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Research Application Summary

Factors explaining producer perception towards weather index micro-insurance: Evidence from Kenya

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Abstract

Studies associate smallholders with negative attitudes towards index-based insurance within prisms of limited prodding the existing manifold risks. This article analyses perception of smallholder farmers towards weather index insurance amid common risks and coping strategies. The study was carried out in Embu County in Eastern Kenya using a sample of 401 smallholders obtained following a multistage sampling technique. The study established that the most important risks to the smallholder farmers include; drought, input costs and crop pests and diseases, while the least ranked risks in the same order of importance were excess rains, floods and frost. Similarly, the results reveal that the smallholder farmers ranked engagement in off-farm work, use of household savings and crop diversification as the most important strategies for coping with drought. In addition, borrowing from banks, food aid and stopping children from attending school were ranked as least important strategies. The findings do not strongly suggest a negative attitude towards weather index insurance among smallholders thus controverting hitherto studies that do not overly explain why? Furthermore the study postulates that other risks facing smallholder farmers and their risk responses disposition may distort and override farmers' attitude towards weather index insurance. The Ordered probit model output revealed that the sex of the household head, size of the household, if a farmer experienced crop loss in the previous seasons, off-farm income, if a farmer received compensation/indemnity, the level of education of the household head, if the household head accessed credit, the years of farming experience and group membership had a significant influence on the perception of the smallholder farmers towards the effectiveness of weather index-based micro insurance scheme. We, therefore, recommend use of farmers' perceptions as vital debut points for advanced research so as to enrich the emerging weather index insurance, dissemination of information and development of pragmatic index based policy frameworks.

Key words: Kenya, farmer perceptions, risk management, weather index insurance

Résumé

Les études associent les petits exploitants à des attitudes négatives vis-à-vis de l'assurance indicielle, à l'intérieur de prismes, qui limitent les risques multiples existants. Cet article analyse la perception des petits agriculteurs face à l'assurance indexée sur les conditions météorologiques au milieu de risques communs et de stratégies d'adaptation. L'étude a été réalisée dans le district d'Embu dans l'est du Kenya en utilisant un échantillon de 401 petits exploitants obtenus à l'aide d'une technique d'échantillonnage à plusieurs degrés. L'étude a révélé que les risques les plus importants pour les petits agriculteurs sont la sécheresse, les coûts des intrants et les ravageurs et maladies des cultures, tandis que les risques les moins élevés dans le même ordre d'importance étaient les pluies excessives, les inondations et la glaciation. De même, les résultats révèlent que les petits exploitants ont classé l'engagement dans le travail hors ferme, l'utilisation de l'épargne des ménages et la diversification des cultures comme les stratégies les plus importantes pour faire face à la sécheresse. Par ailleurs, les emprunts auprès des banques, l'aide alimentaire et l'arrêt de la scolarisation des enfants ont été classés parmi les stratégies les moins importantes. Les résultats ne suggèrent pas une attitude négative envers l'assurance indicielle météorologique parmi les petits exploitants. Mieux encore, l'étude montre que les autres risques auxquels sont confrontés les petits exploitants agricoles et la façon dont ils leur font face peuvent neutraliser l'attitude des agriculteurs à l'égard de l'assurance indexée sur les conditions météorologiques. Les résultats du modèle Probit ordonné ont révélé que le sexe du chef de ménage, la taille du ménage, la perte de récolte dans les saisons précédentes, le revenu hors ferme, le fait de recevoir une compensation/indemnité, le niveau d'éducation du ménage, l'accès au crédit, les années d'expérience en agriculture et l'appartenance à un groupement ont eu une influence significative sur la perception des petits exploitants quant à l'efficacité du système de micro-assurance basé sur les indices météorologiques. Nous préconisons donc l'utilisation des perceptions des agriculteurs comme points de départ essentiels pour une recherche approfondie afin d'enrichir l'assurance de l'indice météorologique émergent, la diffusion de l'information et le développement de cadres politiques pragmatiques basés sur les indices.

Mots clés : Kénya, perceptions des exploitants, gestion des risques, assurance incidentielle

Background

Weather index-based insurance (WIBI) is a topical subject in the present times, and has stirred up discourse because of the vital role played by agriculture to humanity. Agriculture is one of the most weather sensitive sectors with a substantially huge demand for financial protection against weather perils by farmers (Turvey, 2001; Skees, 2008; World Bank, 2011). Weather index insurance refers to a financial product linked to an index that is highly correlated to the local yields and its contracts are written against specific perils or events that are defined and recorded at regional levels (Hazell *et al*., 2010). In addition, Hazell *et al*. (2010) affirm that pay-outs are triggered by pre-specified patterns of the index, and not necessarily the actual yields that are obtained.

Against this backdrop, we examined factors that influence perception towards weather index-based micro insurance amid common risks and risk coping strategies following the case of the *Kilimo Salama* (safe Agriculture in Kiswahili) insurance scheme farmers. The weather index crop insurance scheme was established in 2008, and designed for maize and wheat farmers. The scheme protects farmers' investment in farm inputs such as seed, fertilizer and chemicals against the extreme weather risk of drought or excess rainfall. The project is a partnership between the Syngenta Foundation for Sustainable Agriculture, UAP Insurance, and telecoms operator Safaricom Limited. The scheme uses solar powered weather stations to monitor rainfall and mobile phone payment technology to collect premiums and make payments to farmers, respectively. Every time farmers purchase inputs (seeds, fertilizer or chemicals) from authorized dealers, they pay an extra 5% in addition to price as premium. The insurance scheme is distributed by Agro-dealers. These stockiest register the farmer using a camera-phone to scan a bar code on every input that is sold (seeds, fertilizer and chemicals). Then a text message confirming the policy instantly goes to farmer's cell phone. The Syngenta Foundation for Sustainable Agriculture has set up automated weather stations to monitor the insurance. If a station reports at the end of the season that the local rainfall has been insufficient, farmers in affected area receive a payout via Safaricom M-PESA money transfer service. The scheme modernized manual rain gauges with solar powered and the computerized gauges send out data on rainfall levels, sun and temperatures every 15 minutes. Every farmer who buys insurance is linked to the nearest weather station not more than 20 kilometers from a weather station. If the weather station indicates that the rainfall was insufficient early in the growing season, or too much late in the maize season, all farmers in that area receive an automatic payout. And if the rainfall was only slightly off, farmers get a small payment and if the weather was extreme enough to destroy their whole harvest, they get full compensation as prescribed. We further attempted to show how multiple risks facing smallholder farmers may influence the perception and possibly disadvantage the potential uptake of index insurance. This study, therefore, contributes to the growing body of literature on WIBI. Survey data from smallholder maize producers were assessed to give policy implications for nurturing weather index insurance.

Literature summary

A plethora of literature in crop insurance exists that focus on the analysis of the determinants of crop insurance and uptake (Cole *et al.*, 2013; Daninga and Qiao, 2014) This uptake of insurance products in the agricultural sector, though remains low (Leblois and Quirion, 2013). Likewise, implementation of index based insurance has been slow and subsequent uptake by both potential insurance providers and beneficiaries is still low (Cole *et al.*, 2012). Generally in practice insurance is an expensive measure of risk mitigation, particularly to smallholders given the costs associated with the assessment of damages and subsequent verifications on individual claims of named-peril or multiple-peril insurance contracts (Skees, 2008). In addition, traditional agricultural insurance schemes face financial challenges because of high administrative and operational costs, adverse selection and moral hazard problems (Kang, 2007) that are caused by the prevalence of asymmetric information. Index based insurance thus provides an alternative risk-reducing tool with the potential to alleviate the financial effects of adverse weather (Banerjee and Berg, 2012) which, to a large extent, affect the

smallholder farmers attitudes towards agricultural insurance. The index-based insurance though, is subject to salient limitations like basic risk. However, it can provide a less-costly and more-transparent risk management option than other alternative products, hence enabling farmers to make more-productive investments and better manage consumption risk (Cole *et al.*, 2012).

Study description

Cross sectional data were collected by administering a pre-tested interview schedule to a sample of 401 smallholder farmers obtained following Multi-stage sampling technique. The interview schedule captured information pertaining to the farm characteristics, social-economic, institutional factors and weather index technology characteristics. In addition, common risks faced by farmers, the risk coping strategies used by farmers, source of information about the agricultural insurance scheme and perception of farmers towards index insurance were collected. Moreover, the respondents were asked to rank the commonly experienced risks on a scale of 1-8 and the risk coping strategies they use using a scale of 1-10. The farmers were asked to rate the scheme based on a number of questions relating to the insurance scheme on a Likert Scale with five ranks, 0 to 4 where: *0= poor, 1= fair, 2= average, 3= good and 4= excellent*. Data were then fitted in the ordered probit model to determine the relationship between perceptions and the factors that had been hypothesized to influence it. Thus: $y^* = \beta' X + e$. Where, y^* is the farmers' perception, ranging from 0 (being poor) to 4 (being excellent), *â* is the parameter to be estimated and *e* is the error term that is normally distributed with a mean of zero and variance of one.

Research application

The most important risks to smallholder farmers were drought (1.29), input costs (3.55) and crop pests and diseases (3.63). The least ranked risks in the same order of importance were excess rains (5.53), floods (6.60) and frost (7.86) as shown in Table 1. Proceeds from sales of farm produce are the main income source to the majority of small-scale farmers in developing countries. Thus when the adverse effects of perils damage and reduce the quantity and quality of crop yield, farmers end up with limited food and crop incomes. The latter implication further drives farmers who are low resource users to meagre spending on successive season's farm inputs. This means an arduous season would have consequential spiral effects for several seasons where formal mitigation measures are missing. The input costs (3.55), crop pests (3.63) and market difficulties (3.71) reveal a clustered trend in the ranking of risks affecting the smallholders as given by the means of the respective scores. This implies that farmers perceive they are entangled in an array of perils and exposed to multiple threats where a singular approach to addressing risks may not necessarily be sufficient. Therefore, an indifferent attitude towards weather index based innovations may result, especially if they are perceived as incapable of addressing a range of threats.

Further, the analysis reveals that the smallholder farmers ranked engagement in off-farm work (2.01), use of household savings (3.26) and crop diversification (3.71) as the most important strategies for coping with drought. Borrowing from banks (7.04), food aid (7.27)

Table 1. Order of importance of risks and coping strategies as perceived by smallholders

Risks	Rank	N	Mean	Std Error	Coping strategies	Rank	N	Mean	Std Error
Drought	1	401	1.29	0.073	Off-farm work	1	401	2.01	0.123
Input costs	2	401	3.55	0.124	Household savings	2	401	3.26	0.116
Crop pests	3	400	3.63	0.089	Diversification	3	401	3.71	0.176
Market difficulties	4	401	3.71	0.096	Borrow from relatives	4	401	4.97	0.121
Price volatility	5	401	4.81	0.112	Sell livestock	5	401	5.39	0.128
Excess rain	6	401	5.53	0.100	Reduce consumption	6	401	5.60	0.145
Flood	7	401	6.60	0.113	Index insurance	7	401	5.71	0.116
Frost	8	401	7.86	0.123	Borrow from banks	8	401	7.04	0.109
					Food Aid	9	401	7.27	0.104
					Stop children schooling	10	401	8.36	0.001

Source: Survey data 2015, Embu County

and stopping children from attending school (8.36) were ranked the least important strategies. Notably, in the study is the use of savings as a coping strategy that poses a conundrum because farmers who are low resource users may not always be able to amass sufficient wealth to cover their losses in the event of crop damages and loss. This would be observed more when covariate risks occur. Hazell *et al*. (2010) asserts that loss of productive assets can push households into poverty, from which it may be difficult to recover in subsequent years. Analogous to the ranking of risks in the study, ranking of the risk coping strategies was also clustered as shown by the average scores of selling of livestock (5.39), reduced consumption (5.60) and index insurance (5.71). It can be said that index insurance is preferred, just as much as the other coping strategies, even though in absolute terms the strategies are distinctly ordered. This buttress the explanation that given the average clustered scores where index insurance is embedded, perception towards insurance does not necessarily suggest a strong negative connotation in isolation. Rather, it qualifies that multiple-risks play a role in the orientation of risks response disposition that may in turn distort and override farmers' attitudes towards weather index insurance. Ultimately, farmers may tend to then exude negative perceptions when they shun WIBI products because they are uncertain about relying upon the index insurance to cushion them against devastating crop losses due to the numerous risks that they encounter.

Table 2 present coefficients and marginal effects of the ordered probit model of the various factors influencing producers' perceptions towards index based weather insurance. The marginal effects were estimated because the interpretation of coefficients alone is not sufficiently informative. The marginal effects (partial derivatives) depict the probabilities and impacts of a change in an explanatory variable on the predicted probabilities denoted by columns dy/dx_0 (poor), dy/dx_1 (fair), dy/dx_2 (average) dy/dx_3 (good) dy/dx_4 (excellent). The sex of the household head was significant with a positive marginal effect in rating the effectiveness of weather index insurance of 5.39%. Both male and female genders participate in small-scale farming. This may suggest differences in the way household heads reveal perception towards index insurance technology. Credit access has a probability of 2.64% to positively influence perception regarding effectiveness of the index weather insurance as fair. On the other hand, credit has a probability of 0.14% to negatively influence the rating of index insurance as being good. This can be explained that a change of one unit of credit that is expended for other purposes other than farming activities like the index insurance reduces the rating.

Contrary to expectation, the membership to a group variable had a negative effect on the ratings of the index insurance effectiveness. The probability thus declines by 9.91% where a smallholder farmer participates in the local social groups. Both formal and informal groups are used as important avenues for training farmer field schools (FFS), extension demonstrations and dissemination of information by various organs in the rural setup. This finding suggests that farmers used the groups much more on other social and cultural activities (e.g weddings; funerals) other than agricultural related where index insurance uptake is one. It was noted that farmers' education levels significantly influence perception towards weather index insurance. The probability of education level, reducing the chance of rating good the index insurance scheme was found to be 14.43%. An increase in the level of education implies

Table 2. Coefficients and marginal effects of the ordered probit model of farmer perceptions of weather index insurance

Variable	Coefficients	dy/dx_0	dy/dx_1	dy/dx_2	dy/dx_3	dy/dx_4
Sex of household head	-4.3112(2.2163)*	0.3484(0.3922)	0.0539(0.2550)*	0.0629(0.0912)	-0.6215(0.4207)	-0.3295(0.4945)
Land size	0.7713(0.5191)	-0.0100(0.0164)	-0.1752(0.1404)	-0.0825(0.0739)	0.2549(0.1849)	0.0128(0.0308)
Logoff-farm income	3.4682(1.4704)**	-0.0448(0.0692)	-0.0807(0.3501)**	-0.3710(0.2885)	0.0410(0.4620)**	0.0575(0.1341)
Age of household head	0.1436(0.0959)	-0.0019(0.0030)	-0.0326(0.0205)	-0.0154(0.0149)	0.0475(0.0298)	0.0024(0.0058)
Compensated	-2.4077(1.3646)*	0.1133(0.1542)	0.0028(0.2179)**	-0.0643(0.2261)*	0.1136(0.0829)	-0.0734(0.1384)
Premium paid	0.6560(0.7376)	-0.0085(0.0152)	-0.1490(0.1813)	-0.0702(0.0860)	0.2168(0.2513)	0.0109(0.0264)
Education level	-1.4960(0.9524)*	0.0193(0.0300)	0.3398(0.2103)	0.1601(0.1486)	-0.1443(0.2893)*	-0.0248(0.0611)
Household size	1.9490(0.7139)**	-0.0251(0.0391)	-0.0046(0.1760)**	-0.2085(0.1572)	0.0640(0.2293)***	0.0323(0.0751)
Access to extension	0.4999(1.2929)	-0.0095(0.0356	-0.1258(0.3501)	-0.0474(0.1079)	0.1763(0.4695)	0.0063(0.0213)
Group membership	-1.4063(1.9714)*	0.0112(0.0212)	0.2217(0.2039)	0.1369(0.1553)	-0.0991(0.1623)*	-0.0706(0.2694)
Access to credit	-2.4537(1.3982)*	0.1186(0.1715)	0.0264(0.2054)**	0.1123(0.0830)	-0.0014(0.2404)***	-0.0659(0.1316)
Distance to market	-0.2323(0.1450)	0.0030(0.0049)	0.0528(0.0340)	0.0249(0.0228)	-0.0768(0.0477)	-0.0038(0.0092)
Forecast information	-0.8766(1.8080)	0.0054(0.0100)	0.1377(0.1690)	0.0934(0.1693)	-0.1997(0.1919)	-0.0368(0.1666)
Distance to weather station	0.0868(0.0734	-0.0011(0.0019)	-0.0197(0.0167)	-0.0093(0.0099)	0.0287(0.0232)	0.0014(0.0037)
Years of farming	-0.1331(0.0600)**	0.0017(0.0028)	0.0302(0.0149)**	-0.0142(0.0113)**	-0.0440(0.0196)	-0.0022(0.0053)
Experienced crop loss	3.7249(1.3227)	-0.4288(0.2963)	0.0842(0.2274)	-0.0241(0.0503)	0.0093(0.1769)	0.1079(0.1764)
Predicted probabilities						
Prob(Y=0|X)	0.0044					
Prob(Y=1|X)	0.1523					
Prob(Y=2|X)	0.1419					
Prob(Y=3|X)	0.6955					
Prob(Y=4|X)	0.0058					

Note: ***,**,* means significant at 1%, 5% and 10% probability levels, respectively, LR chi^2 (15) = 41.71, Prob > chi^2 = 0.000, Pseudo R^2 = 0.167, Log likelihood = -135.9741, N=401

that education makes individuals versatile and enhances the way individuals perceive, understand, interpret and respond to issues. In addition, better educated farmers may consider pursuing other economic activities other than agriculture thus the negative effect. Like in other forms of insurance, compensation is vital (Vaughan and Vaughan, 2014), in agricultural insurance practice. We find that the compensation due to crop loss variable led to positive rating of index insurance as fair with a probability of 0.28%. Conversely, the rating of the index insurance had a probability of 6.43% with a negative effect. This implies that although pay-out was done, possibly it did not cover the full losses as experienced by the farmers. This is called downside basis risk. Normally farmers will expect full compensation in the event of loss. Such varied occurrences may wield potential to influence the perception the smallholder farmers hold about index insurance. The number of years of farming experience was also significant in the study. An increase in the years of farming led to a fair and average rating of the effectiveness of the weather index insurance scheme by 3.02% and 1.42%, respectively. Thus the negative sign on the average rating imply that those farmers with more years of farming experience were less likely to rank weather index insurance as average and more likely to rank it as fair. According to Isaboke *et al.* (2012) increase in years of experience leads to a better understanding of farming by way of learning new skills and appreciating new knowledge thus leading to an increase in the extent of adoption of technology.

Further, the effect of household size was significant. This reveals that an increase in size of household by one member reduces the probability of rating the effectiveness as fair by 0.46% while it also increases the probability of good rating by 6.40%. This means that large household may have diversified on crop (s) so as to effectively cope with the common risks. Secondly, in positively increasing the probability these empirical results suggest that an increase in the size of the household impelled the household to view index insurance as appropriate in cushioning themselves against crop loss. The Household head's off-farm income was significant too, and negatively influenced the probability of perceiving weather index insurance as fair. This implies that an increase in off-farm income by one unit reduced the probability of rating the scheme by 8.07%. This is because the farmers who engaged in off-farm activities and other formal employment applied limited time to pursue other on-farm activities and measures of risk management such as index insurance. It is also possible that farmers, who engage more in off-farm activities had higher income which allowed a household to easily smooth consumption. Contrary, it was also observed that an increase in off-farm income by one unit would increase the good probability rating of the weather index insurance scheme by 4.10%. This can be explained that off-farm income may have been used to some extent to meet farm expense requirements such as any extra costs coming with the new innovation of weather index insurance like the premium load on the price of inputs (seeds, fertilizer and pesticides) at the start of a planting season.

Conclusion

The findings do not strongly suggest a negative attitude towards weather index insurance among smallholders thus controverting hitherto studies that do not overly explain why? Furthermore the study rather postulates that other risks facing smallholders and their risk

responses disposition may distort and override farmers' attitude towards weather index insurance.

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References

Banerjee, C. and Berg, E. 2012. Policy for implementation of Index Based Weather Insurance revisited: The case of Nicaragua. In: *123 rd EAAE Seminar*. pp. 1–17. Dublin.

Cole, S., Bastian, G. G., Vyas, S., Wendel, C. and Stein, D. 2012. The effectiveness of index-based micro-insurance in helping smallholders manage weather-related risks. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

Cole, S., Giné, X., Tobacman, J., Townsend, R., Topalova, P. and Vickery, J. 2013. Barriers to household risk management: Evidence from India. *American Economic Journal: Applied Economics*, *5*(1):104–135. http://doi.org/10.1257/app.5.1.104

Daninga, P.D. and Qiao, Z. 2014. Factors influencing holding of drought insurance contracts. *International Journal of Development and Economic Sustainability* 2 (5):16–30.

Gine, X., Townsend, R., Vickery, J. and Take-up. 2008. Patterns of rainfall insurance participation in rural India. *The World Bank Economic Review* 22 (3):539–566. http://doi.org/10.1093/wber/lhn015

Hazell, P., Anderson, J., Balzer, N., Clemmensen, A. H., Hess, U. and Rispoli, F. 2010. The potential for scale and sustainability in weather index insurance: For agriculture and rural livelihoods. Rome: IFAD and WFP.

Isaboke, H.N., Mshenga, P., Mutai, B.K. and Saidi, M. 2012. Determinants of adoption of butternut squash (*Cucurbita moschata*) farming by small-holders in Suba District, Kenya. *Journal of Agriculture & Rural Development* 9: 82–97.

Kang, M.G. 2007. Innovative agricultural insurance products and schemes: Agricultural management, marketing and finance. Occasional Paper 12. Rome: Food and Agriculture Oganization of the United Nations.

Leblois, A. and Quirion, P. 2013. Agricultural insurances based on meteorological indices/ : realizations, methods and research challenges. *Meteorol. Appl.* 20:1–9. http://doi.org/10.1002/met.303

Sakurai, T. and Reardon, T. 1997. Potential demand for drought insurance in Burkina Faso and its determinants. *American Journal of Agricultural Economics* 79:1193–1207.

Skees, J.R. 2008. Innovations in index insurance for the poor in lower income countries. *Agricultural and Resource Economics Review* 37 (1): 1–15.

Smith, V.H. and Baquet, A.E. 1996. The demand for multiple peril crop insurance: Evidence from Montana wheat farms. *American Journal of Agricultural Economics* 78:189–201.

Turvey, C.G. 2001. Weather derivatives for specific event risks in agriculture. *Review of Agricultural Economics* 23 (2):333–351.

Velandia, M., Rejesus, R.M., Knight, T.O. and Sherrick, B.J. 2009. Factors affecting farmers' utilization of agricultural risk management tools: The case of crop insurance, forward contracting, and spreading sales. *Journal of Agricultural and Applied Economic* 41(1): 107–123.

World Bank. 2011. Weather Index Insurance for Agriculture: Guidance for Development Practitioners. Agriculture and Rural Development Discussion Paper 50. Washington, DC: World Bank.