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Agricultural production risks, coping mechanisms and potential for crop insurance in Tanzania

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Abstract

Pessimism surrounding feasibility and viability of crop insurance schemes especially to developing country economies has since been a global phenomenon. However, pragmatic evidence is turning the clock around as more such schemes are now being launched. There have been very few studies on the subject in Tanzania which have not translated into a tangible full-fledged scheme to date. New evidence is unfolding now as shown in this study that its potential is substantive if the existing gaps in terms of information imperfection and asymmetry in respect to its marketability and viability, especially on insurers' side, are filled. Crop insurance potential was confirmed in the study involving 116 bean farmers in Arumeru district during the 2003/04 season. Both objective and subjective conditions for its need were fulfilled according to the study results. In the first case, about 76% of the farmers preferred crop insurance to other mitigation strategies against natural hazard risks. Pests and disease surfaced as the most debilitating risks to the farmers followed by drought. However, Pests and plant diseases are farm management problems which are not insurable. In the second case, profitability levels differ between individual farmers and locations across the three study villages from both rain-fed and irrigated areas. Both profit and loss making farmers were available from any of the villages. As a proxy for farmers' ability to meet insurance costs, profitability results suggested that not all bean farmers were capable of meeting the involved costs. Binary logistical regression analysis results, rather unexpectedly, indicated that the only significant factor influencing preference for crop insurance in the study area was asset index (a proxy for farmer' wealth). All 8 interviewed insurers (both public and private) were not ready to mount crop insurance schemes in the country claiming financial infeasibility of the scheme, lack of adequate market information and lack of requisite expertise. The study recommended the need to mount a crop insurance pilot program which would be initially funded by the Government, of specific peril and voluntary. This should go in tandem with introduction of insurance training in agricultural schools and colleges to increase its awareness to the target populace. Related studies hereafter have also confirmed crop insurance potential in tea and coffee and this paper has taken stock of the results.

Key words: Agricultural Production Risks, Natural Hazards, Coping Mechanisms, Crop Insurance.

INTRODUCTION

The need to launch crop insurance in Tanzania gained much government attention, at least as far as political will is concerned, during the last decade. Media reports attest to this development as for instance, the article in 'The Citizen' of 27 May 2009 reads:*"President Jakaya Kikwete has called for the introduction of crop insurance schemes to cater for the needs of small farmers in the African continent. The president urged the African Insurance*

Organisation (AIO), to start up crop insurance schemes to eliminate risks associated with farming in Africa. He said, despite colossal contributions of agriculture to African economies, the continent's insurance stakeholders continue to disregard the sector. As a result, both agriculture and the insurance sector, remain largely underdeveloped. He noted that Agriculture provides the greatest potential for job creation and foreign exchange earnings, but the spectrum of risks that affect agricultural producers and agri-business, are very huge. One way of overcoming persistent production risks affecting farmers' earnings, is to provide crop insurance. The speech was delivered during the opening of the 36th AIO annual meeting in Dar es Salaam on 26 May 2009".

The above statement reflects the need and positive attitude of the Tanzanian government towards crop insurance in the country. It is interesting to note that the insurance sector had also intimated a similar desire prior to the above government's assertion. In the latter case, the Commission of Insurance launched a trial service (in two districts in Manyara region) of insurance to smallholder farmers in 2007. The initiative was to be funded by the World Bank (WB) and was to be a stepping stone towards introduction of a full-fledged crop insurance scheme in the country (Daily News, 18. 01.2007; Ng'elenge, 2008). No specific details have been published on the development of this trial service since then but one thing is certain that there is neither conventional nor index-based full-fledged crop insurance scheme in the country up to the date of this paper's publication.

The trend in the developing world has been to replace the conventional crop insurance programs with index-based micro insurance programs (Heenkenda, 2011). The former is claimed to command low confidence amongst its potential clients on account of lacking transparency in loss adjustment/assessment and understatement of indemnity payments. However, most of the programs in the latter case are still in their infancy thus credible generalizations on their performance are yet to come out. It is evident from the literature however that the changing trend has been observed from countries that had already gone full-fledged on conventional agricultural insurance. This raises a point of contention as to whether current attempts to introduce indexed agricultural insurance in Tanzania could be rather premature.

The quest for crop insurance in Tanzania is not new however and traces its relatively long history back to 1986 when the first feasibility study was conducted by the National Insurance Corporation (NIC) (NIC, 1986). Few related studies followed thereafter which include the studies by Lema (1987), Akyoo, (2004), Sarris *et al.,* (2006) and Ng'elenge (2008). The study by Sarris *et al.,* (2006) did specifically address the demand for rainfall insurance in Tanzania while the rest of the mentioned studies addressed conventional crop insurance as a prospective mitigation strategy for natural hazard/climatological risks in agriculture.

The lingering question to date is why is the failure to institute the scheme amid the studies above (which have all recommended positively) and a strong presence of 20-plus operating insurance companies in the country? A logical argument against entry barrier by insurers would be lack of enough market information on a crop insurance scheme and lack of awareness of the same on the part of the smallholder farmers. The available studies are a good source for providing requisite information for both of these parties. However, with exception of the study by Sarris *et al.,* (2006), the findings of all of the other studies on Tanzania above have not been published. This might have hampered access to the findings by these valuable end users, hence the observed stand-off.

This paper is based on the data collected from bean farmers in Arumeru district (in Arusha region) during the 2003/04 crop season. The general objective of the study was to assess prevailing risks, coping strategies and their effectiveness in managing crop losses due to natural hazards, and potential for crop insurance for bean farmers in the research area. The attempt was made to specifically carry out the following:

(a) Determine natural hazard risk sources that bean farmers consider important and the available coping and reducing strategies to mitigate them in the study area.

(b) Assess relative riskiness of various natural hazards affecting bean farmers in the study area,

(c) Assess the potential of crop insurance as a strategy to manage natural hazard risks affecting bean farmers in the study area ; and

(d) Determine the factors that influence preference for crop insurance amongst bean farmers in the research area.

This paper has however taken stock of the other pertinent developments, along the research theme, that have taken place since then, especially the findings of a related study by Ng'elenge (2008). The latter was found useful for upgrading, validating or invalidating the earlier findings as it addressed the same specific objectives albeit on smallholder tea farmers in Mufindi district, Iringa region.

Background information and Literature review on crop insurance

Agriculture is biological in nature and overly dependent on the conditions of weather and the natural environment, attributes which are normally beyond human ability to control (Hardaker *et a.*, 1997). Farmers in developing countries and mainly smallholder producers are thus exposed to most types of risks, especially in semi-arid areas. In addition, agricultural risks are covariates, as for example, meteorological or production risks (floods, drought, and windstorm) and price risks affect nearly all

farmers simultaneously within a small rural community. For these covariate risks, local traditional risk coping strategies need to be reinforced by risk pooling arrangements, such as crop insurance, that cut across small rural communities (Hazell, 1991). Covariate shocks, however, cannot be insured by pooling them within a small region, except only if pooled over a much wider range of potentially affected households (Saris *et al.,* 2006).

Risk coping mechanisms are strategies that are developed by communities to address problems related to hazards and environmental stress. They are rules adopted *ex-ante* to help the household to deal *ex-post* with any undesirable consequences. Risk coping strategies are built upon historical knowledge, cultural acceptability and experiences emanating from interaction of these communities with the environment in which they live (PMO 2001; Saris *et al.,* 2006). They include borrowing, sale of assets, use of own food stocks and temporary off-farm employment (Hazell, 1991). They move in tandem with risk reducing strategies which include crop diversification, intercropping, sharecropping, farm fragmentation and diversification into non-farm sources of income. Risk reducing/management strategies are actually actions taken ahead of resolution of any uncertainty to improve the *ex-ante* exposure of producer's household to various risks (Saris et al., 2006).

On the other hand, various authors would refer to crop insurance as either a social or a financial device used in risk management. A comprehensive definition would thus combine the two and describe it as a social cum financial mechanism that aims at reducing the uncertainty of loss through a combination of a large number of similar uncertainties by distributing the burden of loss over space and time through the use of accumulated funds (Ray, 1967, Robert and Dick, 1991) When its coverage is based on the normal yield and linked to agricultural credit system, it is known as credit crop insurance (Gudger, 1991). There are however a number of other variants of crop insurance e.g. crop credit insurance, rainfall insurance and weather index insurance (Heenkenda, 2011; Skees and Barnett, 2006; Roth and McCord, 2008 and Patt et al. 2009).

On a global scale, the need and advantages of crop insurance in managing crop production risks have since been appreciated and documented (Ray, 1967; 1991; Hazell, 1991; and Robert and Dick, 1991; Mark, 2005 and Robert, 2005). The advantages are many but probably the basic one is that of guaranteeing protection against frequent crop failures due to occurrence of natural hazards like floods, wind storms, drought, landslides, eruptions and earthquakes. This advantage has a far reaching effect in enabling farmers to access credit, venture onto new farming technologies and thus make way for greater investments in agriculture. Accordingly then, crop insurance goes a long way to stabilizing farmers' income each year which is needed for repaying debts and meeting essential living costs hence making agricultural production sustainable (Ray, 1991; Mosley and Krishnamurthy, 1995). Moreover, insurance also offers complementary benefits such as reducing reliance on post-disaster financing which can be more costly to the government as crop loss compensation becomes a matter of right to affected insured farmers (Manojkumar *et al.,* 2003 and Roberts, 2005).

The Scope of Crop insurance and the developing economies

Insurability of a risk depends on its predictable probability, nature of hazard (should be physical and not moral), magnitude of loss it causes (insurable interest), and financial strength of insured entity (Ray, 1967; Hazell, 1991). Insurable farm risks therefore include some production risks (meteorological risks like drought, flood, hail and frost) whereas price risks, preventable damages from pests, diseases, excess humidity, excess temperature and most acts of God[1], are not strictly insurable (Hazell,1991). Acts of God refer to events arising out of natural causes with no human intervention, which could not have been prevented by reasonable care or foresight (Robert and Dick, 1991). However, under special circumstances, especially with the advent of modern technology, previously thought uninsured agricultural risks have managed to attract international reinsurance (Gudger, 1991). Reinsurance refers to an insurance taken out by a direct insurer from another insurer (termed the re- insurer), so as to share and spread risk(s) which may be too great for the direct insurer to bear solely alone due to large exposure or accumulation (Robert and Dick, 1991). It enables spread of insurable risks across countries. The scope of crop insurance to poor and illiterate farmers is however very minimal (Ray, 1967) unless the respective governments / states are prepared to bear a substantial part of its costs.Specific/named-risk crop insurance has generally been recommended for developing countries over all-risk crop insurance (Gudger, 1991; Wright and Hewitt, 1990) for its financial viability. Other authors however, recommend all-risk insurance on account of its total coverage of all farmers' risks, its economic benefits which outweigh its costs, and its ability to expand credit flow to farmers thus increasing their input use ability notwithstanding its financial unsoundness (Mishra, 1994).

All-risk insurance is claimed to run the risk of adverse selection thus recording high loss ratios, at times even greater than one. Loss ratio refers to the ratio of indemnity paid to premium collected. It is a very good measure of performance for an insurance scheme

(Robert and Dick, 1991). All-risk insurance schemes are exemplified by the US' Federal Crop Insurance Corporation (FCIC) scheme, which is a public scheme, and India's comprehensive crop insurance scheme. Specific-risk schemes are exemplified by the Mauritian Sugar Crop Insurance fund and USA's Hail Insurance Scheme (Gudger, 1991). The Mauritian scheme is private and in operation now for more than 50 years. According to the Commission of Insurance in Tanzania, Malawi and South Africa are among other few African countries where small-holder farmers are insured against climatic hazards such as drought and floods (Daily News, 18. 01.2007; Ng'elenge, 2008).

A notable feature with all-risk schemes is that they overly depend on government subsidies in meeting their indemnity obligations. Moreover, they are all public as contrasted with specific- risk schemes which are mostly private. According to Gudger (1991), all of the known public schemes which have progressed beyond infancy, globally, have been written by a government. Impliedly, public schemes are unlikely to be mounted in poor developing countries, like Tanzania, given their budgetary constraints.

Crop insurance in Tanzania.

The NIC feasibility study on the subject (NIC, 1986) and the review paper on the same (Lema, 1987) gave the first signs (over 26 years past!) of the need for crop insurance to cover climatological risks facing Tanzanian farmers. The studies above covered a range of crops from coffee, cotton, wheat, maize, rice, sugarcane, sunflower, tobacco, tea to cashew. A number of agro-climatic hazards were established as having significant adverse effects to farmers in the respective locations. These hazards include drought, hail, hurricane, frost, strong winds and floods. The spread and severity of each hazard was however found to differ with each location in each of the nine regions surveyed (Kilimanjaro, Arusha, Kagera, Mwanza, Shinyanga, Iringa, Morogoro, Ruvuma and Mbeya).

A related study was on vulnerability assessment and was carried out by the Prime Ministers' office in 2001. The study was more to do with the government's intention to put in place a national policy on disaster management (PMO, 2001). It was meant to collect data to indicate the nature, spread and magnitude of disasters in the country in a bid to put in place a state of preparedness for saving lives, minimizing suffering and avoiding possible disruption to the function of communities in order to sustain development. Although the study had no direct focus on crop insurance, it however enhanced further understanding of the na ture of natural hazards affecting communities and vulnerability levels of various population groups in the country. It thus augmented the results that had been transpired through the NIC (1986) and Lema (1987) studies.

In an astounding coincidence, the earlier mentioned recent studies on Tanzania have also come up with more or less same results and recommendations. For instance, the study by Saris *et al.,* (2006) found a substantial demand for rainfall insurance on smallholder coffee farmers in Kilimanjaro and Ruvuma regions; Akyoo (2004) discerning a demand for crop insurance on smallholder bean farmers in Arumeru district, Arusha region; and Ng'elenge's (2008) reporting the same for smallholder tea farmers in Mufindi district. Nonetheless, these results are yet to translate into something tangible (in terms of mounting a crop insurance scheme) in the country.

The research problem and its justification

Risk management through risk-transfer devices like crop insurance is still one of the least researched areas in the Tanzanian agricultural sector. As already indicated above, the need for crop insurance in Tanzania had already been recognized as early back as in mid 1980s (NIC, 1986; Lema 1987; PC 1994). Empirical evidence on past disasters like the Kilwa District floods in 1997 – 1998 (El Nino rains), the Lushoto floods of late 1990s and the Rungwe earthquake in 2001 were but a few incidences that showcased the potential magnitude of natural hazard's devastation in the country. These incidences pointed crucially to a lingering need to reduce farmers' exposure to natural hazard risks in their farming operations.

Furthermore, the Planning Commission (PC) of Tanzania under the President's office had also documented more disasters in the past which include major droughts in 1974/75, 1982/83 and 1993/94. Floods were recorded in 1990 and 1993 in Mtwara and Tanga regions respectively (PC, 1994). These events resulted into substantial losses (though un-quantified) on both crops and livestock farming causing agricultural activities to be of high risk, unattractive and unbeneficial to the majority of smallholder farmers.

In the absence of a risk-transfer mechanism like crop insurance in the sector, the affected farmers could only depend on handouts from the government which are mostly given as humanitarian relief aid. No wonder the government is always out to strengthen its capacity to deliver disaster relief to natural hazard victims (see the PMO study of 2001). However, if agriculture is to be commercialised (agro-industrialization), farmers should be made able to recoup their investment costs in event of

such natural hazard strikes. Notably, there have not been serious efforts by the government, financial institutions, or insurance companies to minimize these burdens and risks which confront smallholder farmers through a commercially sustainable way i.e. instituting a risk transfer device for the agriculture sector.

Moreover, it has always been presumed by many that agricultural insurance in general is not a viable undertaking in Tanzania. This position has however not been informed by a technically drawn research findings. This study attempted to assess the potential of crop insurance in the research area in an attempt to dispel the notion which threatens to block the way towards commercialisation of agriculture for sustainable rural development in the country.

Crop insurance has been adopted by other developing countries like India, Mauritius, Chile, Wind Ward Islands, Pakistan, Venezuela, Zambia and Malawi in managing natural hazard risks in agriculture with varying degrees of success (Robert and Dick, 1991). Its need in Tanzania has since been ascertained (NIC, 1986; 1995; Lema, 1987; and PC, 1994). However, despite this realisation it has not been possible to launch the programme in the country in well over 26 years since the first feasibility study was conducted. This is a clear indication that there are information and knowledge gaps on such a programme which need to be filled if its potential is truly to be confirmed. The study was thus carried out to try to fill some of these gaps.

Moreover, scarcity of literature on crop insurance is a global concern (APO, 1991[2]; Robert *et al.,* 1989; Robert and Dick, 1991). It is even more serious in Tanzania given the very few research studies that have gone into it and the non-existence of such a scheme in the country. This study is thus expected to stimulate more research in the area of agricultural insurance.

METHODOLOGY

The NIC's 1986 study adopted a normative research approach (i.e. researchers' point of view) and thus failed to address farmers' perception on risk(s) posed by individual natural hazards, farmers' ranking of the severity (riskiness) of various natural hazards affecting them and farmers' willingness to insure vulnerable crops. In contrast, the current study adopted positive approach to research in order to address the above shortcomings. Positive approach starts from the farmers, focuses on the question on how farmers arrive at various decisions. Normative approach refers to conceptualising, modelling and measuring risk attitude of smallholder farmer from researchers' hypothesis about the economic rationality of individual's decision making (Senkondo, 2000).The other two related studies (PMO, 2001 and Rugumamu, 1991) were lacking in quantitative analytical methods. This study adopted some rigorous quantitative analytical methods like gross margin (GM) and Regression analyses to redress the shortcoming.

In addressing the study's specific objectives, one research question and four hypotheses were respectively answered and tested. In the former case, the task was to explore the type of natural hazard risks that were considered important by farmers whilst in the latter, the following hypotheses were tested:

(i) There is no difference in riskiness between the various natural hazards in the research area.

(ii) There is no difference in mitigation effectiveness against natural hazard risks between various risk coping/reducing strategies in the research area

(iii) There is potential demand for crop insurance amongst bean farmers in the research area which was tested at two stages;

(a) A large section of framers in the research area prefer crop insurance (subjective condition for measuring psychological need for crop insurance by a community).

(b) All farmers in the research area operate profitable farming business (objective condition for measuring community's ability to meet insurance costs).

(iv) Preference for crop insurance is not affected by farmers' profitability, wealth (asset index), farming purpose, farm size, level of education, awareness to crop insurance or farmers' age.

The study involved interviewing both smallholder farmers and insurers as the major stakeholders in the research theme (crop insurance). A total of 116 bean farmers from Kwaugoro (46), Malula/Kolila (30) and Kikatiti (40) villages which are situated in the Eastern province of Arumeru District in Arusha region were randomly sampled and interviewed. Kwa Ugoro village farmers represented irrigation-fed bean production whereas Kikatiti and Malula/Kolila farmers represented rain-fed bean producers in the district. Eight insurers (7 private companies and 1 public corporation – NIC) out of nine operating in Mainland Tanzania then were also interviewed.

Data requirement

Data collection was through a semi-structured questionnaire/checklist approach, which duly reflected the study's positive research approach. Primary data from the two categories of interviewees in respect of the relevant variables for the study were the sole data for analysis as secondary data proved unavailable. Quantification of some qualitative variables in the farmers' questionnaire was carried out as per method suggested by Senkondo (2000) which is referred to as risk analysis using a structured questionnaire. The

method used a likert scale approach to enable quantification of otherwise qualitative variables. This was applied in the assessment of relative riskiness of various natural hazards and for assessing effectiveness of various risk coping/reducing strategies to mitigate them. For the riskiness assessment, farmers were asked to rank various hazards (flood, drought etc) according to the given key with the following ranks: 1 = riskiest; 2 = moderately risky; 3 = not risky and 4 = do not occur. In the effectiveness assessment, the key ranks were: 1 = very effective; 2 = moderately effective; 3 = not effective and 4 = not applicable.

Other qualitative variables such as level of education and preference ranking of natural hazard management strategies were quantified in the normal way using more or less identical keys. Quantitative data in respect of farmer incomes, costs and asset ownership status were directly collected through the questionnaire. These were purely dependent on the farmers' memory as farmers did not keep farm records. Data from insures' checklist were all qualitative.

Data analysis

Both descriptive and quantitative analyses were employed in testing the hypotheses and answering questions under the study. Descriptive analytical methods included; means, percentages, frequencies, cross tabulations and standard deviations. Quantitative methods employed were Gross Margin (GM) and regression analyses.

(i) **Gross Margin (GM) analysis**

Gross margin for every farmer was calculated as the difference between Total Revenue (TR) from bean crop and the Total Variable (TV) costs attributable to it.

GM = TR – TVC

Where;
GM = Average Gross Margin (TSh/ha),
TR = Average Total Revenue (TSh/ha),
TVC = Average Total variable Cost (TSh/ha)

GM analysis was employed to test the hypotheses that all farmers in the research area carry out profitable bean farming operations. This was a sub-hypothesis under the main hypotheses, '*There is potential demand for crop insurance in the research area*'. The other sub-hypothesis under this, *'A large section of farmers in the research area prefer crop insurance'* was descriptively analysed using percentage proportions.

(i) **Regression analysis**:

This was adopted to test the hypothesis that "Preference for crop insurance was not affected by farmers' profitability, farmers' wealth, farming purpose, farm size, level of education, awareness to crop insurance or farmers' age." Preference for crop insurance (PCI) was the dependent variable and the above factors were the regressors (independent variables).

(a) The analytical model for regression analysis

Given a binary dependent variable (PCI), a binary logistic model was used. According to Koutsoyiannis (1977), the disturbance term (μ) under such a dichotomous dependent variable is always heteroscedastic thus maximum likelihood estimation procedures are employed instead of ordinary least squares estimation procedures. The model is specified as follows:

$$PCI = \frac{e^{(\beta_0+\beta_j\chi_j+\mu_i)}}{1+e^{(\beta_0+\beta_j\chi_j+\mu_i)}} \text{ .....1}$$

Where e=natural logarithm

For estimation purposes, the model was transformed into:

$$lnPCI/(1-PCI) = \beta_0 + \beta_i\chi_i + \mu_i \text{.....2}$$

Where;
PCI = Preference for Crop Insurance (dependent variable)
ßo = Intercept
ßi = Coefficients of independent variables
χ_i = Independent variables
μi = Disturbance term

Each individual independent variable was factored into the model in accordance with their own specific attributes as follows:

(i) Farmer profitability

The obtained gross margins in the GM analysis were fed in the regression equation on a categorical basis ranging from 1 to 4. The least category was numbered 1 and covered all gross margins below zero (i.e. all negative gross margins). The highest category was numbered 4 with gross margins above TShs. 100,000. The class interval in the categorization was Tshs. 50,000.

(ii) Farmer wealth

This was calculated using a method adopted from Senkondo (2000) which used the following index:

Table 1. Perceived loss risks for bean crop by village

Perceived risk	Kwa Ugoro (n = 46)	Malula/ Kolila (n = 30)	Kikatiti (n = 40)	Overall (n = 116)
	% of respondents			
Drought	11.1	46.4	25.0	26.0
Pests & Diseases	88.9	53.6	75.0	74.0

Source: Survey data 2003
X^2 = Significant at 0.020

$$AI = \sum_{n=1}^{n=17} k(OV - D/UL)$$

Where;
AI =Asset index
n=number of assets owned by a farmer
k=number of particular asset owned by a farmer
OV=Original value
D= Depreciation (straight line method)
UL=Useful life

The index values were classified into 5 categories; 1 representing a wealth less than 0 and 5 representing a wealth beyond Tshs 500,001. The class interval was also TShs. 50,000/- The categories were the inputs for the regression equation.

(iii) Level of education

This was included in the model on a categorical basis: 1= no formal education; 2 = adult education; 3 = primary education; 4 = secondary education; 5 = college qualification.

(iv) Dummy variables

Except for farm size which values were incorporated raw in the regression equation, other variables like awareness to crop insurance and farming purpose were adopted in the equation as dummy variables i.e.

1 = Aware to crop insurance, 0 = otherwise;
1 = Commercial purpose, 0 = otherwise

(v) Farmer age

This was also adopted in the equation on a categorical basis: 1=18-35 yrs (youths), 2=36-60 yrs (adults) and 3 = above 60 yrs (elders)

RESULTS

Important natural hazards affecting farmers

In overall results, crop pest infestation and disease epidemics stood out as the major natural hazards affecting the farmers followed by drought as scored by 74 percent and 26 percent of respondents respectively (Table 1). In specific terms however, drought seemed to be of least importance in Ugoro village to the other two. This is explained by the fact that the former enjoys irrigation-fed agriculture as opposed to rain-fed agriculture in the latter.

Independence between perceived natural hazard risks and villages (location) was statistically significant at p≤ 0.05 level on a chi-square test. This suggests that some hazards are location specific. Similar results have also been reported in other regions of the country (PMO, 2001). In crop insurance terms, potential is envisaged to drought stricken farmers only as pests and diseases are considered as farm management problems which are not strictly insurable (Hazell, 1991, Ray 1967).

Relative riskiness of natural hazards

The results for the riskiness assessment were as summarized in Table 2 below. In overall results, drought hazard was the riskiest of all followed by crop pests and diseases. Floods, windstorm, landslides and eruptions were not risky in the research area as they seldom occur. Inter-village differences were highly significant (p≤0.001) in respect to flood, drought and pests and diseases hazards. This observation emanates from hazard's location specificity which is based on bio-physical and ecological characteristics. Statistical insignificance for the non-occurring hazards (windstorms, landslides and eruptions) was quite expected as farmer's perceptions on them could hardly be different.

From these results, inference could be made that if crop insurance was to be launched then farmers would be willing to insure the riskiest hazard i.e. drought; assuming a specific – risk scheme. However, farmers' priority on the preference risk for management was on pests and diseases in overall terms (Table 3). The priority assessment was however highly significant (p≤0.01) across the villages. This was expected given differential resource endowment e.g. irrigation scheme at Kwa Ugoro village. Nonetheless, given the fact that pest and disease risks are not insurable, drought is still the priority

Table 2. Assessment of natural hazard riskiness by village

Natural hazard	Assessment	Kwa Ugoro(n = 46)	Malula/Kolila (n = 30)	Kikatiti(n= 40)	Overall (n =116)
		% of respondents			
Floods	Riskiest	0.00	0.00	2.6	0.9
	Moderately risky	2.2	62.1	5.1	18.6
	Not risky	28.9	13.8	7.7	17.7
	Do not occur	68.9	24.1	84.8	62.8
Drought	Riskiest	56.5	93.1	38.5	59.6
	Moderately risky	41.3	6.9	61.5	39.5
	Not risky	0.00	0.00	0.00	0.00
	Do not occur	2.2	0.00	0.00	0.9
Pests and Diseases	Riskiest	53.3	23.3	69.2	50.9
	Moderately risky	46.7	26.7	28.2	35.1
	Not risky	0.00	23.3	0.00	6.1
	Do not occur	0.00	26.7	2.6	7.9
Windstorm	Riskiest	.00	3.4	0.00	0.9
	Moderately risky	6.8	10.3	2.6	6.3
	Not risky	20.5	13.8	13.2	16.2
	Do not occur	72.7	72.4	84.2	76.6
Landslides and Eruptions	Riskiest	0.00	0.00	0.00	0.00
	Moderately risky	2.3	0.00	0.00	0.09
	Not risky	18.20	6.9	10.5	12.6
	Do not occur	79.5	93.1	89.5	86.5

Source: Survey data 2003.

Table 3. Preference ranking of natural hazard management methods by village

Management strategy	**Preference rank**	**Kwa Ugoro (n = 46)**	**Malula/Kolila(n = 30)**	**Kikatiti (n = 40)**	**Overall(n = 116)**
		% of respondents			
Traditional coping strategies	First preference	93.5	10.0	97.4	73.0
	Second preference	6.5	20.0	0.0	7.8
	Third preference	0.0	70.0	0.0	18.3
	Fourth preference	0.0	0.0	2.6	0.9
Government relief	First preference	0.0	0.0	0.0	0.0
	Second preference	37.0	10.0	43.6	32.2
	Third preference	26.1	10.0	20.5	20.0
	Fourth preference	37.0	80.0	33.3	47.0
Crop Insurance	First preference	6.5	70.0	2.6	21.7
	Second preference	45.7	20.0	23.1	31.3
	Third preference	39.1	0.0	64.1	37.4
	Fourth preference	8.7	10.0	10.3	9.6
Minimum Investment	First preference	0.0	20.0	0.0	5.2
	Second preference	10.9	50.0	30.8	27.8
	Third preference	34.8	20.0	15.4	24.3
	Fourth preference	54.3	10.0	53.8	42.6

Source: Survey data
X^2 = Significant at 0.01

Table 4. Effectiveness of risk coping and risk- reducing strategies by village.

Strategy	Effective			Less effective			Overall (n=116)	
	Kwa Ugoro (n=46)	Malula /Kolila (n=30)	Kikatiti (n=40)	Kwa Ugoro (n=46)	Malula /Kolila (n=30)	Kikatiti (n=40)	Effective	Less effective
	% of respondents							
Diversification to off-farm activities	8.7	96.7	5.1	91.3	3.3	94.9	30.4	69.6
Agro forestry	71.7	53.4	59.0	28.3	46.7	41.1	62.6	37.3
Spatial separation of farm plots	63.0	16.7	89.7	37.0	83.3	10.3	59.1	40.9
Diversification into other crops	54.4	13.3	53.9	45.7	86.6	46.2	43.5	56.5
Minimum investment	65.2	10.0	69.3	34.8	90.0	30.8	52.1	47.8
Sale of assets	52.2	10.0	53.8	47.8	90.0	46.2	41.7	58.3
Borrowing from neighbours	46.6	6.7	69.3	43.4	93.4	30.8	47.8	52.2
Temporary wage employment	67.4	6.7	64.1	32.6	93.3	35.9	50.5	49.6
Remittances	30.4	10.0	53.8	69.5	90.0	46.1	33.0	65.0
Government relief	45.6	10.0	56.4	54.3	90.0	43.6	40.0	60.0

Source: Survey data 2003

candidate for insurance as it was also second in the priority results. However, from the combined results above, the null hypothesis that "*there is no difference in natural hazard risk assessment between villages"* was thus rejected in respect of flood, drought and pests and diseases and accepted in respect of windstorms, landslides and eruptions.

Effectiveness of risk-coping and risk-reducing strategies

The summary results of effectiveness assessment for risk-coping and risk-reducing strategies are shown in Table 4 above. Important observation from these results was that all assessments of effectiveness of the strategies, with the exception of agro forestry, differed significantly between the villages ($p \leq 0.01$) on the chi-square test. The exception was attributed to the then on-going Sasakawa Global 2000 agro forestry sponsored activities in the surveyed villages which led to the homogeneous farmers' perception on the effectiveness of this strategy.

Another observation from the results (Table 4) was that farmers are aware of the inherent inability of each risk-coping and risk-reducing strategy to hedge effectively against natural hazard risks. This is normally the technical threshold to justify a need for a risk transfer device, like crop insurance, to enhance farmers' ability in mitigating natural hazard risks that they face (Hazell, 1991).

From the results above, the hypothesis that *"there is no difference in effectiveness between various coping strategies in the research area"* is thus rejected in respect of all enumerated strategies except agro-forestry i.e. the hypothesis is accepted in respect to agro-forestry as a risk-reducing strategy.

Preference for crop insurance

In overall results, crop insurance was preferred by 76.7 percent of the farmer respondents. This was quite

Table 5 GM analysis: Means comparison results

Village	Average GM (Tsh)	Standard déviation (Tsh)	F Value
Kwa Ugoro	53 343.20	51 732.05	18.989***
Malula /Kolila	-18 742.50	63 118.85	
Kikatiti	68 498.15	70 360.48	

unexpected in a situation where 83.6 percent of them were not aware of crop insurance due to its absence in the country. The results could only be explained by the desperate position held by farmers against losses due to natural hazards which compels them to be ready to embrace any option which seems to be able to mitigate against related risks. Both awareness to crop insurance and preference for crop insurance were not statistically significant. This underscored the homogeneity of farmers' responses in these two variables. From these results, the sub-hypothesis that "*a large section of farmers in the research area prefer crop insurance"* was thus accepted.

Preference ranking results of natural hazard management methods (Table 3) bore witness to the above results as crop insurance ranked second after traditional risk-coping and risk-reducing strategies in overall results. In specific terms, Malula/Kolila opted for crop insurance as their first choice as it is the most drought-stricken of the three villages. Preference ranking of these methods was highly significant ($p \leq 0.01$) across the villages signifying that the preferred method is a reflection of the most disturbing hazard in a particular area (location-specificity argument).

Insurers' opinion on the potential of crop insurance in Tanzania

Insurers were highly pessimistic about feasibility of crop insurance in Tanzania. Only 12.5 percent of them think that such a scheme is viable. The given reasons for this pessimism ranged from the perceived high risk in agriculture, lack of reinsurance for agricultural insurance in the country, low farmers' demand, to lack of experience on the part of existing underwriters/insurers. Others reasons mentioned include low agricultural production technology in use (mostly rain-fed), lack of reliable market studies on crop insurance, inability of farmers to meet premium and fear of moral hazard. Ng'elenge (2008) reported more reasons as including lack of historical data on natural hazards occurrence collated with related economic crop loss figures, lack of adequate farm level data, problems in estimating actuarial premiums and indemnification levels and lack of data on the farmers' preference and demand for crop insurance for various crops in the country.

Notwithstanding the insurers' stance above, it was strongly felt that the shown pessimism was more to do with the lack of expertise to operate such a scheme rather than the given reasons. This emanates from the fact that all of the interviewed insurers admitted of crop insurance being a highly specialized discipline, which requires specialized skills to write it. This signified a deficiency for the requisite expertise from the incumbent insurers in the country. According to Robert and Dick (1991), crop insurance should be written by qualified agronomists who have been trained in insurance matters. In Tanzania, given that agricultural schools and colleges are devoid of training courses in crop insurance in their curricular, such specialist are not available locally and are not likely to be in the near future thus this pessimism was really justified.

Profitability of bean farming in the research area

The GM means comparison results as per one-way ANOVA are summarized in Table 5 above: On average, the results suggest that Kwa Ugoro and Kikatiti village farmers were operating profitably whereas Malula/Kolila farmers were loss makers. However, the exceptionally high standard deviation figures suggested that in each village there were both profit making and loss making farmers. The GM means between villages were highly significant ($p \leq 0.01$) suggesting that the extent of profit making between the villages differed a great deal. The sub hypothesis that *"All farmers are operating profitably"* was thus rejected.

These observations were very important in the assessment of crop insurance potential in the area. If it is assumed that profit making is a proxy to farmers' ability to meet insurance costs, then the results suggested that such farmers are present in all of the villages notwithstanding the average results above. This also underscored the need to have a voluntary insurance scheme, if ever launched, so that loss makers would not be forcefully drawn into, much to their burden, should it be made compulsory.

Factors influencing the demand for crop insurance (regression results)

After several running of the binary logistic model, independent variables like farming purpose, level of

Table 6. Regression analysis parameter estimate results

Parameter	Estimated Coefficient value	Standard error
Gmcat (gross margin)-X1	0.2039	0.2204
Asincat (asset index)-X2	0.2862*	0.1406
Farsize (farm size)-X3	0.1284	0.0789

education*, awareness to crop insurance and farmers' age* were finally dropped. The dropping was based on the fact that all of these variables proved to be insignificant and worse still, their inclusion was making the model insignificant at $p \leq 0.05$ level. The final results are summarized in table 6 above:

The negative intercept in this regression equation was meaningless. All independent variables affected the dependent variable positively. However, it was only farmers' wealth, which affected the relationship significantly. This was quite unexpected (Hardaker *et al;* 1997). This could however be explained by the nature of distortions that characterize most developing world economies which account for many of its economic variables' failure to comply with the conventional economic theory principles. The model was quite strong as evidenced by its chi-square value, which was significant at 5% level.

Conclusions and Recommendations

The study concluded that there is potential for crop insurance in the research area as authenticated by the following facts:

(i) The findings of the study showed that both objective and subjective conditions for its need had been fulfilled. The evidence of occurrence of insurable natural hazard risks (like drought) and the preference for crop insurance by a large section of the bean farming community satisfy the subjective condition for a need for a risk-transfer device for farmers. Moreover, presence of profitable farmers in the study area with ability to meet insurance costs, satisfies the objective criterion for crop insurance demand.

(ii) Risk-coping and risk-reducing strategies have been shown to be imperfectly effective in mitigating natural hazard risks as per farmers' own assessment. Implicitly, this is a call for a need to supplement these strategies with a risk-transfer device like crop insurance, as has been the case in other parts of the globe.

(iii)Imperfect and asymmetrical information on the feasibility and viability of crop insurance amongst its major stakeholders (insurers and farmers) have hampered development towards mounting a full-fledged crop insurance scheme despite the liberalized insurance market in the country. This was observed to have a more profound effect on insurers in the back drop of lacking expertise and requisite experience.

In view of the study's findings, the following are therefore recommended:

(a) A pilot crop insurance scheme should be launched in Tanzania (taking into consideration also the recommendation of earlier studies (NIC 1986) to take advantage of the existing potential, and pave the way for a full-fledged scheme in future. The government is urged to guarantee the initial reserve fund for the scheme as indications are clear that private insurance companies are not likely to operate an agricultural insurance scheme. The envisaged scheme should most preferably be of specific-risk cover and voluntary, with its insurability criterion being based on farmers' investment level and ability to operate profitably. The land reforms as per 1999 legislation, especially in relation to offering title deeds to farmers by village councils is a significant boost in launching this scheme.

(b) Further related market studies on crop insurance should be carried out to establish more potential in the country. Sarris *et al.,* (2006) shows a direction to take now in which more quantitative studies that can determine the actuarially fair premium and other levels that farmers are willing to pay are of much importance. This will add value to the qualitative preference assessments that have already been done and will impact very positively on the insurers' pessimism. Foreign expertise from within Africa (Mauritian Sugar Crop Insurance fund is dubbed one of the advanced schemes in the world with an experience of over 50 years) will be more palatable for compatibility reasons. Malawi and South Africa are also prospective learning cases.

(c) Extension services to farmers in respect of management of pests and diseases problems should be strengthened as these surfaced as the major crop production risks in the area. Improved farm management skills are the only solution in this respect as such risks are not insurable.

(d) Agricultural schools and colleges in Tanzania are urged to introduce training in crop insurance (as a risk management method in agriculture) in their curricular to raise its awareness and stimulate its final use in the sector.

REFERENCES

Akyoo AM (2004). Agricultural Production, Natural Hazards, and Risks.

An Analysis of Coping Mechanisms and the Potential of Crop Insurance. Dissertation for Award of MSc Degree at Sokoine University of Agriculture (SUA). Unpublished,: 107.

Asian Productivity Organization (1991). Agricultural Insurance in Asia: Planning and practices. Proceedings of APO seminar on Agricultural insurance, Tokyo, Japan, 21-31 August 1990. 271pp.

Gudger WM (1991). The failed Experiment: Multi-peril Public sector Crop Insurance. In: Strategies for Crop Insurance planning. (Edited by Roberts, R.A.J. and Dick W.J.A.) FAO Agricultural service Bulletin 86. Food and Agricultural Organization, Rome. : 3-23.

Hardaker JB, Huirne RBM, Anderson JR (1997). Coping with risk in Agriculture. Wallingford UK. CAB International.: 274.

Hazell PBR (1991). Appropriate Function of Agricultural Insurance in developing Countries. In: Agricultural Insurance in Asia: Planning and practice. Proceedings of APO seminar on Agricultural insurance, Tokyo, Japan, :21-32.

Heenkenda S (2011). Prospective demand for an Index-Based Microinsurance in Sri Lanka. Asia-Pacific J. of Soc. Sci. (e-journal), 3(1): 1-31.

http://www.microensure.com/news.(2011) Market-led Agricultural Project (MLAP) Pilot Launched in Tanzania.

http://thecitizen.co.tz/newe. (2009) Kikwete Advises African Countries to insure Crops. News Article. The Citizen.

Insurance Institute of India (1998). Agricultural Insurance. Insurance Institute of India. Bombay : 1 – 83.

Koutsoyiannis A (1977). Theory of Econometrics. Second edition. Macmillan Education Ltd; London, UK. : 281-284

Lema JL (1987). Climatological Research in Support of Crop Insurance Scheme in Tanzania. Unpublished paper research paper,: 1- 46.

Manojkumar K, Sreekumar B, Ajithkumar, GS (2003). Crop Unsurance Scheme: A Case Study of Banana Farmers in Wayanad District. Demand Assessment for Crop Insurance in Tanzania. Dissertation for Award of MSc Degree at Sokoine University of Agriculture (SUA). Unpublished. : 95.

Mehr RI, Cammack E (1966). Principle of Insurance. Richer D. Irwin, Inc. Homewood, Illinois. : 1-81.

Mishra PK (1994). Crop Insurance and crop credit: Impact of the comprehensive crop Insurance scheme on cooperative credit in Gujarat. J. of Intl. Dev.: 6(5):529-568.

Mosley P, Krishnamurthy R. (1995). Can crop Insurance Work? The case of India. J. of Dev. Stu. 31 (3): 428-450.

Ng'elenge HS (2008). Demand Assessment for Crop Insurance in Tanzania. Dissertation for Award of MSc Degree at Sokoine University of Agriculture (SUA). Unpublished. : 95.

Patt A, Peterson N, Carter M, Velez M, Hess U, Suarez P (2009). Making Index Insurance Attractive to Farmers, Mitigation and Adaptation Strategies for Global Change, 14 (8): 737-753

Planning Commission. (1994). Research on the feasibility of crop insurance in Tanzania. Unpublished working paper,: 1-5.

People's Online (2007). Tanzania Launches Agricultural Insurance Services. Quoted News Article. Daily News.

Ray PK (1991). A practical guide to multi-risk crop Insurance for developing Countries. Oxford & IBH publishing co. PVT. LTD. New Delhi. : 1-20.

Ray PK (1967). Agricultural Insurance: Principles and organization and application to developing countries. Pergamon press : 1-39.

Robert RAJ, Dick WJA (eds) (1991). Strategies for Crop Insurance Planning. FAO United Nations, Rome. : 45-60,

Roberts RAJ, Gudger WM, Gilboa D (eds). (1989). Crop Insurance. FAO Agricultural Services Bulletin 78, Food and Agriculture Organization of the United Nations, Rome.

Robert RAJ (2005). Insurance of Crops in Developing Countries. Demand Assessment for Crop Insurance in Tanzania. Dissertation for Award of MSc Degree at Sokoine University of Agriculture (SUA). Unpublished. :95.

Roth J,McCord MJ (2008). Agricultural Microinsurance: Global Practices and Prospects, Appleton, Wisconsin, Microinsurance Centre.

Rugumamu W (1991). Towards Developing Environmental Disaster Relief coordination network in Tanzania. J. of Geo. Asso. of Tanzania 26: 88-99.

Sarris A, Karfakis P, Christiaensen L (2006). Producer Demand and Welfare Benefits of Rainfall Insurance in Tanzania. FAO Commodity and Trade Policy Research Working Paper (18): 1-33.

Senkondo EMM (2000). Risk Attitude and Risk perception in Agro forestry Decisions. The Case of Babati, Tanzania. Unpublished thesis for award of Ph.D. Degree at Wagenigen University, The Netherlands. : 208.

Skees J, Barnett B (2006). Enhancing Microfinance Using Index-based Risk-transfer Products. Agricultural Finance review, 66 : 235-250.

Tanzania Prime Minister's Office (1991). Disaster Vulnerability analysis. Unpublished research paper : 1 – 29.

Tanzania National Insurance Corporation (1986). A report on Crop Insurance in Tanzania. Climatological Research in Support of Crop Insurance Scheme in Tanzania. Unpublished research paper,: 1- 46.

Tanzania National Insurance Corporation (1995). A feasibility study on the pre-requisite for Crop and Livestock insurance in Tanzania. Unpublished proposal for Economic Policy Research agenda: 1-5.

Wright BD, Hewitt JA (1990). Crop Insurance for Developing Countries. In: Food security and food inventories in Developing Countries. Wallingford (UK), CAB International. : 107-130.