in the economic status and cultural factors of the farmers in the region.

Income has a negative and significant effect on WTP at the sub-county level ($\beta = -0.127$, $p<0.1$). This finding conforms to that of Jin et al. (2016), who also found a significant negative relationship between farmers' income and the demand for agricultural insurance in China. This is not surprising, as most farmers in Uganda have small landholdings, with most of the land being rain-fed and cropping, generating less income (UBOS, 2022). Hence, farmers with lower premiums are more likely to opt for index insurance at the subcounty level. Furthermore, primary education has a positive and significant effect on WTP ($\beta = 0.7323$, $p<0.01$) and a significant negative effect of higher education on WTP ($\beta = -2.0199$, $p<0.1$) at the sub-county level. At the parish level, primary education has a negative and significant relationship with WTP ($\beta = -0.720$, $p<0.01$), while higher education has a positive and significant relationship with WTP ($\beta = 2.0331$, $p<0.1$). This confirms the significant effect of education on WTP, akin to the studies by Senapati (2020), Aditya et al. (2018), and Fonta et al. (2018) in India and Burkina Faso. These results indicate a higher probability of less educated farmers purchasing index insurance at the sub-

county level and more educated farmers opting for index insurance at the parish level. The reverse findings were expected because higher education levels often correlate with a greater understanding of the risks and benefits of formal insurance, and hence a preference for index insurance at the parish level.

The results further indicate that farmers with less than 10 years of farming experience have little or no chance of purchasing index insurance at sub-county or parish levels. More years of farming did not affect the DII. This could be explained by the possible positive and negative relationships between farming experiences and demand. Farmers with more years of farming may have had worse experiences of crop damage or losses, making them more likely to take up agricultural insurance. However, more years of farming may also mean adaptability to weather risks, and thus less interest in agricultural insurance. Regarding risk attitude, the results show that risk-averse farmers are about 13% more likely to purchase index insurance at the subcounty level and about 12% less likely to buy it at the parish level than those willing to take risks. Overall, the results for farmers' socioeconomic attributes suggest that age, income, education, risk attitude, and farming experience influence the DII. Thus, providing insurance through existing local institutions can positively influence farmers' DII. NGOs and IS, as formal institutions, may have greater influence than VSLAs. While IS offers agricultural inputs such as high-quality seeds, NGOs are linked to marketing networks, developing vulnerable individuals, and building capacity. As such, NGOs and IS may be more beneficial to farmers than are VSLAs. Thus, the results confirm that institutional arrangements are key in influencing the farmers' DII in Uganda. Therefore, the results support the predictions of NIE theory.

Conclusion and Implications

Utilising NGOs and IS as trusted last-mile delivery mechanisms by farmers could enhance DII. The government needs to consider IS and NGOs alongside commercial banks and MFIs to provide agricultural insurance in a market dominated by smallholder farmers, where index insurance is being piloted as a niche product. It is also essential to strengthen regulatory and technical support for institutional arrangements that provide insurance to enhance accessibility and DII. This calls for policymakers and insurers to prioritise well-coordinated efforts with institutional arrangements to create a robust, sustainable distribution network, thereby addressing gaps in physical accessibility and consequently improving DII. Nonetheless, insurers should consider the feasibility of these partnerships. NGOs, by their nature, can bring private philanthropy in the agricultural insurance space and have the capacity to reach farmers in distant rural areas. However, partnerships with IS may be costly given the institutional silos between IS and insurers. As a result, the integration of IS requires agricultural insurance training to enhance farmers' capacity to provide insurance on a wider scale. Furthermore, since governments and funders closely monitor the operations of NGOs, this makes them more credible and easier to establish partnerships with, compared to IS, whose operations are usually short-lived and hardly monitored, which questions the sustainability of such partnerships. Therefore, efforts should be made to ensure that IS and NGOs provide guidance on how insurance can guard against agricultural risks to increase awareness, build confidence, and ultimately drive a higher DII to support the long-term sustainability of the insurance market.

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