AGRICULTURAL PRODUCTION, NATURAL HAZARDS AND RISKS: AN ANALYSIS OF COPING MECHANISMS AND THE POTENTIAL OF CROP INSURANCE

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS OF SOKOINE UNIVERSITY OF AGRICULTURE, MOROGORO, TANZANIA.

2004

ABSTRACT

The study examined natural hazard risks, coping mechanisms and potential for crop insurance on bean farmers in Arumeru district, Arusha region. Objectives were to determine natural hazard risk sources and available coping mechanisms, assess riskiness of various natural hazards, potential of crop insurance and determine factors influencing its preference. Data collection was through formal surveys to 116 farmers and 8 insurance companies, supplemented by informal interviews with various experts from the Directorate of Insurance, National Insurance Company, agricultural officers at the Ministry of Agriculture, Dar es salaam and extension officers at Kwa Ugoro, Malula/Kolila and Kikatiti villages. Qualitative analytical techniques included descriptive methods such as cross tabulations, means, percentages, frequencies, standard deviations and risk analysis using a structured questionnaire. Quantitative methods included Gross Margin (GM) analysis, Pearson Chi square (X^2), one way Analysis of Variance (ANOVA) and Regression analysis. Natural hazards were found to be location specific and their riskiness was significantly different (different levels) across villages. Coping mechanisms were found to be imperfectly effective in managing natural hazard risks signifying a need for a risk transfer device, like crop insurance. Crop insurance was favoured by 76.7 percent of the respondents and ranked second in preference as a risk management method. Pests and diseases were the riskiest followed by drought. Positive margins were recorded to 72.4 percent of the respondents. Ability to meet insurance costs was thus high. Farmers' preference for crop insurance was confirmed and, unexpectedly, wealth status was the only significant factor that influenced it positively. Insurers were however sceptical about its feasibility. Pilot crop insurance scheme as a precursor to a full-fledged scheme in future and further market research studies to establish more potential for crop insurance are

recommended. Agricultural schools and colleges are urged to include crop insurance in their curricular to stimulate its awareness.

DECLARATION

I, ADAM MESHACK AKYOO, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my original work and that it has never been submitted for a degree in any other University.

Signature.....

Date.....5. 03. 2004.....

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ACKNOWLEDGEMENT

Many individuals and organizations have greatly contributed in various ways to this study. I am generally grateful to all those who worked behind the scene in one way or another to make this work a success.

I greatly acknowledge the financial assistance offered to me by the Evangelical Lutheran Church, Diocese of Meru (DME) in Arumeru district, Arusha region. I am particularly indebted to Honourable Bishop Paulo Akyoo and my best friend cum high school classmate Mr. Elishilia Kaaya. The assistance given fully financed my entire Master's programme at Sokoine University of Agriculture. Without it this study would have not been possible.

I am sincerely grateful to Professor Dr. Andrew Temu and Dr. Joseph Hella for supervising this study. I have greatly benefited from their patience, guidance, encouragement, and constructive criticisms. I feel to have been privileged to work under their supervision.

My fieldwork could not have been a success without the co-operation of Arumeru district Council. To them I say '*Ahsanteni sana*'. Special thanks should go to extension officers for Kikatiti and Malula/Kolila villages; Messrs Massawe and Kimaro respectively and Mwalimu Mshana from Kwa Ugoro village for assisting in the enumeration of the field questionnaires.

Moreover, farmers from all the surveyed villages and Insurers in Dar es Salaam who participated in the study are highly acknowledged for their cooperation. My heartfelt gratitude are also due to the Director of Insurance Mr. I.L. Kamuzora, Director of Surveillance and Research in the Insurance Supervisory Department Mr. Samwel E.

Mwiru, Director of Non-life Insurance at the National Insurance Corporation (NIC), Mr. C.N. Ravi and NIC marketing Manager, Non- life Insurance, Mr. F. Bwimba for their assistance and cooperation.

The contribution of my family has been very enormous and encouraging. I wish to specially thank my wife Frida, for her constant encouragement and personal sacrifices during the whole period of my studies. I am also grateful to my children Robert, Dogoo, Elisha, Grace, Miriam, Neema, Nancy-Noela and Elizabeth for their patience during the entire period of my absence. Thanks are also due to my closest brothers - Ngei, Shushu, Jae, Nandwa, Kisali, and Tareto - and sisters - Nkaali, Nannde, Nkaanfu and Nana for their prayers and encouragement. Dr. Jae and his wife Eva deserve a special mention for their unique contribution in ensuring smooth completion of this programme. Brother Ngei's assistance during survey of Dar- es-Salaam was invaluable and highly appreciated. Above all, I remain indebted to my parents who lit the candle of my education.

Lastly, I am grateful to my classmates; Allan, Raymond, Bariki, Ezekiel and Sindy for their friendliness and moral support during the entire period of my study. God bless you all.

DEDICATION

This work is dedicated to my parents Meshack Alfayo Akyoo and Mama Yekobeth Ezekiel Kaaya, my late brother Stefano Meshack Akyoo and my late mother in- law Warankira Sangito Urio.

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LIST OF ACRONYMS

ADBs	Agricultural Development Banks
ANOVA	Analysis of Variance
APO	Asia Productivity Organization
BOT	Bank of Tanzania
CI	Crop Insurance
D	Depreciation
FAO	Food and Agriculture Organization
FCIC	Federal Crop Insurance Corporation
FIs	Financial Institutions
GM	Gross Margin
MAC	Ministry of Agriculture
NBS	National Bureau of Statistics
NGOs	Non-Governmental Organizations
NIC	National Insurance Corporation
OV	Original Value
PC	Planning Commission
PCI	Preference for Crop Insurance
PMO	Prime Minister's Office
UL	Useful Life
URT	United Republic of Tanzania
USA	United States of America

CHAPTER ONE

BACKGROUND INFORMATION

1.1 Introduction

This chapter presents general information in regard to key thematic issues of this study. It introduces crop insurance, natural hazards and agricultural production risks, which are the underlying keywords. The information is carefully coined to support the research study problem statement, objectives and hypotheses.

1.2 Smallholder agriculture and risk

Agriculture is mostly carried out in the open air, and always entails the management of inherently variable living plants and animals. It is biological in nature, depending on weather and the natural environment whose full and complete control is beyond human ability. Production risk comes from the unpredictable nature of the weather and uncertainty about the performance of crops or livestock e.g. through incidences of pests and diseases, or from many other unpredictable factors. Other agricultural risks include; price or market risk, institutional risk, human or personal risk, and financial risk (Hardaker *et al.*, 1997).

Farmers in developing countries, and mainly smallholder producers are mostly exposed to most types of risks, especially in semi-arid areas. The covariability problem is defined as the tendency of two or more risks moving or occurring together. Traditional risk-coping and risk-reducing strategies cannot deal effectively with the covariability problem that characterizes most agricultural risks. In addition, production 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 insurance, that cut across small rural communities (Hazell, 1991).

Insurance is defined as a social cum financial device that aims at reducing the uncertainty of loss, or risk through a combination of a large number of similar uncertainties, and through distribution of burden of loss, by the use of funds accumulated in advance (Ray, 1991). Risk relates to an event that may or may not occur, the likelihood of which can be predicted with a certain degree of confidence (Robert and Dick, 1991). Uncertainty relates to an event that may or may not occur, the probability of the occurrence not being measurable.

According to Ray (1991), insurance has three basic functions in the modern society:

(i) Insurance makes indeterminate individual losses largely determinate by considering them in groups and thus enables such losses to be met with a relative ease through measures taken in advance.

(ii) It lessens the burden of loss in one season or in one or more areas by spreading it over a number of seasons and over wider areas. It thus evens out a loss burden over space and time and makes it easily bearable.

(iii) Under insurance, small contributions collected from many individuals/entities over a series of years are utilized to indemnify larger losses that affect a few in a particular year.

Agricultural insurance is divided into crop insurance and livestock insurance. The scope of this study restricts itself to crop insurance which is explained further in the following sections.

1.2.1 Insurability of risks

Ray (1967) and Hazell (1991) both agree on the characteristics of an insurable risk as to include the following:

(i) The risk must be one which, when considered in the aggregate, has some uniformity of behaviour so that it is possible to measure and predict the probability of loss in the future. Such uniformity can be established only when sufficient data have been collated with regard to the risk or risks in question.

(ii) The risk should be one that cannot be wilfully caused to occur without involving some sacrifice on the part of the insured. This means that insurance is available primarily against physical hazards and not moral hazards.

(iii) The loss following the risk should be large enough to cause a substantial reduction in income or investment. However, the loss should neither be minor, negligible, nor catastrophic.

(iv) The objective and subjective conditions should be fulfilled. This implies that there should be a psychological urge among members engaged in some economic pursuit and they should be mentally and technically capable of satisfying that urge. They should also have necessary financial capacity to bear the costs of insurance. For a country of poor and less educated farmers the scope of farm insurance is limited, unless the state is prepared to bear a substantial part of its costs. Subjective factors include demand for insurance protection on the part of a considerable section of people and an understanding on their part of the meaning and significance of insurance. In summary, the

insured must feel the need to insure against the risk and must have financial capacity to pay premium.

In general therefore, insurability of a risk depends on its predictable probability, nature of hazard (physical versus moral), magnitude of loss it causes, and financial strength of insured entity.

1.3 Crop insurance

Crop insurance is a method of protecting farmers against uncertainties of crop yield arising out of practically all natural factors beyond their control. These factors are of two kinds:

(i) Vagaries of weather such as droughts, hot winds, fires, excess moisture, storms, hail; frost, floods, earthquake and landslides and

(ii) Plant diseases and pests, including animal infestations (Ray, 1991).

The intended purpose of crop insurance is two fold; first, stabilizing farmers' income and second, ensuring enough income each year to repay debts and meet essential living costs (Hazell, 1991). These objectives must be achieved at a lower cost than the cost of risk. If these objectives are met, farmers will be encouraged to seek higher average profit. It is further contended (Mosley and Krishnamurthy, 1995) that crop insurance is meant to solve two of the major problems of rural development in poor countries, that is, reluctance of low – income farmers to invest in new technology and chronic financial weaknesses of institutions that lend to them.

1.3.1 Need for crop insurance

Agricultural production is inherently risky as farmers face a variety of weather, pest, disease, input and market related risks. Given an uncertain income each year, farmers do worry about their ability to repay debts, meet overhead costs (e.g. land rent, school fees, taxes etc) and in many cases, their ability to maintain their families (Hazell, 1991).

Uncertainty of crop yield is one of the basic risks that every farmer has to face in all countries, whether developed or developing. These risks are especially high in the tropical and sub-tropical geographical areas compared to temperate regions. In most of these countries the overwhelming majority of farmers are poor and have extremely limited means and resources and are unable to bear the risks of crop failure (Ray, 1991). However, the risks of crop production have to be faced as a serious crop failure means not only the loss of farmers' incomes but also the loss of their investments in crops.

Ray (1991) further contends that various methods have been adopted to help farmers to compensate, at least partially, for losses of their crops emanating from natural calamities. Reduction or suspension of land rent taxes, moratorium, scaling down or cancellation of accumulated agricultural debts, and direct relief from the state are the more usual methods in use. Despite their usefulness, farmers cannot expect them as a right but rather only as a concession, which is largely dependent on the policies and resources of the government. Moreover, even when law provides concessions and relief, their permanence may not be feasible or strictly desirable.

In Tanzania, the commonest method in use is the offer of direct relief to disaster victims from the government. This, in recent times, has been done to flood victims in Kilwa district in 1997-1998 and earthquake victims in Rungwe district in 2001. Food relief

supplies are so frequently offered to famine victims due to persistent drought in central Tanzania especially Dodoma region. Government take-over of Cooperative Unions' debts with commercial banks in early 1990s was also a kind of moratorium for further lending to them by commercial bankers, which was meant to indirectly relieve farmers of further debt burden. Scaling down of debts is indiscriminately (not necessarily farmers) done to commercial bank customers especially on non-performing loans.

1.3.2 Special benefits of crop insurance

Crop insurance has several benefits which vary according to the nature and extent of protection provided by it (Ray, 1991). The benefits include:-

(i) Cushioning the shock of disastrous crop loss by assuring farmers a minimum protection against natural hazard risks and uncertainties for which they have no control over their occurrence.

(ii) Helps to ensure a considerable measure of security in farm income and thereby contributes to a greater stability in general economic conditions of the rural community. As agricultural income is an important factor in national income, crop insurance also has an effect on the prosperity of the country as a whole.

(iii) Through accumulation of premiums in a reserve fund, crop insurance can be an important means of saving by the rural community.

(iv) It protects farmers' investments in the production of crops and thus gives them greater confidence in venturing on new and improved farming practices

as well as in making greater investments in agriculture for improving crop yields and increasing agricultural production.

(v) It improves the position of farmers in relation to agricultural credit. One of the major causes of indebtedness of farmers in developing countries is the distress caused by frequent crop failures. Crop insurance, by guaranteeing a protection against such failures, would go a long way to free the farmers from indebtedness of the private moneylenders. As put forth by Abada (1991), insurance can sometimes substitute for the lack of physical assets i.e. it can offer 'surrogate' collaterals to banks.

(vi) By encouraging self-help and mutual aid, it would promote attitudes among farmers that are favourable to cooperative efforts. This is underscored by the fact that insurance protection of losses is through a risk sharing mechanism of pooling together similar uncertainties and spreading them over space and time.

(vii) The government would be relieved of the irregular financial burden of providing relief and distress loans to farmers in case of large-scale crop losses, as compensation will be met by respective risk underwriters (the insurers).

(viii) Combined with storage of commodities as reserves, the programme would help to normalize the availability of supplies and stabilize prices in both surplus and deficit years.

(ix) Helps to maintain the dignity of farmers, as they will not have to depend on hand outs from the government in case of crop failures, as the indemnity they receive in such eventuality is their right. Farmers under crop insurance are assured of maintaining a decent standard of living not by charity but by their own efforts (sustainable agriculture).

Despite of all these advantages, and the role of agriculture in Tanzania's economy, crop insurance is yet to be adopted as a viable scheme to protect farmers from the woes of natural calamities. There is, however, a general pessimism of its viability but this is not supported by any concrete research findings. There is thus a need for a tailored research to assess the potential of crop insurance in a Tanzanian context.

1.3.3 Problems and difficulties of crop insurance

Notwithstanding the above benefits, crop insurance has its own problems. Insurance Institute of India (1988) has identified eight of them. Ray (1991) categorized them into two groups that are explained below:

1.3.3.1 The basic problems of crop insurance

The basic problems of crop insurance are threefold:

(i) Widespread lack of knowledge about the nature and functions of crop insurance. Many farmers in the developing world are not aware of the inherent potential of crop insurance in mitigating natural hazard risks to crop production due to restricted exposure on one hand and to high levels of illiteracy on the other. In Tanzania, non-existence of such a scheme further aggravates the problem.

(ii) The nature of agriculture entails high physical and 'moral' hazards that make the insurance business risky and uncertain. Physical hazards emanate from unfavourable weather conditions, which always affect farming. Moral hazard is a result of intentional negligence on the part of insured farmer(s) in attempting to benefit from insurers. More precisely, moral hazard refers to a subjective characteristic of the insured that increases the probability of loss e.g. dishonesty (Mehr and Cammack, 1966). Combination of these two, significantly increases the chances of insurers to pay indemnities at frequencies which are higher than anticipated thus incurring losses. Insurers in Tanzania could be wary to venture into crop insurance due to this problem.

(iii) The special nature of crop insurance as contrasted with other insurances. This makes it difficult to determine the insurance liability and potential losses, which may either be total or partial depending on the stage of crop growth at the time of loss occurrence. In essence, this is the reason behind the requirement of using qualified agronomists, who have been trained in insurance matters, in loss adjustments (assessment) under crop insurance. Loss adjustment refers to the determination/estimation of suffered loss (and hence indemnity amount to be paid) caused by an occurrence of an insured risk. Indemnity refers to compensation or remuneration for crop loss sustained. Agronomists are considered to be better placed to assess crop loss at any stage of its development. In Tanzania, insurance training in agricultural colleges and universities is not part of the curricular. It is really difficult to anticipate vibrant crop insurance in Tanzania under such conditions.

1.3.3.2 Operational cum technical problems of crop insurance

(i) Lack of reliable adequate length of time series data on crop yields and losses. These data are important for actuarial calculation to determine correct premium rate to be levied against the insured. This is so because normally an actuary determines the rate. The latter refers to a highly skilled specialist trained in mathematics, statistics and accounting who is responsible for the application of mathematical doctrines of probabilities to vital statistics in deriving rates of premium, reserves, dividend calculations and other statistics pertaining to an insurable business (Robert and Dick, 1991). The long time series data is vital for actuarial calculations, which are done by the actuary.

In Tanzania, this problem is quite limiting as such data in respect of crop yield and losses are not available. For instance, this study attempted, in vain, to collect time series data in respect of crop losses under each natural hazard affecting a Tanzanian farmer at the ministry level. Things are even worse at the farmers level as they are not used to keeping farm records. Data collected from farmers fully depend on their memory thus have very minimal levels of reliability.

(ii) Wide variety of agricultural practices (even with regard to the same crop) often result in high variability of yields, which makes it difficult to establish insurance coverage and premium rates. In a situation where crop insurance is based on area-yield approach, proper determination of premium and even the area to be covered would be possible under homogeneous farming practices within a locality. Heterogeneity in farming practices reflects itself in differential yields and losses. However, under area-yield approach,

underwriting conditions for crop insurance apply indiscriminately to all farmers without regard to such possible differences. Heterogeneity of farming practices is thus a problem under such a scheme. In Tanzania, farming is still under traditional methods thus heterogeneity of practices is likely to be very high. In such a circumstance, any insurance scheme based on standardized farming practices can not work and, therefore, normal farming practices have to be taken as the basis.

(iii) Existing land tenure and land record systems in many developing countries are limiting to crop insurance due to lack of adequate land survey and land records. This makes it difficult to determine farmers' insurable interest since the relation between landlord and tenant and between owner and cultivator may not always be clearly defined.

Insurable interest refers to an interest of such a nature that, should the event insured against take place, the insured might suffer a financial loss. If the happening of the event insured against can not cost the insured money, then he/she has no insurable interest (Mehr and Cammack, 1966). Under insurance, insurable interest of the insured should be clearly determined.

In Tanzania, notwithstanding some current government efforts on land reforms, almost the entire rural farming land is unsurveyed posing a possible limitation to mounting of crop insurance in the country. The new legislation on land, which confers authority to village council to offer customary rights

of occupancy, is a welcome idea in this regard (see section 25(1) of village Land Act No.5 of 1999).

(iv) General ignorance and poverty of farmers on the principles and values of insurance. The concept of crop insurance is quite new and unknown to both farmers and extensionists in Tanzania. Illiteracy level is also high among farmers. Educating extensionists on crop insurance could be a better starting point in bringing awareness and understanding of crop insurance in Tanzania.

(v) Lack of trained personnel and training facilities in crop insurance. Crop insurance is a highly specialized discipline in the insurance industry. Its writing requires a blend of both insurance and agronomy knowledge. A commercial insurer seldom bears requisite experience and knowledge to write it. Robert and Dick (1991) argued that it is far easier to teach an agricultural professional insurance than vice versa. They further contend that the trick worked perfectly well during the mounting of crop insurance scheme in Chile. In Tanzania, this deficiency is so serious as explained in the above sections.

(vi) Lack of infrastructure especially in rural areas. Crop insurance requires smooth infrastructure to provide easy access to the farms by loss adjusters when losses occur. It is also good to enhance frequent monitoring of farming operations by the insurance agency to ensure full compliance with the agreed terms. Poor infrastructure is a limitation to the scheme. Tanzania's poor rural infrastructure poses the same problem.

(vii) Limited financial resources. Experience world over shows that loss ratios (i.e. premium /indemnity) at the initial stages of any crop insurance scheme are exorbitantly high, at times, over one. In the absence of international re-insurers, it becomes difficult for insurance agencies to meet indemnity liabilities that are falling, given minimum reserves coming out of premium collections. The position is more pronounced under all-risk crop insurance. Some governments have thus been subsidizing the schemes at their initial stages before being self-propelling. Subsidies are more important to governments whose farmers are poor and illiterate like Tanzania.

For crop insurance to thrive in Tanzania, the government should be able to subsidize the would-be schemes otherwise to depend on private insurers to mount the schemes on their own might not be a feasible idea.

1.3.4 Crop insurance and credit accessibility

Many farmers, especially small farmers, do not have resources of their own to invest heavily in agriculture and even buy inputs for agriculture. Availability of credit can enhance the use of agricultural inputs, capital and machinery investment and consequently output. An important role of credit is to facilitate inter-temporal trade and transfer of resources across time. Insurance transactions cause transfer of resources across states of the world. These two types of activities are intimately connected in developing countries. One important reason is the dominant role of agriculture, which is subject to a variety of risks (Mishra, 1994).

Agricultural risks are a concern of agricultural credit institutions. Confronted with risky borrowers, lenders must seek to reduce the possibility of poor loan recovery rates even if this will mean only a modest level of lending to agriculture (Hazell, 1991). Also, to protect their own capital, commercial banks adjust interest rates to reflect risk premiums and insist on collateral. These practices can be quite effective in managing risk but they lead to lending portfolios that serve large commercial farms and neglect most of the smaller and high-risk farmers. Given high risk lending portfolios and limited ability to manage risks, Agricultural Development Banks (ADBs) almost invariably suffer from poor loan recovery rates and rely in direct access to government funds to maintain their financial viability. In Tanzania, this is a phenomenon of the past. Insurance should reduce the risk of loan default for given amounts of credit enabling banks to increase their lending to agriculture and or improve their loan recovery rates considering that current Financial Institutions (FIs) are private, commercial and highly geared towards profits. Banks do need collateral for their loans and insurance can sometimes be used as collateral (Abada, 1991).

1.3.5 Crop insurance and agricultural investment

If a farmer knows that he/she will be financially compensated when his/her income is catastrophically low for reasons beyond his control, he/she is more likely to allocate resources in a profit maximizing way (Ray, 1967). According to Abada (1991), observations in Philippines revealed that risk averse farmers tend to cut losses by investing only the barest minimum inputs of production with consequent low productivity. A system that guarantees the loss of farm investments or income would reverse the risk – averse nature of most farmers.

Crop insurance would also encourage farmers to venture on new and improved farming practices as well as making greater investments in agriculture (Ray, 1991).

1.4 Statement of the research problem

Crop insurance is yet to be introduced in Tanzania. However, conditions for its need are now fully satisfied by the frequent occurrence of natural disasters, which are causing substantial losses in crop production. Among the outstanding disasters include Kilwa District floods in 1997 – 1998 (El Nino rains), Lushoto floods of the late 1990's and the Rungwe earthquake in 2001.

According to the Planning Commission (PC), which is under the President's office, major droughts in Tanzania occurred in 1974/75, 1982/83, and 1993/94. Floods occurred in 1990 and 1993 in Mtwara and Tanga regions respectively (PC 1994). All these events led to substantial losses both on crops and livestock, causing agricultural activities to be of high risk, unattractive and unbeneficial to the majority of smallholder farmers. Notably, there has not been serious efforts by neither the government, financial institutions, nor insurance companies to minimize these burdens and risks which confront the smallholder farmers.

Tanzania is yet to have a policy on disaster management in place. Rugumamu (1991) has since recommended the need to create a national policy on natural disaster problems. Disaster vulnerability study of September 2001 by Prime Minister's office (PMO) was also meant to collect data to indicate the nature, spread and magnitude of disasters in the country. This information is important to the government in trying to put in place a state of preparedness in a bid to save lives, minimize suffering and possible disruption to the function of the communities in order to sustain development (PMO, 2001). More devastating though, is the fact that the country is devoid of any risk-transfer mechanism

(compensatory mechanism) like insurance in its agricultural sector thus leaving small farmers to wholly accommodate all the inherent risk shocks.

The disaster relief fund under the Prime Minister's office (PMO) is only concerned with the provision of humanitarian aid to disaster victims. This signifies that farmers are over-exposed in terms of loss to farm investment due to natural hazard risks. This is the greatest setback towards commercialisation of agriculture in Tanzania as it limits transfer of resources and credit sanctioning to invest in crop production. Lack of a reliable strategy to hedge against these losses to Tanzanian farmers emanating from natural calamities is thus a serious problem worth addressing.

1.5 Objectives of the Study

1.5.1 General objective

The key objective of the study is to assess prevailing risks, coping strategies and their effectiveness in managing crop losses due to natural hazards, and the potential for crop insurance in the research area.

1.5.2 Specific objectives

(i) To determine natural hazard risk sources that farmers consider important and the available coping strategies to mitigate them in the research area.

(ii) To assess relative riskiness of various natural hazards under study.

(iii) To assess potential of crop insurance in managing natural hazard risks in the research area.

(iv) To determine the factors influencing preference for crop insurance amongst farmers in the research area.

1.5.3 Hypotheses

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

(ii) There is no difference in effectiveness between various coping strategies under study in the research area.

(iii) There is potential for crop insurance amongst bean farmers in the research area:

(a) A large section of farmers in the research area prefer crop insurance.

(b) All farmers in the research area operate profitable farming business.

(iv) Preference for crop insurance by farmers is not affected by farmers' profitability, wealth (asset index), farming purpose, farm size, level of education, awareness to crop insurance nor farmers' age.

1.5.4 Research question

What are the natural hazard risks that are considered important by farmers in the research area?

1.6 Justification of the Study

Farmers rely on a mix of strategies to manage risk. In agricultural sectors or countries where there are many production possibilities for utilizing a common resource base and a wide range of marketing alternatives, farmers use a broad mix of strategies. However, where production and marketing possibilities are more restricted, farmers stress a much narrower range of risk responses (Martin and McLeay, 1996). Tanzanian farmers are in the second category.

Decision to adopt a certain risk management strategy is influenced by farm type, farmers' attitudes and objectives and resource base. Management of risk and uncertainties of natural hazards on crop production is rather special as their occurrence is beyond farmers' control. Suggestions have been made to go for a risk-transfer mechanism like crop insurance, which manages the involved risks and uncertainties on a shared basis as has been the case in India, Mauritius, Chile, Wind Ward Islands, Pakistan, Venezuela, and Zambia (Robert and Dick, 1991).

The need for crop insurance in Tanzania is long overdue (NIC, 1986; Lema, 1987, PC, 1994). In the NIC (1986) study, it was recommended that a detailed research agenda should be drawn in terms of conducting detailed technical, administrative and climatological studies upon which justification or rationale for mounting crop insurance in Tanzania can be made. Sequel to that, the Planning commission (PC), in 1994 set up a study group, with NIC playing a secretariat role, to assess the feasibility of developing and administering smallholder crop insurance in Tanzania. The proposal was developed but research findings have never been published to date.

In its input to the Planning Commission's effort above, NIC reiterated that the feasibility of crop and livestock insurance in Tanzania is no longer negotiable as political forces both in Tanzania and Africa as a whole can not spare the country from this economic development (NIC, 1995). They went even farther and issue a draft "Mkulima crop insurance policy". Notwithstanding this development, the policy is yet to be operative in Tanzania to date.

There is thus a clear indication that there is a need for more focused research findings to fill up the existing gap in information asymmetries on crop insurance in order to

properly ascertain its potential (or otherwise) in the Tanzanian context. This study is a step in this direction. In this endeavour, this study adopted a case study of bean farming in the eastern province of Arumeru district. The reasons for the selection of the area and the crop are explained in section 3.2.7 of this report.

Furthermore, scarcity of literature on crop insurance is a global concern. As such, efforts by FAO to produce its bulletins number 78 and 86 on the subject, and a similar endeavour by Asia Productivity Organization (APO) in compiling proceedings of a seminar on the subject, which was conducted in August 1990, were categorically meant to curb this deficiency (APO, 1991; Robert *et al.*,1989; Robert and Dick, 1991). In Tanzania, this problem is even more serious as researchers haven't ventured into this area since then. This study will thus be very beneficial to Tanzania on this front, both in terms of literature provision and stimulation of further research in the field.

1.7 Organization of the Study

The study is organized in five chapters. The first chapter covers the introductory part while the second dwells on the relevant literature review from all corners of the globe. The third chapter covers research methodology and the fourth presents the research findings and their discussions. Conclusion and recommendations are given in chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This section reviews global literature on crop insurance concepts and their applicability, mostly, in the developing world's agricultural sector development. This focus intends to simulate these scenarios with the Tanzania's situation to enhance proper analysis of the key outstanding issues under this study.

2.2 The concept of crop insurance

2.2.1 Definition

Robert and Dick, (1991) defines insurance as a financial mechanism that aims at reducing the uncertainty of loss by pooling together a large number of uncertainties so that the burden of loss is distributed. Specific definition is given by Ray (1967) that defines crop insurance as a social device which 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.

The two definitions differ only in the area of determining whether crop insurance is a financial or a social device of risk management. A close examination of the two reveals that both refer to one and same thing. It is a financial device in that money is the basis for the build up of its reserve fund and a social device due to the fact that community is supposed to be making contribution to the fund through premium payment. The two definitions are thus similar.

There are however, two variants of this definition that are worth mentioning here for a better conceptualisation of the term. These are Credit Crop Insurance and Crop Credit Insurance. Gudger (1991) has defined the terms to reveal that the only difference between them lies in the fact of whether crop insurance being administered is linked or not linked with the value of crop production loan. Credit crop insurance refers to the insurance coverage that is decided based on the normal yield and the cropped area of each insurance unit of a farmer. It is irrespective of the value of the crop production loan though it is linked to agricultural credit system. On the other hand, crop credit insurance refers to the coverage that is decided based on the amount of the production loan of individual farmers. Each farmer has a different amount according to the different value of his/her loan, regardless of his cropped area.

The mechanism of operation for crop insurance is such that uncertainty of loss is reduced through combination of a large number of similar uncertainties, which are then spread over space and time. The reserve fund, accumulated through premium collections, is used to pay indemnities to victims in event of occurrence of crop yield loss due to an insured risk (Ray, 1967).

2.2.2 The scope of crop insurance

Due to insurability criteria discussed earlier, not all agricultural risks are insurable. Insurable risks (Hazell, 1991) include some production risks like losses due to catastrophic weather event (e.g. drought, pest, hail, flood), most health risks and some asset risks. However, most market and resource risks, a wide array of production risks especially preventable damages from pests, disease, excess humidity, excess temperature and most acts of God, are not strictly insurable). 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).

Other authors have a different view on some previously thought uninsured agricultural risks. It is claimed that the current superior control of technology and its consequent melioration of the risks thought to be uninsured (like pests, drought and diseases) has made agricultural industries viable reinsurance risks (Gudger, 1991). Reinsurance refers to an insurance taken out by a direct insurer from another insurer (termed the reinsurer), 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). Reinsurance enables the spread of insurable risks across countries. However, to attract international reinsurers is not a simple task. It calls for an operation of a very viable insurance scheme both financially and economically. This has since been a limitation to developing country's schemes.

2.3 Agricultural production and crop insurance

Agricultural production is often subject to large fluctuations in output and/or prices. These fluctuations, un-moderated, could pose frequent threats to the survival of producers with levels of consumption near subsistence. In general, agricultural income risk is a challenge to the financial viability of farming enterprises and it induces distortions in agricultural resources allocation (Wright and Hewitt, 1990). Income risk is brought about by problems emanating from both production and marketing side. Production risks are mainly meteorological/climatological whereas price fluctuations stand out as the major marketing risk in agriculture. Crop insurance is seemingly a better intervention in managing production risks.

The insurance mission towards agricultural risk management is concerned with sharing losses that are unpredictable in the individual case but predictable on a group basis (Mehr and Cammack, 1966). The prevalence of risk in agriculture is not new and farmers, rural institutions and lenders have, over generations, developed ways of reducing and coping with risk (Hazell, 1991). The Prime Ministers' office (PMO) study affirm to the fact that Tanzanian farmers do also have some risk responses in terms of coping mechanisms which develop gradually over time. Risk coping mechanisms are strategies developed by communities to address problems related to hazards and environmental stress. Such strategies are built upon historical knowledge, cultural acceptability and experience through interacting with environment within which they live (PMO, 2001).

Generally, in order to cope with agricultural risks, farmers and rural societies adopt both risk coping and risk reducing strategies. Risk reducing strategies include crop diversification, intercropping, farm fragmentation and diversification into non-farm sources of income. Risk coping strategies are relevant for dealing with catastrophic income losses once they occur. The strategies include borrowing, sale of assets, use of own food stocks, or temporary off-farm employment (Hazell, 1991).

In Tanzania, the Prime Minister's office (PMO) 'vulnerability analysis' study of September, 2001 found that most of the rural communities had developed a number of coping strategies against drought and floods. The study does not mention the actual strategies. It however, contended that there was no evidence of official efforts to assist these communities to improve these coping mechanisms though the government, development agencies, donor community and NGO's are pursuing many programmes

aimed at disaster prevention, mitigation and preparedness but the information on various aspects of risk and vulnerability analysis is limited.

2.4. Agricultural production risks

The major risks confronting farmers can be grouped into six categories:

(i) Market risks – such as fluctuations in output prices and inputs and interest rates, which are affected by unpredictable changes in world markets and government policy.

(ii) Resource risk – such as uncertain supplies of labour, lack of credit and irrigation water, or the untimeliness of supply of seeds and fertilizers.

(iii) Production risks – which cover a whole gamut of pests, diseases and weather related risks.

(iv) Health risks –human sickness, death and accident.

(v) Asset risks – such as theft or fire damage to buildings, machinery and livestock.

(vi) Other risks – such as confiscation of land, war damage and other "acts of God".

Other authors have come up with broader categorizations of risks. For example, Insurance Institute of India (1988) categorization has four groups as shown below:

(i) Natural, climatic or meteorological risks which include floods, drought, cyclone/hurricane, hailstorm, plant diseases, insects and other pests.

(ii) Social risks such as fire, burglary, theft, embezzlement, civil commotion, and moral hazard.

(iii) Economic risks such as adverse price fluctuations and depreciation in the value of investment in agriculture.

(iv) Personal risks such as accident or disease suffered by the farmer, his/her family members and workers.

The nature of agricultural production makes it impossible to separate it from the vagaries of weather. According to Ray (1967), natural hazards affecting farm property fall essentially into three categories namely; natural elements, plant and animal diseases and insects pests.

Risk due to natural calamities comprise the uncertainties of weather which include drought, flood, frost and freeze, windstorm, natural fire and lightning which are generally referred to as meteorological risks. Crop insurance is solely concerned with the management of production shocks to the farmer caused by these risks.

According to Robert and Dick, 1991, crop insurance provides protection against loss or damage to growing crops including perennial crops such as tree crops, against specified or multiple risks, e.g. hail, windstorm, fire, flood and drought. Measurement of these losses could be by "yield" basis, production costs basis, agreed basis or rehabilitation costs basis. Worldwide statistics (Abada, 1991), have it that cost of production criterion is the most commonly used by the majority. A proportion of the value of the yield approach is practiced in Japan and United States of America (USA) and amount of production loan extended to farmers criterion is in use in India. The last approach is only applicable under credit-linked crop insurance, which is further explained later in the chapter.

2.5 Classification of crop insurance

There is now a gradual growth of literature on crop insurance following the impetus of the 1980s. The available literature has been very consistent in the classification of crop insurance as a discipline. The difference has only been on the efficacy analysis of different classes of crop insurance on being adopted as operating scheme(s) by a country.

Crop insurance can be classified into different types according to different criteria used (Ray, 1991). Four criteria are discussed below:

(i) According to hazard(s) insured against

On this basis, the insurance may provide a specific cover, combined cover or all risk cover. The best example of specific risk cover is Hail Insurance, which is written on a large scale by private insurers and small agricultural insurance societies in Europe and USA.

Under combined risk cover, more than one risk is covered such as hail and fire, or hail, drought, flood and windstorm. All risk crop insurance covers all risks facing the farmer. It was introduced in USA and Japan in 1939.

(ii) According to number of crops covered

Crop insurance can be separate for each crop in which case it is referred to as Single Crop Insurance. It may also be multiple or combined crop insurance if crops are grouped together as one unit and claims become payable when the combined yield of all the crops falls below the guaranteed level. The main drawback of combined crop insurance is that if a farmer suffers loss in one crop and is not compensated on the ground that the

combined yield of all crops was not less than the guaranteed yield, the farmer is dissatisfied. It is therefore uncommon.

(iii) On the basis of scope and application

This could either be voluntary insurance or compulsory insurance. Compulsion element is in most cases associated with public all risk cover insurance schemes especially in their initial stages. Voluntary schemes are mostly risk specific and private.

(iv) On the basis of administration

This refers to either public or private insurance. Abada (1991) holds that crop insurance, as a business does not usually sit well with private insurance industry because of the general notion that insuring crops against the hazards posed by nature might be a losing proposition. It has been noted (Wright and Hewitt, 1990; Gudger, 1991) that a government has underwritten every all-risk insurance program that has progressed beyond infancy. These observations are worth noting when considering Tanzania scenario on the potential of mounting the scheme.

2.6 All risk and specific risk crop insurance

It is now generally accepted that all-risk crop insurance is unviable for the developing world nations and recommendations are for specific or named – risk insurance programmes (Gudger, 1991; Wright and Hewitt, 1990). However, Mosley and Krishnamurthy (1995) and Ray (1991) still advocate all – risk programmes for the developing world.

Supporting theory as suggested by Ray (1991) contends that, insurance against only a few of hazards leave the farmers exposed to other hazards, making the protection

inadequate. Mosley and Krishnamurthy (1995) account the failure of all-risk insurance on only low premiums being charged and that if the trend is reversed the programme may be sustainable. Mishra (1994) holds that empirical evidence reveals that all- risk crop insurance is not financially viable but has economic benefits that significantly outweigh its costs. The benefits include its ability to bring about expansion in the flow of credit to insured farmers in terms of both the number of borrowers and size of borrowed funds in the agricultural sector with consequent increase in input use by farmers under no subsidy situations. It is however noted from the literature that this is a general advantage of crop insurance as a scheme and not an exclusive advantage of all-risk crop insurance. Mishra's assertion may thus not be very convincing. In any case financial viability is necessary for any crop insurance scheme either operating or to be mounted.

The advanced theories against all-risk insurance include the fact that it is expensive and over dependent on government subsidies thus making it less sustainable. Other reasons given for its failure to perform well are its very high administration costs and the inherent political motives that lead to the inability of the government to charge fair premiums and enforce impartial adjustments. These motives lead also to failure to screen out undeserving farmers thus rendering rejection criteria inapplicable. In this circumstance therefore, the schemes run high risks of adverse selection. Adverse selection (Gudger, 1991) refers to the process by which the riskiest farmers select themselves out for insurance. Under all-risk crop insurance, underwriting is characterized by a tendency to accept farmers who meet administrative criteria without sufficient concern to the ability of the farmer to neither operate profitably nor reference to the riskiness of operating in a given location. The total reflection of all these is that crop insurance should be operated under purely commercial basis.

The most sophisticated critique is however given by Wright and Hewitt (1990) who contends that, the failure is, as such, coming right from the original standard model. They claim that there is very little in the way of formal economic argument or ex-ante evaluation available to justify the design, implementation, or continuation of all- risk crop insurance schemes that exist in many countries today. Even the elementary statement of objectives is claimed to be typically unavailable.

In the standard model (Chambers, 1989), the farmer is modelled as producing a vector output Y from inputs X, given random production disturbances (Weather and pests) denoted by Ø, with joint density h (Ø). Thus, realized output is y = (x, Ø), where Ø is a particular set of realizations of Ø .The output y are sold at random prices p where the joint density of p is v (p). Total revenue R equals Py. Insurance indemnities I ® are added to, and insurance costs σ are subtracted from net revenue to obtain the farmers' realized net income Π, which is thus defined as: -

$\Pi = R + I(R) - \sigma - wx$; Where w denotes input prices (assumed non random).

According to chambers (1989), the above theory is good but it does not apply to the crop insurance problem. Furthermore, it has several deficiencies as a basis for analysis of crop insurance. First, the problem it models is not that of crop insurance but rather insurance of total revenue. Moreover, alternative means of handling risk that are observed to be important in practice, and are affected by insurance, are absent from the analysis e.g. traditional risk reducing strategies and other coping mechanisms

2.7 Natural hazards in Tanzania

In attempting to study potential for crop insurance in Tanzania, it is imperative to know the kind of natural hazards that affect farmers in the country as crop insurance is all about managing risks emanating from them. According to NIC (1986), agro-climatic hazards in Tanzania include drought, hail, hurricane, frost, strong winds and floods. Since these findings were obtained from a survey of nine regions (out of twenty regions then), there is a strong conviction to believe that these hazards are scattered all over the country. The only difference will be on the frequency of occurrence and severity of crop loss appertaining to each one of the hazards in a specified location. The details as to the type of hazard, the region affected and crops affected in that study are summarized under table 5.

Table 5: Climatic hazards affecting crops in selected regions of Tanzania

Natural hazard	Affected crop	Affected region
Drought	Coffee	Kilimanjaro, Arusha, Kagera
	Cotton	Mwanza, Shinyanga
	Wheat	Arusha, Iringa
	Maize	Arusha, Iringa
	Rice/Sugar cane	Morogoro
	Sunflower/Tobacco	Iringa
Strong winds	Coffee	Kilimanjaro, Arusha, Kagera, Mbeya
	Tea	Kagera
	Wheat	Arusha
	Rice	Morogoro
	Cotton /Tobacco	Mwanza, Shinyanga
	Sunflower	Iringa
Hurricane	Coffee	Kagera
	Rice	Morogoro
	Tobacco	Iringa, Ruvuma
Frost	Cashew nuts	Ruvuma
	Maize	Iringa, Arusha
	Cotton	Mwanza, Shinyanga
	Sunflower	Iringa
Floods	Maize	Iringa, Arusha
	Rice	Morogoro

Source: Compiled from NIC (1986), Various pages (Lema, 1987).

The Prime Minister's disaster vulnerability analysis study (PMO, 2001) provides the best update of these climatological hazards in the country. Its strength lies on its wide coverage involving all-of the twenty regions of mainland Tanzania by then[1] and fifty seven (57) districts. The most common natural hazards in Tanzania are weather and pest related ones as shown in table 6. These statistics are given on a scale incorporating various disasters in respect of disease epidemics, pests, drought, floods, fire and major accidents. Others include cyclones/strong winds, refugees, conflicts (internal displacement of persons), landslides, explosions, earthquakes, and others (unspecified). The table shows only those hazards that are agriculture-related and thus bears witness to the NIC findings above.

Table 6: Occurrence frequencies of selected disasters in Tanzania

Type of hazard	Percentage
Pests	19.4
Drought	17.4
Floods	10.4
Fire	5.4
Cyclone/strong winds	3.2
Landslides	0.9
Earthquakes	0.4

Source: Prime Minister's office (2001).

It is important to know some of the definitions of these hazards to enhance proper understanding of their nature. The definitions given below are in accordance with Robert and Dick (1991).

[1] Before Manyara region was introduced

2.7.1 Agricultural drought

This refers to insufficient supply of moisture from precipitation or stored in the soil that is inadequate to fulfil the optimum water needs of plants to the extent of impairing crop yield. Under these conditions, the soil moisture tension becomes too large for the rooting system to take up enough water to maintain the plant in a state of turgor, and hence a growth check occurs.

2.7.2 Hailstorm

Hail is a solid precipitation in the form of hard pellets of ice, which fall from cumulonimbus clouds. These balls or lumps of ice are often spherical, conical or irregular in shape and are composed of alternate concentric layers of ice and compacted snow. Hail has a diameter ranging in size from 5 to 50 mm, sometimes even more.

While extremely large hailstones are rare, hailstorms are a great problem to farmers, especially in North America. In Africa, hailstorms cause considerable damage to valuable crops.

2.7.3 Hurricane

Hurricane is an intense tropical cyclone (storm). It is called typhoons in the Pacific Ocean; cyclones in the Indian Ocean; hurricane in North Atlantic (gulf of Mexico and Caribbean) and willy-willies off Australian coast.

2.7.4 Frost

Frost occurs when the temperature of the air in contact with the ground, or at screen level (about 4ft or 1.2 metres) is below the freezing point of water (ground frost' or 'air frost' respectively). The term is also used for icy deposits that may form on the ground and on objects in such temperature conditions.

2.7.5 Strong winds

Strong winds, according to Beaufort scale of wind force, would start from wind force 8. These can take a form of localized mild windstorms, tropical storms or hurricanes. Banana is known to be the most susceptible crop to damage by winds as has been observed in the Windward Islands of St. Lucia, Dominica, St. Vincent and Grenada which lie in the North Atlantic tropical cyclone system (Robert and Dick, 1991).

2.8 Insurance Premium

Premium refers to the monetary consideration payable by the insured to the insurer for the period or term of insurance as provided by the insurance policy in question (Mehr and Cammack, 1966). Premium is perhaps the most important component of crop insurance in that its rate will very much determine the success and sustainability of any scheme. However, determination of actual premium rate has been an incessant problem in many schemes especially public all-risk ones (see sections 2.4 and 2.5). According to Abada (1991), calculation of premium rate is critical in that premium payable should be enough to cover the pure risk under the policy, meet administration costs of the insurer, contribute in building of the catastrophe reserve fund while at the same time leaving some profit to the insurer. The following always hinders attainment of this goal:

(i) Scarcity of time series weather data in areas devoted to crop production.

(ii) The difficulty of obtaining accurate empirical information on effects of various weather risks on crop yields and crop product quality.

In Tanzania, the second problem is seemingly more serious probably due to poor linkage between Meteorology department and the Ministry of agriculture or may be because crop insurance had not been in the government's domain of agricultural areas to be researched on before, thus that kind of data could not be found important to merit their collection.

As a matter of principle, agricultural insurance must only operate by keeping the loss ratio in the 30% range, if an insurer is to be able to build up a reserve adequate to confront the periodic major losses that are inevitable in agriculture (Roberts and Dick, 1991; Hazell, 1991). Other scholars (Patrick *et al.*,1985; Lloyd and Mauldon, 1986; all cited by Wright and Hewitt, 1990) maintain that private insurance underwriters typically design their programmes to achieve an average loss ratio of not more than 0.7. Loss ratio refers to the ratio of indemnity paid to premium collected. It is a very good measure of performance for any insurance scheme. It is subject to an insurer maintaining a balanced portfolio[2]. A balanced portfolio is composed of three elements:

(i) The premium of each item in the portfolio must be adequate to pay for the average variation of losses around the mean over a long span of years. In other words financial viability of an insurer, assuming no subsidy from the government, requires that the insurer should keep the average value of its annual outgoings (i.e. indemnities plus administration costs) below the

[2]Portfolio refers to the total value of written policies by an insurer at any one particular time

average of the premium it collects from farmers. This can be illustrated by the formula;

$Z = A+I / P < 1$

Where A=average administration cost

I=average indemnities

P=average premium collected from farmers.

(ii) A portfolio should constitute items with performances which are inversely correlated i.e. losses in one area are offset by the profits generated in other areas thus producing an overall positive result. For example, insuring farmers both in irrigated and non-irrigated areas could be in line with this proposition. Drought hazard could devastate the whole crop in the non-irrigated areas at a particular year but the irrigated areas will not be affected. In that case, indemnity will be paid to farmers in the affected areas only. Premium from the unaffected farmers will counteract the effect of the paid indemnity.

(iii) The relative weights of the various elements in a portfolio must be kept in balance, so that a loss in a single element will not prejudice the overall results of the entire portfolio. This is in accordance with the investment portfolio theory, which argues that no more than 5% of a portfolio should be invested in any single option. This minimizes risk exposure to the insurer. Quite frequently, a single item can be separated into a number of different exposures based upon geographical dispersion, different climates and different planting and harvesting dates to fulfil this condition.

In general, premium rate determination is central to any crop insurance programme. Many authors have emphasized this point. Robert and Dick (1991) assert that innovative and experienced agricultural professionals can only obtain a good premium rate through translating and interpreting long time series of disaggregated agro-climatological data. The importance of trained agricultural professionals has been duly discussed in chapter 1 of this study. They insist that determination of the applicable rate is very sensitive due to the fact that insurance, as a business, is highly leveraged. This means that a small error is multiplied manifold. For example if premium is put at 5% instead of the correct rate of 7.5%, the error is not 2.5% but 50%. However, the process of its determination depends more on experience and judgement assisted by the construction of hypothetical portfolio and correlation analyses of meteorological conditions and subsequent yields, than upon any rigid scientific methodology. It can thus be generalized that the task of determining the right rate of an insurance premium is a long run goal, which has a purpose of achieving a reasonable return to the insurer after administrative costs are paid, and investment income is taken into account.

Hazell (1991) stresses that premium should be based on sound actuarial calculations that use available weather records and well-maintained records on insured farmers. Deducing from this, it can safely be said that for new schemes, the starting rate is liable to change as scheme progresses. This is due to the fact that more data will come to light in the process thus giving way to more reliable empirical analyses leading to more accurate premium rates. The best example of this is shown by the Indian Comprehensive crop insurance which charged a premium rate of between 5-10 percent (of the guaranteed yield) during its decade run as a pilot scheme only to change the rate to between 1 percent and 2 percent after becoming full fledged (Mishra, 1994).

2.9 Crop credit insurance

As already defined earlier in the chapter, crop credit insurance normally refers to crop insurance cover to a farmer to the extent of his/her crop production loan. It does not provide guarantee for repayment of loans, since credit guarantee business is outside the scope of crop insurance. In this understanding therefore, non- bank borrowers are not beneficiaries of this facility.

It is a related form of agricultural insurance (Wright and Hewitt, 1990). Coverage is based on the amount of credit extended to a farmer, and the insurance is mandatory for access to official credit. It has been used in Brazil with disastrous budgetary consequences (Crawford 1977; Lopes and Dias 1986). The loss ratio in Brazil ranged from 2.44 to 4.2 from 1975 to 1981 with an overall ratio of 3.87 countrywide (Lopes and Dias, 1986).

The Indian comprehensive crop insurance is also linked to credit (Mishra, 1994). Its economic advantages, which are related more to its ability to expand credit flow into the Indian agricultural sector, contradict its financial inviability. In this case, evidence is clear that withdraw of government subsidies could definitely lead to the collapse of the scheme. This deficiency is however waged more on the nature of the scheme itself, i.e. all-risk insurance, than to its credit linkage (refer section 2.5 of this report).

Another scholar, Lipton (1979) argues that small farmers face a situation of inadequate availability of credit partly because of absence of crop insurance, but existing empirical evidences indicate that owing to moral hazard, crop insurance becomes costly to supervise. He further argues that the wide spread of farming activities coupled by asymmetric information on crop insurance matters, highly increases the cost of measuring expected yield and assessment of indemnity. This assertion is strongly

opposed by Gudger (1991) who claims that there is no empirical evidence to show that credit linked crop insurance has neither enhanced crop accessibility to farmers nor repayment capacity of farmers to their creditor bankers. He strongly assert that under credit-linked insurance, the beneficiary is the lender and not the farmer; and that under such linkage, financial intermediation by banks and insurance services are merged together as one and same thing while actually they are different and should operate uniquely if farmers are to benefit from them.

In the same token, Mishra (1994) has tried to show the mechanism of operation of crop insurance as a substitute collateral and a common device used in rural credit markets with a view to limiting the consequences arising out of agricultural risk, information asymmetries and enforcement problems. The argument holds that this is because formal credit institutions in developing countries find it too costly to screen and monitor borrowers directly, so they take recourse to collateral in the form of landed properties. Mishra has shown that collateral raises the expected return to the lender as per following equation: -

$$E(v) = Li\ (1 - p) + (c - L)\, p$$

Where i is the interest rate, L the loans size, p the probability of default and C is the value of the collateral to the lender. E (v) is the expected return to the lender. If there is no collateral, i.e. c= o, the expected return is equal to the interest earning (Li) times the probability of repayment (1 – p), minus the value of loan times the probability of default (assuming for simplicity that loans are either fully repaid or fully defaulted). As collateral is added (i.e. c > 1), the second term of the equation increases, thereby raising the expected return.

For the borrower, the default condition is U (W – D – C) > U (W-L (1 + i)), where W is the current wealth and D is the loss of future earning from default. If (D + C) > L (1 + i) i.e. the loss of future earnings plus collateral is greater than the loan amount plus interest, there will be no incentive to default (Binswanger 1986 cited by Mishra, 1994).

The above review highlights the inherent potential of crop insurance in reducing default risk of farmers to Financial Institutions (FIs) and banks. Insurance will always guarantee farmers' yield at any eventuality thus repayment capability of loans is firmly maintained. On the other hand , CI's potential in this direction could be thought of in respect of the policy itself being used as a collateral in the equations above. There is no doubt to question plausibility of this arrangement as currently in Tanzania, banks are allowed to take liens over unexpired life assurance policies as full collaterals against credit facilities (BOT, 1991). Hopefully, liens over crop insurance policy, if ever existed, could likewise be accepted.

2.10 Crop insurance in Tanzania

Following severe droughts of mid 1970s and early 1980s, there was a popular demand by the members of parliament to the government to look into the possibility of crop insurance for Tanzanian farmers. National Insurance Corporation (NIC), the then sole insurance organ of the state, was given the task to carry out a feasibility study. NIC complied and produced their report in 1986 (Lema, 1987).

The findings of the NIC (1986) study were based on a research conducted in nine regions of Tanzania. These regions with their respective crop(s) of interest in bracket were: Kilimanjaro (coffee, sugarcane); Arusha (coffee, maize, wheat); Mwanza and Shinyanga (cotton); Kagera (coffee, tea, sugarcane); Morogoro (rice, sisal, sugarcane);

Iringa (tobacco, sunflower, wheat, and maize); Mbeya (coffee); and Ruvuma (tobacco and cashew nuts). The study tried to establish natural hazards affecting the respective crops in the regions from which NIC could conclude farmers' demand for crop insurance. Farmers themselves were not asked of their perceptions on those risks and their interest/preference for crop insurance. The researchers assumed that they could determine and presume the farmers decisions given the nature of their findings (Normative research approach).

A review of the NIC study reveals the following conclusions:-

(i) That major hazards retarding crop yields or damaging crops in Tanzania are climatological. The hazards include; drought, hailstorm, hurricane, frost, strong winds, and floods. It was contended that these hazards have very high potential for insurance relative to organizational, management and crop husbandry problems.

(ii) Farmers were willing to insure their crops depending on the severity of the hazard and relative importance of the crop affected in terms of both income and food sources.

The NIC study is an incentive for further research in crop insurance so as to be able to establish with some degree of certainty as to whether it is a bankable investment idea in Tanzania. The other related studies by Rugumamu (1991) and PMO (2001) on disaster relief coordination network in Tanzania and disaster Vulnerability analysis respectively have provided important meteorological data and findings that are important for further research in this respect.

2.11 Planning for a crop insurance scheme

Tanzania can be said to be in the initial stages of crop insurance scheme consideration. A knowledge on the basic principles behind planning such a scheme is thus of utmost importance. According to (Abada, 1991), anyone planning for a crop insurance programme should first be able to answer the following questions:

(i) Will the intended clientele realize the need for crop insurance?

In principle, to justify demand for crop insurance, a large section of the community should show that they have a psychological desire for it (Ray, 1991). This desire should be reflected in their preference for crop insurance. Preference for crop insurance is subject to proper awareness and understanding, by the would-be clientele, of the inherent potential of crop insurance in the management of agricultural production risks.

(ii) Will the required premium be affordable among the clientele and yet allow the insurer to recover his costs and build up reserves?

This is the most critical area which follows from the first item above (see section 2.7 of this report). If premium rate is beyond the level of farmers' ability to pay, then it is not advisable to mount the scheme. Likewise, if it is too low to meet the insurers' costs then the scheme, even if mounted, will collapse. A middle of the road moderation premium rate should thus be sought for a successful scheme

(iii) Will the insurance package be attractive and responsive enough to sustain the clientele's patronage of the programme?

For farmers to keep on buying crop insurance, they ought to feel that the policy is beneficial to their sustainable crop yield realization. This can only occur if the insurer tailors its services according to the needs of the clientele and that the costs involved justify realized gains. Continuous research on the needs of the farmers is thus an imperative task of the insurer in crop insurance.

(iv) Will the country be better off with crop insurance?

Mounting crop insurance in a country should be in line with its agricultural development objectives. These objects may also dictate the type of crop insurance scheme to be mounted depending on the target group, and national agricultural policy priorities. Logically, no country can ever decide to mount such a scheme if not under assumption that the scheme will take it a step far better off from where it were before it.

Planning for crop insurance also entails answering many more other questions that are equally important. The main ones include selection of the type of scheme to be mounted (public or private), selection of crop(s) to be included in the scheme, selection of areas to be covered and selection of farmers to be insured. The first two are discussed further below.

2.11.1 Selection of scheme type

Many authors have recommended private schemes over public ones for developing world countries (refer section 2.5). It would appear however, that decision in this respect

is not that simple. One wonders why USA for example, has not given up its public all-risk scheme under Federal crop Insurance corporation (FCIC) in favour of the named-risk private sector Crop Hail Insurance cover. FCIC, according to Gudger (1991), is inferior in all respects to the private scheme. Statistics show that between 1984 and 1986, 35 out of 47 crops under the scheme were recording loss ratios above one. The government was thus made to subsidize it at a rate of 30% of its operational costs plus a commitment to make up the losses being made by the scheme. On the other hand, crop hail Insurance has all of its loss ratios below one. Notwithstanding all this, FCIC has never been discarded. This implies that national objectives of establishing the scheme may sometimes override financial viability criterion. FCIC, for that matter, seems to be politically motivated and has a specific purpose to serve.

2.11.2 Selection of crop

Criteria to determine the crop(s) to be incorporated in the scheme have been duly elaborated by Abada (1991). These criteria include the following characteristics:

(i) The crop being considered should assure the food security of the country. It follows therefore that, if Tanzania ventures in crop insurance, it should include all major staples like, maize, rice, and beans[3].

(ii) The crop should be a commercially produced one, that contributes to the overall economic stability of the country i.e. Export oriented or Import substitution.

[3] This is based on the interview with Mr.C.N. Ravi , the NIC Director of Non-life insurance.

(iii) The population of the farmers producing the crop should be large enough to affect a broader base for crop insurance.

(iv) There should exist a database (yield and loss statistics) that covers some length of time to allow for an appropriate premium rating. In the Indian comprehensive crop insurance, five years series data are used in determining indemnity amount payable to the farmers under the 'area approach' crop insurance (Mishra, 1994). The calculations are based on the following formula;

$$Ij = Ty - Ay/Ty \,.Sj, \text{ if } Ay < Ty$$

Where; Ij =indemnity for farmer j.

Sj = sum insured by farmer.

Ay = actual average yield of the defined area

Ty = threshold yield of the insured for the defined area.

This indemnity is equal to 80 percent of the average (moving average) area yield for the preceding 5 years. Premium determination might require a longer series data of more than 10 years.

(v) There should be well-developed infrastructure on production, marketing or credit for possible linkage with insurance.

2.12 Analytical Methods in related studies

Proper analysis is the key to rightful decision making in any endeavour. Analytical methods are nonetheless, a function of previous methodologies and procedures for which improvements can be made to enhance new findings and/or strengthen reliability of old findings.

Crop insurance as a subject has however, suffered a notable misfortune in this respect. It has so far been observed that the substantial body of literature on it which has come up (since 1980s) are almost all descriptive and/or of policy advocacy (Gudger, 1991). Analytical works have been very few and of restricted scope. Gudger further contends that several dissertations on the subject, up to early 1990s, focused primarily on the theoretical aspects and thus a number of equally abstruse articles were produced. He qualified his worry by asserting that no single careful in-depth case study of an operating crop insurance system had been produced then. Gudger's observation can not be more true to date especially in the Tanzanian context which has never known crop insurance even in its college and university academic curricular.

On the global scale, standard model was probably the most celebrated analytical framework for crop insurance. However, the shortcomings of this model have made it an irrelevant tool in that respect as has been shown under section 2.5 of this report. Given the prevailing situation, the only plausible option remains with the need to improvise on the methodologies that have so far been employed by other researchers in Tanzania on the same subject for better results. In this case therefore, three studies in Tanzania merit attention, namely; 'Towards Developing an Environmental Disaster Relief Coordination network in Tanzania study' (Rugumamu, 1991), 'Feasibility study on Crop Insurance in Tanzania (A report on Crop Insurance in Tanzania)' (NIC, 1986) and 'Disaster Vulnerability Analysis study' (PMO, 2001).

Rugumamu's study was purely descriptive and of policy advocacy nature employing no specific methodology in deriving its findings. It was rather a review paper aimed at influencing national policy on disaster management. It is thus of no significant importance and relevance to the present study.

NIC's study was a bit more scientific in that it used some statistical means like percentages in determining the magnitude of various variables. Among the variables under reference were related to the number of affected farmers by a given natural hazard, number of times affected etc. The methodology has since been criticized of hindering inter- regional comparisons due to its weakness of using different time horizons in different regions (five, and in some cases ten years) and sample size variations between regions (Lema, 1987). Most important though is that the study completely failed to tap and assess very important attributes in relation to the following:

(i) Farmers' perception of each natural hazard's risk.

(ii) Farmers' ranking of the severity (riskiness) of various natural hazards affecting farmers and,

(iii) Farmers' willingness to insure affected crops

These are the areas the current study attempted to redress by adopting a positive approach instead of the adopted NIC's normative approach to research[4].

PMO's study was superior to the above two researches in all aspects ranging from sampling of study units, wider coverage of research area to data analysis. Simple random sampling, systematic random sampling and stratified sampling methods were all used. Data analysis was mainly descriptive employing frequencies and cross tabulations. Independence between variables was analysed on a Pearson Chi-square (X^2) and likelihood ratio test statistics e.g. independence between type of disaster/ hazard and the region of occurrence. The study was however, totally devoid of quantitative analysis methods a weakness that is redressed in this study.

[4] Normative approach refers to conceptualising, modelling and measuring risk attitude of smallholder decision makers that starts from researchers' hypothesis about the economic rationality of individual's decision making. These hypotheses are tested based on the predictive power of alternative models. Positive approach starts from the farmers, focuses on the question of how farmers arrive at various decisions. It entails close observation of farmers' behaviour and attitude and understands what types of decision those farmers take and in which situation. Interested readers are referred to Senkondo (2000).

2.13 Conclusive opinion

Given the weaknesses of the previous related studies as shown above, this study adopted a positive research approach by making the farmers assessors of some variables according to their own situational perceptions. This involved assessment of variables like effectiveness of coping strategies in managing agricultural production risks and riskiness of various natural hazards. This methodology is referred to as structured questionnaire approach in risk perception/ assessment. It has been used to farmers in Babati District, Manyara region (Senkondo, 2000). Notwithstanding its qualitative nature, this methodology was found to give similar results like the more quantitative strength of conviction method. The latter involves the use of subjective probabilities in risk analysis. Questionnaire approach is thus simpler and quicker.

Rigorous quantitative methods employed were Gross Margin (GM) analysis and regression analysis. These two methods were employed to test the most important hypothesis of the whole study 'there is potential for crop insurance in the research area'. This hypothesis has two dimensions according to the underlying literature.

Literature has it that demand for crop insurance (see chapter one) is subject to fulfilment of two conditions. First, there should be a large section of people engaged in a certain economic pursuit (in this case bean production) and having a psychological need for crop insurance. Second, that section of people should be able to meet insurance costs. The first condition in this study is measured by establishing the proportion of bean farmers who have preference for crop insurance while the second condition is measured on the profitability analysis of farmers on the basic assumption that profitable farmers are the ones capable of meeting the insurance costs. GM analysis was thus meant to achieve this goal. This analysis is dealt with in more detail in the following chapter.

Regression analysis was employed to assess the factors affecting preference for crop insurance amongst bean farmers in the research area. The model building was based on the fact that the dependent variable was dichotomous (dummy variable). Normally, in such functions the disturbance term is always heteroscedastic (heterogeneous variance) (Koutsoyiannis, 1977) thus maximum likelihood estimation procedures were employed instead of Ordinary Least Squares estimation procedures. Binary logistic regression model was thus employed. Literature from various authors (Gudger, 1991; Ray, 1991; Robert and Dick, 1991) suggested for the inclusion of farming purpose (commercial or subsistence), farmers' wealth (asset index), farmers' profitability, farm size, awareness to crop insurance, and education level as independent variables of the regression equation. Logic dictates that age of a person is always a factor in decision-making. Farmers' age was thus included as another independent variable to the equation.

The details of methodology used in this study are covered in the following chapter.

CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter presents the methodology used in the study. It covers the description of the study area and the justification for its choice, data requirement and their sources, questionnaire design, sampling techniques, data collection methods and data analysis techniques. Limitations of the study methodology are given at the end of the chapter.

3.2 Description of the study area

3.2.1 Location

The study was carried out in Arumeru district Eastern province in Arusha region. Arumeru district lies on the slopes of mount Meru. Mount Meru, the second highest mountain in Tanzania after Kilimanjaro, rises up to 4 228 metres above sea level.

Arumeru district is one of the five districts of Arusha region. The district is located north east of the region, bordering Kilimanjaro region to the east, Manyara region to the south and Monduli district to the west. It lies between longitudes 36°15′ -36°55′ east and latitudes 3°00′-3°40′ south.

3.2.2 Climate and topography

The district has bimodal type of rainfall, that is, short rains (vuli) and long rains (Masika) which fall in November to January and March to June respectively; thus the district has two agricultural seasons. The district is divided into three agro-ecological zones /belts:

(i) Highland/Upper belt

This is a mountainous area rising between 1400m and 1800m above sea level. It has an average annual rainfall of about 1000mm. Forests forming water catchments for most streams cover most land area. Main economic activities are agriculture and livestock kept under zero grazing system. Crops grown include coffee, pyrethrum, banana and round potatoes.

(ii) Middle zone/belt

This belt rises between 1,000m and 1,350m above sea level, receiving an average annual rainfall of 500mm. Major economic activities are livestock keeping and agriculture. Crops grown in this belt are coffee, banana, maize, beans, wheat/barley, rice, fruits and horticultural crops.

(iii) Lower zone/belt

This belt rises between 800m and 1000m above sea level, receiving average annual rainfall of about 300mm. Most of the rivers and/or streams originating from the upper belt spill their waters in this zone making irrigation the mainstay of the farmers. Agriculture is the most important activity and major crops include rice, maize, beans, banana, cassava, sisal and horticultural crops.

3.3.3 Soils and vegetation

Soils in Arumeru district are relatively new, fertile and mainly of volcanic origin. The soils are well drained dark sandy loams with moderate to high natural fertility and favourable moisture holding properties.

3.2.4 Demography

According to 2002 census, the district population is 514,651 consisting of 262,964 females and 251,687 males. Regional average household size stands at 4.5 members and population growth rate is 4.0 (URT, 2003).

3.2.5 Economic Activities

The district has an area of 2,966 square kilometres (284,340 ha), which is just 3.4% of the total area of the region. Agricultural land is only about 18% of the total district land whereas 49% is used for grazing, pasture, national parks, forests and water. The remaining 33% is barren land of no major economic value. The available small agricultural land has thus to be fully utilized to meet food requirements of the district and beyond. Full utilization entails proper management of farming risks facing the farmers. In terms of farming, Arumeru is highly vulnerable to floods and drought which frequency of occurrence is annual (PMO, 2001). The root causes of these hazards are deforestation, poor farming methods and climatic change. Land use pattern is summarized in table 1 below:

Table 1: Land use pattern in Arumeru district

Economic activity	Area (ha)	Total area (%)
Unsuitable and other uses	90,582	33.09
Grazing	58,762	20.29
Agriculture	51,575	17.81
Water	40,717	14.06
National Parks	16,349	5.75
Forests	16,188	5.59
Pasture/Fodder	9,876	3.41
Total land	254,340	100

Source: Arumeru district baseline information report (2002).

Agriculture is both for food and cash crop production as per following statistics in table 2 below.

Table 2: Food crop production in Arumeru district

Crop	Area under cultivation (ha)	Average yield (tones/ha)	Production (tones)
Maize	16,000	3.0	48,000
Banana	9,000	5.0	45,000
Beans	10,000	1.0	10,000
Vegetables	500	7.0	3,500
Paddy	600	2.0	1,200
Sweet potatoes	200	3.0	600
Irish potatoes	290	2.0	580
Cassava	150	3.0	450
Total land area under cultivation	36,740	-	-

Source: Arumeru district baseline information report (2002).

According to the Ministry of Agriculture (MAC) and the National Bureau of Statistics (NBS) records, regional average yield figures for bean stand at 1,571 kg/ha and 1,656 kg/ha for male headed and female headed bean growing holdings respectively (MAC, NBS, 2000). The district figure is thus below the regional average. However, the crop is now doubling as both cash and food crop in the district.

Coffee has since been the major cash crop in the district. The current slump of coffee world market price has threatened the future economic importance of the crop in the district. Price risk is thus a major problem to coffee farmers. Crop insurance has a minimum scope in hedging export price risks to farmers. Other major cash crops include pyrethrum, sugar cane and pigeon peas. Cash crops profile in the district is as shown in table 3 below.

Table 3: Cash crop production in Arumeru district

Crop	Area under cultivation (ha)	Average yield (tones/ha)	Production (tones)
Coffee	19,000	0.5	9,500
Pyrethrum	175	1.0	175
Sugar cane	420	10.0	4,200
Pigeon peas	400	1.75	700
Total land area under cultivation	19,995	-	-

Source: Arumeru district baseline information report (2002).

Floriculture is growing fast and is currently practiced by large-scale farmers. About 75 ha are under flowers in green houses.

3.2.6 Use of agricultural inputs

The use of inputs is very limited and/or very low (only about 25%) due to high input prices. Table 4 shows that in spite of the availability of adequate supplies of the required inputs, very little is finally distributed to farmers. This implies that distribution levels reflect purchasing power of farmers.

Table 4: Demand, supply and distribution of agricultural inputs in Arumeru district.

Type of input	Demand (tones)	Supply/ Availability (tones)	Distribution (tones)
Nitrogen fertilizers	1,700	1700	350.0
Chemicals	1,000	1,000	300.0
Improved maize seed	400	400	100.0
Other fertilizers	400	400	20.0
Improved bean seed	450	450	5.4

Source: Arumeru district baseline information report (2002).

Adoption of modern methods of farming is a function of intensive input use. Crop insurance thrives well where modern farming techniques are in operation. However, consideration of insurance to Tanzanian farmers should initially take care of the prevailing situation in the assumption that the same will be an engine to modernize farming as it progresses.

3.2.7 Choice of crop and the study area

King'ori and Mbuguni are divisions found on the eastern province of Arumeru district. They were selected for this study to reflect the diverse ecological suitability of bean crop production in the district. King'ori division is famous in rain-fed bean cultivation while Mbuguni boasts of irrigation-fed bean production. King'ori lies on the middle belt while Mbuguni is on the lower belt. The selected villages from King'ori division were Kikatiti and Malula/Kolila whereas Kwa Ugoro village was selected from Mbuguni division. Selection of these villages was purposeful based on criteria such as accessibility and potential for bean crop production.

Bean crop was selected based on the strength of its ever-growing commercial importance in the district. Crop insurance is all about commercial farming. Moreover, the National Insurance Corporation (NIC) report on crop insurance in Tanzania of 1986 did not include bean crop in its research findings. This study found it important to make a case study of bean crop in an attempt to increase the available knowledge of crops with insurance potentialities in Tanzania. This is important because a vibrant crop insurance scheme is subject to its ability to spread production risks over locations (space), crops and time horizons.

3.3 Data requirement and their sources

Initially, both primary and secondary data were expected to be collected. The secondary data required for analysis were in respect to crop losses for each natural hazard. These data proved to be unavailable from both the Ministry of Agriculture and official publications. Primary data were thus the only type collected from farmers and insurance companies.

The research has taken a positive approach as opposed to normative approach. The positive approach, which starts from the farmers, focuses on the question of how farmers arrive at various decisions. The approach entails close observation of farmers' behaviour and attitude, and understands what types of decision those farmers take and in which situation (Senkondo, 2000). This approach explains how different households with different resource endowments differ in decision-making.

In this study, farmers' questionnaire was designed to reflect the research's positive approach i.e. a design that enabled farmers to take a leading role in the assessment of the respective variables under study. Farmers were thus to assess the riskiness of different natural hazards, assess the effectiveness of various coping and risk-reducing strategies and rank risk management strategies according to their own perceptions.

The approach has had an effect on the analysis of natural hazards' riskiness. The use of normative approach would have otherwise necessitated the use of Stochastic Dominance analysis (Senkondo, 2000) in determining riskiness of each natural hazard. Suffices to say that normative approach would basically mean determination of hazards' riskiness and effectiveness of the coping mechanisms from the researcher's point of view whereas positive approach refers to same determination from farmers' point of view.

3.4 Questionnaire design and sampling techniques

Both questionnaires were structured. The farmers' questionnaire (appendix 1) consisted of six sections. The first section covered general farmer characteristics that include age, gender, role in the household and level of education. Second section was on land use and ownership, which covered variables like sources of income, farm, size, land ownership status and farming purpose. The remaining sections covered variables in respect of production risks and their management, profitability, capital and agricultural finance.

The insurers' questionnaire (appendix 2) was made in five sections covering insurer identification variables, agricultural insurance, livestock insurance, crop insurance and future prospects of crop insurance in Tanzania.

Farmers were sampled from the respective village registers using simple random sampling technique. Systematic random sampling could not be adopted as farmers had not been ranked according to their income levels in the register. For insurers, the idea was to interview all nine insurance companies currently operating in Tanzania mainland but data could only be obtained from eight of them though all were served with the questionnaire. The study interviewed bean farmers in Arumeru District and insurers in Dar-es –salaam. The selection was geared towards involving these two categories of respondents as they are considered the major stakeholders in the whole theme of crop insurance.

Constrained by both time and budget, a total of only 116 bean farmers were interviewed. However, 8 insurance companies out of 9 companies operating in mainland Tanzania were interviewed. Sampling frames were obtained from village registers and the Commissioner of insurance respectively.

As explained in section 3.2.7 of this report, selection of villages in the survey was purposeful. Accessibility and bean production potential were among the selection criteria for the villages. Proximity to suburban centres was also a criterion in keeping abreast with the budget constraint. Two villages, Kikatiti and Malula/ Kolila , were thus selected from the middle belt and only one village, Kwa Ugoro, from the lower belt. The middle and lower belts are the major bean producing areas in the province under rain-fed and irrigated farming respectively. Two villages were selected from the middle belt on account of more accessibility and closer proximity to the suburban centres of Kikatiti and King'ori kibaoni as compared to the lower belt villages.

3.5 The framework of analysis

3.5.1 Conceptual framework

The framework (fig. 3.1) displays a pictorial representation of the relationship existing between crop production and different types of natural hazards. The latter are shown as principle agents of crop loss. The conceptualisation holds that, under crop insurance arrangement, crop losses caused by natural hazards are recovered through indemnity payment from the insurers. Farmers' investment is thus recouped and the continuity of crop production cycle is maintained making the whole system of production sustainable. Insurance cannot be applied on the natural hazards, as their occurrence is not under human control. Insurance thus hedges against crop losses to be caused by natural hazards and not against natural hazards themselves.

Crop loss in a locality that has been hit by a natural hazard (e.g. flood) is always total, notwithstanding the existence of one or more coping strategies like diversification, plot separation, etc. However, loss to a farmer could be partial under a certain coping strategy assuming, for example that, other crop fields that are spatially separated escape

the carnage. The framework assumes loss on a localized field. The framework bears direct relationship with the research methodology in that all of the variables in respect of the themes under study originates from it. For example, potential of crop insurance is shown to be a function of farmer profitability and preference for the same. Natural hazards to be assessed of their riskiness are vividly shown. More importantly, interrelationship between variables in regard hereof is easily ascertained.

The framework also relates to the study objectives as evidenced by the depicted variable interrelationships. The framework provides a general set-up for the whole subject so that each and every objective is fully represented but for the details. For example, objective one was just about selecting (according to research findings) the respective natural hazards considered important by farmers. The framework duly displays all possible natural hazards. This applies also to objective two, which required riskiness assessment for the same hazards. Objective three was to assess potential for crop insurance and the framework depicts the kind of variables to be studied in order to achieve it i.e. the interrelationship between crop loss, coping mechanisms and crop insurance. The relationships between farmer profitability, farm investment, natural hazards and preference for crop insurance as shown in the framework provide the basis for studying potential of crop insurance in the research area. Most factors studied under objective four are directly represented in the framework save for factors like awareness, age and level of education, which are sourced from literature and logical deductions.

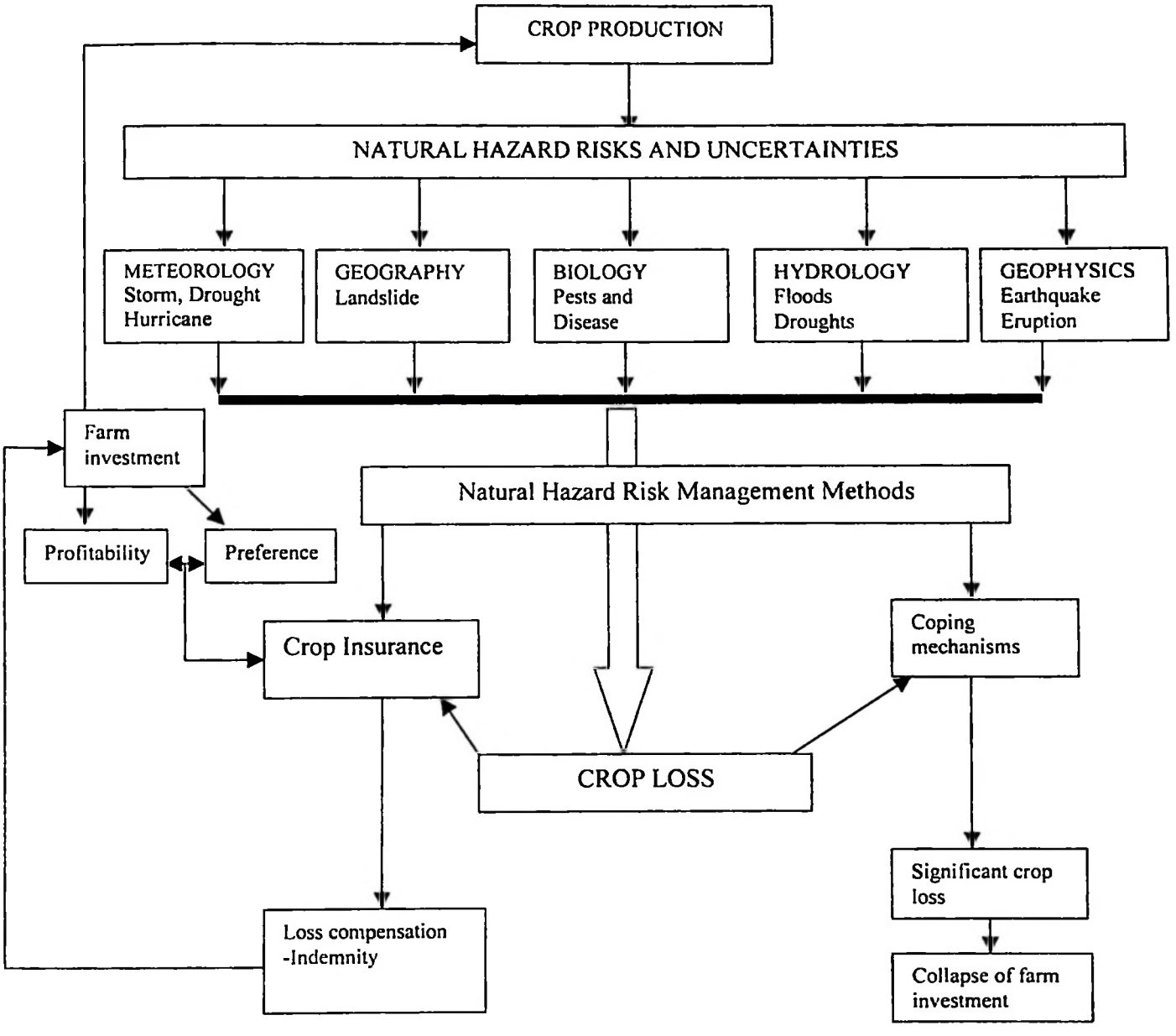

Fig. 3.1: The Research Conceptual Framework: Modified from Rugumamu (1991)

3.5.1 Methods for data analysis

3.5.1.1 Descriptive and qualitative analyses

Descriptive and quantitative analyses were employed in this study based on objectives and hypotheses to be tested. For the descriptive analysis, means, percentages, frequencies, cross tabulations and related statistics such as standard deviation were used.

3.5.1.2 Quantitative analysis

Quantitative analysis involved the use of Gross Margin, Pearson Chi-square (X^2), one way Analysis of Variance (ANOVA), and Regression analysis. These techniques were used to test the hypotheses that; there is no difference in effectiveness of various risk coping strategies between villages in the research area; there is no difference in riskiness of various natural hazards between villages in the research area; there is potential for crop insurance amongst bean farmers in the research area and; there are no influencing factors on crop insurance preference by farmers in the research area (see chapter one). Specificity of each method as relates the testable hypothesis is given below.

3.5.1.3 Gross Margin (GM) analysis

Gross Margin analysis was specifically employed in this study to test the hypothesis that there is potential for crop insurance in the research area. Profitable farmers represent a positive sign to crop insurance potential in the area. This was however complemented by a qualitative analysis to check the proportion of farmers preferring crop insurance in the research area. This is according to the underlying literature as elaborated under section 2.11 of this report.

GM analysis has also been employed on medium scale sugar farmers in Morogoro (Philip, 2001) and specifically on bean farmers in Kigoma (Silomba, 2000). In this study analysis was used to assess profitability of bean farmers in Arumeru District, Eastern province in Arusha region. The data used were directly collected from farmers as the liberalized market leads to every farmer selling his/her output to any competitive buyer. There were no central points like cooperative societies where data could be obtained.

Gross margin for every farmer was the difference between his/her total revenue out of the bean crop and the variable cost attributable to it.

GM=TRi –TVCi

Where;

GM=average gross margin (Tsh/ha)

TRi =average total revenue

TVCi =average total variable cost (Tsh/ha)

3.5.1.3.1 A consideration of the components of the formula

(i) TRi =Total revenue (Tsh/ha)

The yields and selling prices were obtained directly from farmers. Total revenue per farmer was the product of selling price and yield. Selling prices differed between farmers depending on the time of selling. High prices were matched with high total variable costs emanating from incremental storage costs incurred especially on pesticides.

(ii) TVCi = Total variable costs (Tsh/ha)

These were obtained from bean farmers. The cost of each item was accordingly calculated on a per hectare basis. The costs involved include charges for ploughing, harrowing, planting, weeding, and harvesting. Other costs were on land hire, threshing,

grading, packaging, transport, seed purchase, and market levies. Seeds are normally recycled by farmers. However, seed purchase and family labour in various operations were accordingly valued on the applicable rates during 2000/2001 season which was rated a normal/average season by the farmers. Gross margins were calculated for all farmers interviewed. It was the basic unit of analysis in evaluating farmers' profitability. The logical premise is that profit-making farmers will be able to meet insurance cost (premium) if crop insurance is in place.

3.5.1.3.2 Advantages and disadvantages of the GM technique

The key advantages of GM analysis as an economic analytical tool include its easiness to be understood, its ability to draw logical interrelation of economic and technological parameters and its forecasting ability of rational variants for the operational structure of an enterprise (Philip, 2001). It is disadvantaged by its inability to take into account variations in fixed cost structure within and/or among enterprises and its failure to make allowance for complementary and supplementary relationships between enterprises.

3.5.1.4 Regression analysis

Principally, most people dislike risk in the sense that they are averse to risk when faced with significantly risky outcomes. A person who is risk averse will be willing to forgo some expected returns for a reduction in risk. Evidence of farmers' risk aversion is reflected in many of their actions, such as their willingness to buy certain kinds of insurance (Wageningen University, 2003).

Regression analysis in this study was employed to test the hypothesis that preference for crop insurance (CI) in the research area was not affected by such factors like farmers'

profitability, wealth (asset index), farming purpose, farm size, level of education, awareness to crop insurance nor farmers' age. Given a binary dependent variable a binary logistic model (see section 2.11) was used in the analysis.

The model is specified as follows:

$$PCI = \frac{e^{(bo+bjxj+ui)}}{1+e^{(bo+bjxj+ui)}}$$ Where; e = exponent

For estimation purposes, the model was transformed into:

$$\frac{\ln(PCI)}{(1-PCI)} = bo + bixi + ui$$

Where;

PCI=Preference for crop insurance ; 1= preferring; 0 = otherwise

bo = intercept

bi's= propensities of independent variables

xi's= Independent variables (profitability, wealth (asset index), farming purpose/ objective, farm size, level of education, awareness to crop insurance and farmers' age).

μi =Disturbance term

3.5.1.4.1 A Consideration of independent variables of the regression analysis

(i) Profitability

Profitability in this study has been tested by gross margin analysis. Profitability is thought to be a factor/variable in the relationship in that profitable farmers are more likely able to meet insurance costs. The more profitable the farmer is, the more likely he/she is to opt for insurance. It is thus expected to have a positive sign in the relationship. In the model, profitability was considered in categorical basis (see table 7).

Table 7: Gross margin analysis categories

Category number	GM range (Tsh/ha)	Description
1	<0	Loss makers
2	1.0-50,000	Low profit
3	50,001-100,000	Average profit
4	>100,000	High profit

(ii) Asset index

Calculation of asset index followed the procedure adopted by Senkondo (2000) for Babati farmers. Seventeen items of durable assets were included in the questionnaire (see the section on capital). The respondents were asked to indicate the number of durable items owned, the initial value and the expected useful life. The index was then calculated using the following formula:

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

Where; AI =Asset index

n=number of assets /items 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 asset index is the proportion of the remaining value of the assets summed over all the assets owned. For purposes of depreciation, salvage value of every asset was assumed zero. The index was adopted to give an indication of the wealth status of farmers. It was expected that, the wealthier the farmer be, the less likely to opt for insurance (Hardaker, *et al.*, 1997). The variable was thus expected to have a negative sign in the equation. The following categorization was adopted in incorporating the index in the regression equation.

(iii) Farming purpose

Crop insurance's scope is mainly on commercial farming operations (Gudger, 1991). It is incorporated in the regression equation as a dummy variable: 0 = farming for subsistence purposes and 1= farming for commercial purposes. It is thus expected to have a positive sign.

Table 8: Asset Index categories

Category number	Index range
1	<0
2	1 – 50,000
3	50,001 –100,000
4	100,001 –500,000
5	>500,001

(iv) Farm size

It is expected that as farm size increases, investment on the farm also increases. This means that financial commitments in terms of level of investment on the farm increases with size. It was thus expected that farmers with large farms are more likely to go for insurance. The variable was thus expected to be positively signed.

(v) Level of education

Educated farmers are more likely to be aware of the benefits of crop insurance in managing production risks. They are thus more likely to transfer the risks they face to a third party like an insurer than their uneducated counterparts. The variable was thus expected to be positively signed. Its incorporation in the model was through the categories shown in table 9 below:

Table 9: Education level categories

Category	Description
1	No formal education
2	Adult education
3	Primary education
4	Secondary education
5	College qualification

(vi) Awareness

Awareness of crop insurance and its potential for managing agricultural production risks determines farmers' preference for crop insurance (Ray, 1991). Awareness of crop insurance was thus expected to take a positive sign in the regression equation. It was incorporated in it as a dummy variable: 1= aware; 0= not aware.

(vii) Age

Risk averse nature is logically expected to increase with age i.e. young farmers are more willing to take risk than old farmers. Old generation are thus expected to go for a risk transfer mechanism like crop insurance faster than the young generation. However, on the other hand, elders are slower in adopting new technologies. In the Tanzania case, where crop insurance has never been operating, the second situation (early adoption by young generation) might be more applicable. The variable was thus expected to record a negative sign in the regression equation. The following categories in Table 10 went into the regression equation;

Table 10: Age categories

Category	Age range (Years)	Description
1	18 -35	Youths
2	36 -60	Adults
3	>60	Elders

The general picture of the whole range of independent variables in the regression equation is summarized in table 11 below.

Table 11: Summary of independent variables used in regression analysis

Variable estimated	Description	Expected sign of coefficients
Farm size	Hectares	+
Education level	Categories	+
Profitability	Categories	+
Asset index	Categories	-
Farming purpose	Dummy variable	+
Awareness	Dummy variable	+
Age	Categories	-

3.5.1.5 One-Way analysis of variance (ANOVA)

ANOVA was used to test statistical significance of Gross Margin means between villages.

3.6 Limitation of the study methodology

The limitations of the study methodology emanated from the areas of budget, data availability and reliability, and inadequate reference material for literature review. Each component is discussed further below:

(i) Budget constraint

The available budget for this research was not enough to suit coverage of a significant portion of the district area that is famous in bean production. The coverage was thus not the best representative of the District's position in this respect.

(ii) Data availability and reliability

Crop insurance potential could be well assessed where disaggregated agro-climatic data are available. Long series data in respect of crop losses disaggregated into respective natural hazard(s) causing them, proved to be unavailable even at the Ministry level. This has had a negative impact in the assessment of the hazards' riskiness nationally.

Moreover, most data were collected from farmers. Tanzanian farmers do not keep farm records thus their responses depend on their memories of the respective issues. Such data can hardly be fully reliable. Farmers under this study had the same shortcomings thus reliability of the collected data could somehow be carrying the same weakness.

(iii) Inadequacy of reference material

Crop insurance has never been operated in Tanzania. Research on it has also been limited not only in Tanzania but also on the global scale. It was thus very difficult to access relevant materials appertaining to the theme of this study.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Overview

This chapter presents the empirical findings of this study from the survey data. The findings are presented in a way that allows for logical flow of ideas as governed by study objectives and hypotheses.

4.2 Socio-economic characteristics of the respondents

Socio-economic characteristics are important attributes of any society as they reflect its behaviour in decision making and its probable expected responses to many stimuli exposed to it. Socio-economic characteristics of the sampled farmers are summarized in Table 12. From the results (table 12), it is evident that mostly farmers aged between 36 years to 60 years practice bean farming in the research area. This category constituted about 55.2 percent of the farming community followed by the youth category of between 18 to 35 years that made about 42.2 percent of the interviewed farmers. The category of old people (above 60 years) was only 2.6 percent of the farmers. Inter-village differences also followed the same trend. These results were quite expected as the leading group above is normally well endowed with resources, experience and energy needed to pursue farming. The second category is very energetic but somehow lacking in resources and experience. The last category is the most ill placed in terms of the three prerequisites to farming hence the observed trend.

Female interviewees were only 7.8 percent of the overall respondents whereas the rest 92.2 percent were males. This observation is characteristic of most African cultures, which, in most cases, deny women of resources ownership in favour of their male

counterparts. This is characteristic of most patriarchal African societies. Economic activities are thus mainly male dominated. In the research area, tribal culture of Wameru is equally suppressive in terms of female ownership of economic resources. This is exacerbated by the fact that land is inherited only by sons and never by daughters. Women are thus dispossessed and denied fair participation in various economic pursuits by the very social fabric in which they live.

Bean farmers in the research area were moderately educated in that about 73 percent had completed primary school education. Secondary school leavers constituted about 19.1 percent while tertiary education qualifiers were only 0.9 percent. This is a very encouraging observation as illiterates and semi illiterates were about 7 percent. The national adult literacy average is 71 percent thus national illiteracy level is about 21 percent (NBS, 2002). Farmers with this level of education are good at adopting modern innovations given conducive farming environment. This applies also to innovations like crop insurance. Ray (1967) underscored the minimal scope of crop insurance under situations of high levels of illiteracy and abject poverty.

A notable feature of the respondents was their multiple income sources. Majority of them, about 87 percent and 8.6 percent depend on sale of food and cash crops as their income sources respectively. The other major income source is the sale of livestock and livestock products that was recorded by 27.6 percent of the farmers. Other sources like wage employment and other off –farm activities were minor and practiced by very few farmers. These multiple sources are a risk response measures which are aimed at cushioning the shock of loss in one source through diversification.

Majority of the respondents (over 65 percent) cultivate between 0.5 to 2.5 hectares. This again is characteristic of Tanzanian agriculture, which is dominated by smallholders. This suggests that agricultural policy advices in Tanzania should target smallholder farmers if they are to make any significant impact in the sector. Considerations in respect to crop insurance should also be equally and purposely directed.

Table 12: Distribution of socio-economic characteristics by village

Characteristic	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
	% of respondents			
Age category				
18-35 years	47	36.7	40.0	42.2
36-60 years	52.2	63.3	52.5	55.2
>60years	0.0	0.0	7.5	2.6
Gender of respondent				
Male	8.7	16.7	0.0	7.8
Female	91.3	83.3	100.0	92.2
Level of education				
Non-formal éducation	0.0	10.0	0.0	2.6
Adult education	2.2	13.3	0.0	4.3
Primary education	62.2	70.0	87.5	73.0
Secondary education	33.3	6.7	12.5	19.1
Tertiary education	2.2	0.0	0.0	0.9
Sources of income				
Sale of food crops	97.8	83.3	77.5	87.1
Sale of cash crops	0.0	13.3	15	8.6
Sale of livestock & livestock products	19.57	33.3	32.5	27.6
Wage employment	2.2	0.0	0.0	0.9
Other off-farm activities	0.0	0.0	2.5	0.9
Cultivated farm size				
0.1 – 2.5 ha	67.4	66.7	62.5	65.5
2.6 – 5.0 ha	15.2	10.0	22.5	16.4
5.1 – 7.5 ha	10.9	3.3	2.5	6.0
> 7.5 ha	6.5	20.0	12.5	12.1

4.3 Bean production in the study area

Traditionally, agricultural production has been merely centred on the cultivation of bean and maize crops as the major staples in the study area. However, traditional farming was only meant to meet subsistence needs as contrasted with the contemporary farming which has a more commercial outlook. Traditional bean farming in the area was thus characterized by use of local seeds namely *nkatuvela* and *nkanamuna*. The current commercial drive has seen the intensive use of exotic and improved bean varieties. The common varieties in use at present are Canadian wonder and Soya bean seeds.

Both small and medium scale farmers cultivate bean. The former group are the majority. The overall average cultivated area per farmer is 5.13 hectares and the average yield per hectare is 765.2 kg/ha. Both variables are characterized by large standard deviations reflecting existing differences between individual farmers as shown in table 13 below. The above grain yield rate is 50 percent lower than the regional average, which stands at 1,571 kg/ha and 1,656 kg/ha for male and female-headed households respectively. The reported land holding is however above the National average of 4.0 hectares. Small-scale farms comprise holdings between 0.01 ha to 20 ha (NBS and MAC, 2000).

Table 13: Average bean production and area under cultivation by village

Variable	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
Grain production (kg/ha)*	795.9	581.3	867.8	765
	(283.4)	(365.9)	(248.8)	(314.7)
Cultivated area (ha)*	6.7	4.2	4.0	5.13
	(24.1)	(5.7)	(5.9)	(15.8)

* Figures in parentheses are standard deviations

4.4 Natural hazard risks in bean cultivation in the study area

During the survey, farmers were asked to indicate their perceived natural hazard risks in their farming operations. The results of their responses are shown in table 14 below.

Table 14: 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

X^2 = Significant at 0.020

In overall terms, the results suggested that the major natural hazard risk in all villages was that of crop pest infestation and disease epidemics. The incessant problem of premature senescence, defoliation, yellowing of leaves and stunted growth have been finally diagnosed as being caused by a pest known as *Ootheca bennigseni.* This problem had since puzzled farmers as to its cause as it is always aggravated by drought conditions. It is thought to have crossed to the area from the nearby Hai district, which had been seriously affected during 1998 – 2000. Seedling mortality and damping off are other disease problems in the area that are caused by the Bean maggot *Ophiomyia spp.* Notwithstanding the prevailing situation farmers were unhappy with the inadequate supply of agro-chemicals in the area.

Drought seems to be an equally important risk to Malula/Kolila village affecting about 46.4 percent of the respondents. Relatively, drought impact is minimal in Kwa Ugoro village affecting only 11.1 percent while pest and diseases are most intense in the same

village and Kikatiti. The low drought threat in Kwa Ugoro village is accounted by the existence of irrigation scheme due to its locational advantage.

The information regarding the natural hazard risk affecting a particular village has to be obtained from the specific data of the respective village as general conclusions might not give a very true picture as already seen above. This is further justified by the fact that independence between perceived natural hazard risks and villages (location) as tested on a chi- square test, was found to be statistically significant at $p \leq 0.05$ level. Such results were also found to apply to twenty researched regions in Tanzania (PMO, 2001). This suggests that some hazards are location specific.

However, among the mentioned hazards, crop pests and diseases is considered to be a farm management problem and thus it is not strictly insurable (Hazell, 1991; Ray, 1967). Drought is a meteorological hazard that is quite insurable (NIC, 1986; Lema, 1987). Potential for crop insurance is thus envisaged for drought stricken farmers.

4.5 Riskiness of natural hazards in the research area

During the survey, farmers were asked to assess the riskiness of various natural hazards according to their own experience and perception of each particular hazard. Farmers' assessment was based on the extent and ability of a hazard to cause crop loss thus both severity and frequency of the hazard concerned were taken into consideration. The most severe hazard was assessed 'very risky' and the least severe was assessed as either 'moderately risky' or 'not risky'. The results of the assessment are summarized in table 15 below.

From the findings of table 15, it is vividly clear that drought hazard was the riskiest of all in overall terms followed by crop pests and diseases. Flood, windstorm and landslides & eruptions were not risky in the research area as they hardly occur. The situation is however different when individual villages are examined. Floods for example, were moderately risky in Malula/Kolila village while of no significance in the other two villages. Also, pests and diseases were not a major problem in Malula/Kolila as compared to Kwa Ugoro and Kikatiti villages. This observation further cements the earlier observation on location specificity based on bio-physical and ecological characteristics.

Chi-square test results for the independence between riskiness assessment of natural hazards and villages (locations) revealed high statistical differences ($p \leq 0.01$) in respect to flood, drought and pests and diseases hazards.

Table 15: 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	Very risky	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	Very risky	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	Very risky	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	Very risky	0.00	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	Very risky	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

The associations in respect to windstorms and landslides & eruptions were however statistically insignificant. The null hypothesis that there is no difference in risk assessment between villages under study was thus rejected in respect to the former three hazards and accepted in respect to the latter two natural hazards.

Riskiness assessment of natural hazard is important in the consideration of crop insurance potential since farmers and insurers ought to know the riskiest hazard(s). This knowledge is important in determining insurability of the respective risk(s) given its nature and its selection among others. In most cases insurers are willing to insure specific hazard risks rather than all risks if crop insurance schemes are to be viable (Gudger, 1991).

From the findings in table 15, it could be said that farmers would like to manage drought hazard since it was the riskiest. However, this could not be the priority of the farmers. In trying to assess the farmers' priority in this regard, the study asked them to indicate the hazard they would mostly prefer to manage of all the others affecting them. The results are summarized in table 16 below.

The results (Table 16) suggest that farmers' priority, in overall terms, is to manage crop production risks emanating from pests and diseases as reported by 51.7 percent of respondents. In specific terms, Malula/Kolila farmers would rather prefer to manage drought risks before the others as voted by 73.3 percent of the farmers.

Table 16: Most preferred natural hazard risk for management by village

Risk	Management preference			
	Kwa Ugoro (n = 46)	Malula/ Kolila (n = 30)	Kikatiti (n = 40)	Overall (n = 116)
	% of respondents			
Flood	2.2	13.3	0.00	4.3
Drought	37.0	73.3	30.0	44.0
Pests & Diseases	60.9	13.3	70.0	51.7

X^2 = Significant at 0.000

Kwa Ugoro and Kikatiti villagers both reported pests and diseases risks as their priority choice for management. This preference has a bearing on the potential for crop insurance in the research area. Drought risks are insurable as contrasted by pests and diseases risks (Hazell, 1991; Ray, 1967,1991; Gudger, 1991, NIC, 1986, Lema, 1987). In this understanding, *ceteris peribus,* Malula/Kolila farmers are thus likely to benefit from crop insurance than otherwise. However, the relationship between the risk management preference and the type of risk management method to be adopted might not be that simple in real terms. The intricacies of the process will be apparent later in the chapter.

4.6 Agricultural risk coping mechanisms in the research area

Farmers in the research area, like any other farmers in Tanzania, have developed various risk coping and risk reducing strategies in trying to come to terms with the debilitating effects of natural hazards.

The study was interested in assessing the effectiveness of the most common risk coping and risk reducing strategies used in the research area. The risk coping strategies to be assessed ranged from diversification to non- farm activities, agro forestry, and spatial separation of farming plots, diversification into other crops to minimum investment strategies. Risk reducing strategies included sale of assets, borrowing from neighbours, temporary wage employment, remittances from relatives and government relief. The assessment was carried out by asking the farmers to indicate whether a strategy is very effective, moderate or not effective in managing natural hazard risks. The results of the assessment for each strategy are presented from table 17 to 28.

4.6.1 Diversification to off- farm activities

Indulgence into off- farm activities in addition to farm activities is a good measure to hedge against agricultural production risks. This is a diversification move that assures farmers of their income even under total crop loss due to natural hazards. In the study area, this strategy takes the form of livestock keeping, permanent wage employment and operation of self-liquidating merchandize businesses at varying levels and extents depending on the capital position and location of the farmer.

In overall results, the strategy was assessed to be ineffective by 63.5 percent of the respondent farmers. Only 8.7 percent of the farmers assessed it to be very effective while 21.7 percent reported as moderately effective. Specifically, Malula/Kolila assessed the strategy as effective while Kwa Ugoro and Kikatiti thought it to be ineffective. The reason for this observation is attributed to the nature of farmers in Malula/Kolila area (West of Kilimanjaro International Airport). Most of these farmers are businesspersons and office employees from nearby Moshi and Usa- River towns in Kilimanjaro and Arusha regions respectively. These farmers are taking bean farming as a side line income generating source hence the observed assessment. Farmers in the other two villages mostly depend on agriculture as their major source of income. Such differences could explain for the observation that statistically, the assessment of this strategy between the villages was highly significant at $p \leq 0.01$ level on a chi-square test. The summary results are shown in table 17 below.

Table 17: Assessment of effectiveness of diversification to off-farm activities strategy by village

Strategy	Assessment	Ugoro (n = 46)	Malula/ Kolila (n = 30)	Kikatiti (n = 40)	Overall (n=116)
		% of respondents			
Diversification to off-farm activities	Very effective	2.2	30.0	0.00	8.7
	Moderately effective	6.5	66.7	5.1	21.7
	Not effective	84.8	0.00	87.2	63.5
	Not applicable	6.5	3.3	7.7	6.1

X^2 = Significant at 0.000

4.6.2 Agro forestry

Agro forestry is a type of mixed cropping that involves association of tree crops and annual crops. It has advantage in productive efficiency and risk reduction.

Falconer (1990) has pointed to the supplementary role, the seasonal importance and the buffer food and cash sources for emergencies of tree products. This buffer stems partly from the flexibility of the harvesting schedule (Guggenheim and Spears, 1991). Ranganathan *et al,*. (1991) have observed that a positive interaction between the tree and agricultural component of an agro forestry system only occurred in a year with drought. Food security is considered as an important reason for the implementation of agro forestry projects in developing countries. In the study area agro forestry involves cultivation of pigeon peas with the annuals (mainly maize and beans).

In overall results, agro forestry was assessed as being moderately effective by 58.3 percent of the farmers. The trend across villages was also the same in that majority of the respondents assessed the strategy as being moderately effective. Based on the Chi-

square test, the assessment between villages was not statistically significant at $p \leq 0.05$, suggesting that the strategy is equally perceived in all villages surveyed. This homogeneity is hinged on the fact that Sasakawa global 2000 sponsored agro forestry promotion activities operate in the research area. In this programme, farmers are encouraged to intercrop their bean crop with pigeon peas (*Cajanus cajanus*). Farmers' experience and perceptions on agro forestry are thus likely to be the same under this arrangement hence the observed results. The summary results on this strategy are presented in table 18 below.

Table 18: Assessment of effectiveness of agro forestry strategy by village

Strategy	Assessment	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
		% of respondents			
Agro forestry	Very effective	4.3	6.7	2.6	4.3
	Moderately effective.	67.4	46.7	56.4	58.3
	Not effective	26.1	36.7	38.5	33.0
	Not applicable	2.2	10.0	2.6	4.3

X^2 = Significant at 0.406

4.6.3 Spatial separation of farming plots

Spatial separation of farming plots is normally adopted as a risk reducing strategy on the assumption that occurrence of a natural hazard will not devastate all of the plots at the same time. This separation is more effective if the plots are situated in different ecological zones. In the study area separation was observed to occur in two ways. In the first instance, some farmers have, especially from Kikatiti village, plots in the nearby highland areas of Sakila village. In the second instance farmers from Kwa Ugoro and

Kikatiti villages have plots from both sides i.e. lower and middle belts respectively. This arrangement takes the advantage of the available irrigation water in the lower belt in event of a drought strike. The incentive for lower belt farmers to maintain plots in the middle zone is to hedge against possible flood damages which are, nonetheless, very sporadic. The striking observation was however on Malula/Kolila farmers who recorded no single respondent neither owning nor hiring more than one farming plot. This could be explained partly by the prevailing land pressure due to ever growing population and partly by the nature of the farming community who are mainly part timers. The farmers with more than one farming plot across the villages are shown in table 19 below

Table 19: Farmers with more than one farming plots by village

Number of plots	Kwa Ugoro (n=46)	Malula/ Kikatiti (n=30)	Kikatiti (n=40)	Overall (n=116)
	% of respondents			
2	34.8	0.00	10.0	17.2
3	8.7	0.00	7.5	6.0

The assessment of spatial separation of plots as a coping strategy followed the same trend like that of agro forestry. The only difference was that, unlike in agro forestry, chi-square test for effectiveness assessment of this strategy between villages was highly significant ($p \leq 0.01$). The probable reason for this could be the fact that this strategy is practiced by very few farmers at different levels in terms of number of plots involved and distances between them due to unavailability of requisite land area. In these circumstances, farmers' assessments are likely to differ, as their experiences on the strategy are also very diverse.

Inter-village differences in the assessment were quite interesting in that majority (over 50 percent) of respondents in Kwa Ugoro and Kikatiti assessed the strategy as moderately effective whereas the same proportion of Malula/Kolila farmers assessed it ineffective. These observations were quite expected on the strength of the fact that the latter farmers do not practice this strategy in their farming operations while the former do. Kwa Ugoro and Kikatiti farmers had thus similar experiences on the strategy as contrasted with their counterparts in Malula/Kolila. The summary results are presented in table 20 below.

Table 20: Assessment of effectiveness of spatial separation of farming plots strategy by village.

Strategy	Assessment	Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
		% of respondents			
Spatial separation of farming plots	Very effective	8.7	6.7	28.2	14.8
	Moderately effective	54.3	10.0	61.5	44.3
	Not effective	34.8	60.0	10.3	33.0
	Not applicable	2.2	23.3	0.0	7.0

X^2 = Significant at 0.00

4.6.4 Diversification to other crops

Diversification to other crops is a risk reducing strategy that involves growing other crop(s) beside the main one on the assumption that failure in one crop will be countered by a success in the other(s). This can be done under intercropping or even under pure stands whichever is in preference. In the study area, intercropping was the major

prevailing form. Intercropping of maize, beans and pigeon peas was the major observed mixture. Almost all respondent farmers were found to intercrop maize and beans. This was hardly for risk management but for a balanced crop to meet their staples needs. There was only a single case of reported intercropping between coffee and banana from a farmer at Kikatiti village owning a farm plot at Sakila village. Sunflower was found to be grown in pure stands but that does not necessary mean separate plots.

This strategy was branded ineffective by over 50 percent of the respondents. Assessment between villages was statistically different at $p \leq 0.01$ on a Chi square test. The average number of crops per plot in the research area was two and in most cases the intercropping was between beans and maize or beans and pigeon peas. In my opinion, such a combination is not likely to hedge against natural hazard destruction, as the involved crops are equally susceptible to drought, pests and diseases. In the event of them being grown on the same plot, they will both succumb to natural hazard devastation. The observed results were thus expected. This strategy can only be effective if it is combined with the spatial separation of plots strategy. It is very likely that farmers who noted it as being effective were those with more than one plot. The summary results are presented in table 21 below.

Table 21: Assessment of effectiveness of diversification to other crops strategy by village.

Strategy	Assessment	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
		% of respondents			
Diversification to other crops	Very effective	8.7	3.3	2.6	5.2
	Moderately effective	45.7	10.0	51.3	38.3
	Not effective	43.5	73.3	46.2	52.2
	Not applicable	2.2	13.3	0.00	4.3

X^2 = Significant at 0.001

4.6.5 Minimum Investment

Minimum investment is a risk reducing strategy that is used by risk averse farmers to cut down possible losses through investing only the barest minimum inputs of production (Abada, 1991). The assumption is that, the losses in case of occurrence of a risky hazard will only be commensurate with the investment level. This strategy normally leads to low productivity.

In the research area, minimum investment strategy was mainly reflected in the uncultivated portions of farmers' plots. However, other plots were left uncultivated to allow them to fallow rather than for managing natural hazard risks. Commercial oriented farmers argued that they would only leave portions of their farms uncultivated for lack of adequate capital but not for fear of natural hazard risks.

The strategy was almost equally reported as being moderately effective and ineffective by 47.8 and 44.3 percent of respondents respectively. The assessment between villages was highly significant statistically ($p \leq 0.01$) probably due to the above perception differences. Summary results are presented in Table 22 below.

(vi) Sale of assets

This is a risk coping strategy that farmers adopt in trying to come to terms with the aftermath of a risky hazard occurrence. An asset acquired earlier is sold to compensate for a current loss of income due to an unexpected crop loss. The assumption is that such a sale will carry them through the temporary adverse conditions before resuming productions in ensuing seasons. It is thus a self–compensating mechanism.

Table 22: Assessment of effectiveness of minimum investment strategy by village.

Strategy	Assessment	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
		% of respondents			
Minimum	Very effective	4.3	6.7	2.6	4.3
Investment	Moderately effective	60.9	3.3	66.7	47.8
	Not effective	32.6	80.0	30.8	44.3
	Not applicable	2.2	10.0	0.00	3.5

X^2 = Significant at 0.000

This strategy was reported to be very effective compared to other strategies discussed before. Its self-compensating nature could be the probable explanation for this observation. About 24.3 percent of all respondents reported it as very effective, highest being at Kikatiti and Kwa Ugoro (Table 23). However, the major portion of the respondents (about 31.3 percent) reported it as ineffective. Across the villages, 73.3 percent of farmers in Malula/Kolila noted it to be ineffective. This is explained by the fact that these farmers are mostly part timers in farming. Their other income generating activities like merchandize business could be better solutions to the problem of crop failure than selling own asset(s) hence the observed response. More important though, is the fact that the assessment between villages was found to be highly significant statistically ($p \leq 0.01$) on a chi-square test. The summary results are presented in table 23 below.

Table 23: Assessment of effectiveness of sale of asset strategy by village

Strategy	Assessment	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
		% of respondents			
Sale of	Very effective	28.3	6.7	33.3	24.3
Assets	Moderately effective	23.9	3.3	20.5	17.4
	Not effective	23.9	73.3	7.7	31.3
	Not applicable	23.9	16.7	38.5	27.0

X^2 = Significant at 0.00

4.6.7 Borrowing from neighbours

This is another risk coping strategy that relies on borrowing from neighbours to hedge against a temporary adverse situation emanating from crop loss due to natural hazards. Its effectiveness will thus depend on one's relationship with neighbours and the latter's ability to grant credit(s) sought.

In overall terms, the majority i.e. 43.5 percent of the respondents noted the strategy as ineffective. About 42.6 percent of the respondent farmers assessed it as being moderately effective. Assessment between villages was highly significant statistically ($p \leq 0.01$). The summary results are presented in table 24 below.

Table 24: Assessment of effectiveness of borrowing from neighbours strategy by village

Strategy	Assessment	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
		% of respondents			
Borrowing from Neighbours	Very effective	10.9	0.00	2.6	5.2
	Moderately effective	45.7	6.7	66.7	42.6
	Not effective	39.1	66.7	30.8	43.5
	Not applicable	4.3	26.7	0.0	8.7

X^2 = Significant at 0.000

4.6.8 Temporary wage employment

Temporary wage employment is a risk coping strategy that provides for an alternative income source to farmers in bad years. It entails temporary labour hiring in working temporary jobs in return for a wage. It can take a form of a hired job in either another farmer's field/enterprise or in any other prospective employers' enterprise within the farmers' vicinity.

The strategy was reported as being moderately effective and ineffective by 47.0 and 43.5 percent of the total respondents respectively. The assessment between villages was likewise significant statistically ($p \leq 0.01$) on a chi square test. The different perceptions on the strategy across the villages were due to difference in farmer type between the villages. For instance, Malula/Kolila farmers are part timers while the rest are full time farmers. The importance attached to the strategy in each village is thus likely to differ hence the observed difference. The assessment results are summarized in table 25 below.

4.6.9 Dependence on remittances

Remittance as a risk coping strategy exploits the presence of well-to-do relatives who are able to salvage the position of farmers in cases of adverse situations of crop loss. The prospective relatives are mostly educated daughters, sons and other kinsmen working in urban centres on salary employments. Few of these relatives can also be businesspersons.

Table 25: Assessment of effectiveness of temporary wage employment strategy by village

Strategy	Assessment	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
		% of respondents			
Temporary wage employment	Very effective	6.5	0.0	2.6	3.5
	Moderately effective	60.9	6.7	61.5	47.0
	Not effective	30.4	73.3	35.9	43.5
	Not applicable	2.2	20.0	0.0	6.1

X^2 = Significant at 0.00

In overall terms, this strategy was reported inefficient by 58.3 percent of the respondents. However, about 53.8 percent of Kikatiti village farmers assessed it to be moderately effective. These farmers could probably be having prospective relatives in various towns hence the response. The assessment between villages was highly significant statistically ($p \leq 0.01$). The results are summarized in table 26 below.

Table 26: Assessment of effectiveness of remittances strategy by village

Strategy	Assessment	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
		% of respondents			
Remittances	Very effective	0.0	0.0	0.0	0.0
	Moderately effective	30.4	10.0	53.8	33.0
	Not effective	65.2	70.0	41.0	58.3
	Not applicable	4.3	20.0	5.1	8.7

X^2 = Significant at 0.001

4.6.10 Dependence on Government relief

Government relief is another risk coping strategy that involves provision, by the government, of humanitarian aid to disaster victims of a natural hazard strike. Its effectiveness depends very much on whether the government budget is allowing (Ray, 1991). It is thus offered to farmers on a charity basis not as a right.

The strategy was reported not effective and moderately effective by 37.4 and 41.7 percent of the respondents respectively. The assessment between the villages was also highly significant statistically ($p \leq 0.01$) on a chi-square test. The results are summarized in table 27 below.

Table 27: Assessment of effectiveness of government relief strategy by village

Strategy	Assessment	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
		% of respondents			
Government Relief	Very effective	4.3	0.0	2.6	2.6
	Moderately effective	41.3	10.0	53.8	37.4
	Not effective	39.1	63.3	28.2	41.7
	Not applicable	15.2	26.7	15.4	18.3

X^2 = Significant at 0.009

4.7 General discussion on the coping mechanisms' effectiveness assessment

The above results have shown that farmers are very clear of the inherent inability of each risk coping and risk reducing strategy in hedging effectively against natural hazard risks. The weaknesses seem to differ from one strategy to another as suggested by the observed trend of assessment responses. In technical terms, this is the central point against which risk–pooling mechanisms like crop insurance are suggested for societies so as to supplement these traditional strategies. Hazell (1991) has put this argument clear and insisted that the failures of these traditional methods emanates from the covariability nature of agricultural risks. The observed results are thus indicative of the need for such supplementation to the bean farmers in the research area. The general picture of the assessment of the effectiveness of the risk-coping and risk-reducing strategies is shown in Table 28 below.

Another important general observation from the general findings is that the assessment of the strategies, with the exception of agro forestry, differs significantly between the villages as evidenced by the results of the statistical chi-square test. This is indicative of the farmers' differing perceptions on the strategies across the villages as governed by their long time interactive experience with the environment in which they live.

4.8 Potential for crop insurance in the research area.

This section presents results in respect to responses from both the farmers and insurers. Among the variables concerned include; farmers' awareness to crop insurance, willingness to insure crops by both parties, land ownership by farmers and general insurers' opinions regarding feasibility of crop insurance in Tanzania.

Table 28: General results of the assessment of 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 plot separation	63.0	16.7	89.7	37.0	83.3	10.3	59.1	40.9
Diversification to 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

* A merger of 'very effective' + 'moderately effective' categories

** A merger of 'not effective' + 'not applicable' categories

4.8.1 Farmers' awareness to crop insurance

The survey established that farmers' awareness to crop insurance across the researched villages was very poor. Overall, only 16.4 percent of the respondents claimed to be aware. This is quite an unhealthy situation in terms of assessing the existing potential of crop insurance in the research area. According to Abada (1991), the scope of crop insurance is minimal to farmers who are unaware of it as they would not be able to ascertain its benefits. However, this unawareness is mainly accounted for by lack of crop insurance scheme not only in the research area but in the whole country. Awareness between villages was not statistically different. The summary results are presented in table 29.

Table 29: Awareness to crop insurance by village

Awareness to crop insurance	Kwa Ugoro (n = 46)	Malula/ Kolila (n = 30)	Kikatiti (n = 40)	Overall (n = 116)
	% of respondents			
Yes	19.6	13.3	15.0	16.4
No	80.4	86.7	85.0	83.6

X^2 = Significant at 0.741

4.8.2 Preference for crop insurance

Survey results revealed that majority of the respondent, about 76.7 percent, were in favour of crop insurance. This was quite unexpected given the above unawareness. The only explanation could be that the farmers are overwhelmed by the general understanding that insurance is for compensating suffered losses. This specifically explains the desperate position of farmers against losses due to natural hazards and thus underscores the inherent potential for crop insurance in the research area. Theory suggests that potential demand for crop insurance is a function of having a large section

of farmers with psychological urge for it and a need to satisfy that urge (Ray, 1967; Hazell, 1991). It is further suggested that such farmers should be capable to meet the costs of insurance a question that is answered later in the chapter. Summary results are presented in table 30. Preference for crop insurance between villages was not significant at $p \leq 0.05$ level. This implies that responses in all villages were not different. Moreover, large sections of farmers in all villages had preference for crop insurance.

Table 30: Preference for crop insurance by village

Prefer crop insurance	Kwa Ugoro (n = 46)	Malula/ Kolila (n = 30)	Kikatiti (n = 40)	Overall (n = 116)
	% of respondents			
Yes	84.8	70.0	72.5	76.7
No	15.2	30.0	27.5	23.3

X^2 = significant at 0.243

4.8.3 Preference ranking of natural hazard management methods

After ascertaining the general preference status of farmers for crop insurance, the study went further to establish their preference ranking of four methods of natural hazard management. The sought information was meant to supplement the information on crop insurance preference. In essence, the approach aimed at assessing the actual importance that farmers in the research area attach to crop insurance as a natural hazard risk management method relative to the other available options. The summary results are shown in table 31.

In general results, traditional coping strategies were recorded as the most important as reported 73.0 percent of the respondents. Crop insurance was second with 21.7 percent

of the respondents. In specific terms, Malula/Kolila village had about 70 percent of its respondents voting for crop insurance as their first choice. These results are very positive in suggesting that there is potential for crop insurance in the research area. Presumably, the ranking could have been significantly improved in favour of crop insurance if awareness was a bit higher.

Table 31: 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

X^2 = Significant at 0.01

4.8.4 Land ownership

Land holdings of the farmers in the study villages were found to be either farmer owned or leased. The owned holdings are held under either customary laws or village governments offer. No holding was legally held under land ordinance cap.334 (i.e. long time lease under legal right of occupancy). In crop insurance terms, this is not a healthy situation because untitled ownerships pose difficulties in assessing the insurable interest of insured farmers on the land holding concerned (Mehr and Cammack, 1966).

In Tanzania, the recent land reforms under Land act 1999 have vested the power of issuing rights of occupancy to villagers on the respective village councils. These are very positive and important developments in preparing the ground for possible launching of crop insurance. The results of land ownership status are summarized in table 32 below.

Table 32: Land Ownership status by village

Ownership status	Kwa Ugoro (n=46)			Malula/Kolila (n=30)			Kikatiti (n=40)		
	Plot 1	Plot 2	Plot 3	Plot 1	Plot 2	Plot 3	Plot 1	Plot 2	Plot 3
Hired	8.7	65.0	33.3	6.7	0.0	0.0	22.5	14.3	33.3
Under customary law	91.3	30.0	66.7	73.3	0.0	0.0	72.5	42.9	66.7
Allocated by Village government	0.0	5.0	0.0	20.0	0.0	0.0	5.0	42.9	0.0

4.9 Insurers' opinions on the potential of crop insurance in Tanzania

4.9.1 Feasibility of crop insurance in Tanzania

The survey tried to get an indication from the insurance agents as to whether crop insurance is feasible in the Tanzanian context. The findings are summarized in table 33.

Table 33: Feasibility of crop insurance in Tanzania

Feasibility	Count frequency of Insurers (n=8)	Percentage
Yes	1	12.5
No	3	37.5
Indifferent due to lack of a thorough market study	2	25.0
No comment	2	25.0

From the table above, it is clear that many insurers are pessimistic about the feasibility of crop insurance in Tanzania. Only a single insurer out of eight interviewed (i.e.12.5 percent) thinks that crop insurance is feasible in the Tanzania context. Those who had negative opinions gave a number of reasons for their pessimism such as high risk involved in agriculture, low technology, lack of market and low demand from farmers. Others include lack of reinsurance, lack of experience, inability to meet premium cost and fear of moral hazard (Table 34). Each of the given reasons above is discussed below to assess its relevance in the Tanzanian context.

(i) High risk in agriculture

According to Robert and Dick, (1991) there has always been a lukewarm attitude against crop insurance on reason that insuring crop is highly risky and therefore not likely to be

a profitable venture. However, any insurance mission is about managing risks and crop insurance makes no exception. Moreover, crop insurance schemes, despite the scepticism surrounding it, are to date scattered worldwide

Table 34: Reasons for infeasibility of crop insurance in Tanzania

Reason for infeasibility	Count frequency of Insurers (n=8)	Percentage
High risk	4	50.0
Lack of reinsurance	3	37.5
Low demand from farmers side	2	25.0
Lack of experience	2	25.0
Low agricultural Production technology	1	12.5
Lack of reliable market study	1	12.5
Inability of farmers to meet premium	1	12.5
Fear of moral hazard	1	12.5

Insurable risks are only those which meet insurability criteria as spelt out by Hazell, (1991) and Ray, (1967). These criteria are duly discussed in section 1.5 of this report. It is only when a risk does not meet the criteria conditions, and especially when it does not lend itself to estimation that insurance becomes infeasible. Crop insurance should thus be thought along the same lines. Studies by NIC (1986) and Lema (1987) have suggested that climatological risks like drought, hail and floods facing most Tanzanian farmers are insurable. This reason might thus not be a very strong argument against launching of crop insurance in Tanzania.

(ii) Low technology in agricultural production

It is quite true that many Tanzanian farmers (who are mostly smallholders) are yet to adopt modern farming technology in their farming operations and this could be a limiting factor in operating crop insurance in Tanzania. Nonetheless, according to the Insurance institute of India (1988), contemporary approach is to take care of the existing agricultural technology of the area concerned at the material time of crop insurance consideration. In this case modalities of operating the scheme are expected to be reflective of the conditions on the ground. Tanzanian case can as well be evaluated on its own merit.

(iii) Lack of reliable market study

This is obviously the major shortcoming that is probably the source of all the other reasons. The NIC (1986) is the only study that has so far been carried out with an intention to assess the potential of crop insurance in the country. The study is very inadequate especially in quantitative terms regarding market potential of crop insurance in Tanzania. This reason therefore, is seemingly a genuine stumbling block to mounting of crop insurance in Tanzania to date.

(iv) Low farmers' demand

This reason is directly related to (iii) above in that no reliable study has ever been conducted to assess farmers' demand for crop insurance in Tanzania. NIC (1986) suggested the existence of crop insurance potential on the assumption that farmers affected by natural hazards would automatically go for the insurance. This assumption overlooked the analysis of farmers' preferences and perceptions on the matter and their ability to meet the involved costs. In short, farmers' demand for crop insurance has not been analysed thus it is improper to conclude that it is low.

(v) Lack of reinsurance

Normally, reinsurance arrangements are mostly possible in an on-going scheme. This is so because international reinsurers have to assess the financial viability of the scheme first before engagement. This can thus be hardly a reason for the infeasibility of crop insurance in Tanzania where no such a scheme has ever been mounted since then. For instance, should this be a real burning problem, the government could have been made to offer local guarantee to the scheme during its initial stages and thereafter international reinsurance could be sought as it progresses.

(vi) Lack of experience

It is rather lack of expertise than experience that matters most in crop insurance issues. If requisite expertise is available experience is easily acquired over time. As put forth by Roberts and Dick (1991), qualified agronomists are the ones supposed to be trained in crop insurance for a successful operation of the scheme. In Tanzania, this is such a major problem given that agricultural insurance is not even in the curricular of agricultural schools and colleges. The poor performance, for example, of livestock insurance being carried out by NIC has much to do with lack of expertise on the part of the insurance company itself. Expert opinion on agricultural insurance suggests that livestock insurance and crop insurance should be run together for better results (Sud, 1999). Running livestock insurance scheme alone might thus be a self-defeating proposition.

(vii) Farmers' inability to meet premium costs

In the absence of a reliable market study or even a pilot operating scheme, farmers' inability to meet insurance costs can hardly be proved. This can thus not be taken as a reason for the claimed infeasibility of crop insurance in Tanzania.

(viii) Fear of moral hazard

Control of moral hazard in any insurance policy (not only crop insurance) is a duty of the insurer who is writing it. It is however true that crop insurance is highly specialized and thus requires specialized expertise. It is probably lack of this expertise, which can aggravate the fear for moral hazard but not that the fear for moral hazard makes crop insurance infeasible in Tanzania.

4.9.2 Insurers willingness to insure crops

It was also of interest to the study to know whether the insurers in Tanzania (both public and private) are willing to include crop insurance in their portfolio. The enquiry during the survey asked them to indicate their willingness or otherwise. The inquiry results are summarized in Table 35 below.

From table 35, it is shown that only 25 percent of the interviewed insurers were ready to include crop insurance in their portfolios. Despite conducting a feasibility study on crop insurance in 1986, which signalled a very good potential for same, NIC was not among the insurance companies ready to operate crop insurance in Tanzania.

Table 35: Willingness to include crop insurance in insurers' portfolio

Whether to include crop insurance	Count frequency of insurers (n=8)	Percentage
Yes	2	25.08
No	5	62.5
No comment	1	12.5

Deductively, they could be deciding from the experience of the trend, which has so far been shown by the six year old livestock insurance. NIC claimed that the performance of livestock insurance has since been 'very poor'. Poor performance was attributed to livestock keepers' ignorance on the benefits of this particular insurance and their preference for self-insurance to that of livestock. As previously observed, lack of requisite expertise is the hidden cause behind the performance of the livestock insurance thus judging the prospects of crop insurance from that experience might be quite misleading.

4.10 Agricultural finance issues.

4.10.1 Borrowing from banks

Banks are the major sources of external finance to many business enterprises including agriculture. The survey tried to establish the extent of farmers' bank borrowing in the research area and the results are summarized in table 36 below.

Table 36: Bank borrowing by village

Borrowing from bank	Kwa Ugoro (n = 46)	Malula/Kolila (n = 30)	Kikatiti (n = 4)0	Overall (n = 116)
	% of respondents			
Yes	0.0	3.8	0.0	0.9
No	100.0	96.2	100.0	99.1

In overall results, bank borrowing was astonishingly low at less than 1.0 percent. Specifically, all interviewed farmers in Kwa Ugoro and Kikatiti were totally not borrowing from banks. This shortcoming could be a reason for lower yields, which were below regional average since it translated into lack of adequate capital to invest in the

farms. The survey tried to find out the reasons for the observed situation and the results are summarized in table 37 below.

Table 37: Reasons for not borrowing from banks

Reason for not borrowing from bank	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
	% of respondents			
No need	2.4	21.1	5.0	6.9
Lack of collateral	19.0	15.8	20.0	18.8
Higher interest rate	78.6	57.9	67.5	70.3
Lack of interested bank(s)	0.0	5.3	7.5	4.0

From the results (Table 37), higher interest rates account for the greater part of the farmers' failure to borrow from banks followed by lack of collateral. Crop insurance has a potential to redress the shortcomings being caused by both reasons. Under normal circumstances, banks will charge premium interest rates on ventures thought to be highly risky. Uninsured crops are highly risky to a lender. If crops are insured, the riskiness of their production diminishes significantly thus banks are likely to be ready to lend at lower rates. On the other hand, crop insurance can ease the problem of collateral by either substituting fully the requirement of landed properties as collaterals or by making hypothecation of crop itself feasible. Mishra (1994) showed empirically that crop insurance enhanced credit accessibility to farmers in India in almost the same way, a process she termed 'collateral effect'.

4.10 Gross Margin (GM) analysis results

The objective of GM analysis is to determine farmers' profitability as explained in section 3.5.3 of this report. Means comparisons results as per one-way ANOVA are summarized in table 38 below.

Table 38: 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	

*** F-value significant at $p \leq 0.01$ level

The results suggested that Kwa Ugoro and Kikatiti bean farmers were operating profitably given their positive margins. Malula /Kolila on the other hand, were on average operating unprofitably. However, the high value of standard deviations (which are all higher than their related mean) in all villages suggested that in each village there were both profit and loss making farmers notwithstanding the obtained means as authenticated by table 39. This realization is important in assessing the potential for crop insurance as it becomes clear that farmers capable of meeting insurance costs can come from any of the villages. The GM means between villages were highly significant at 1% level implying that the extent of profit making between villages differs.

Table 39: GM categorization results by village.

GM category* (Tsh/ ha)	Kwa Ugoro (n=46)	Malula / Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
	% of respondents			
Loss (≤ 0)	10.9	66.7	17.5	27.6
Low profit (1-50 000)	28.3	23.3	27.5	26.7
Moderate profit (50 001-100 000)	47.8	6.7	17.5	26.7
High profit (>100 000)	13.0	3.3	37.5	19.0

* Categorization is arbitrary

From table 39, it is possible to derive a table for profit making and loss-making farmers across the villages as summarized in table 40. Kwa Ugoro village was leading in farmer profitability results and Malula/Kolila was the lowest. This is explained by the fact that Kwa Ugoro village is blessed with irrigation water scheme whereas Malula /Kolila is the most drought stricken of the three villages. Soil fertility differences were not ascertained in this study. Profit making and loss making farmers were found to differ significantly across the villages at 1% level.

If the assumption is that profitable farmers are the ones capable of meeting insurance costs, then table 40 suggests that every village has a score of such farmers albeit on differing extents.

Table 40: Profitability categories of farmers

Farmer category	Kwa Ugoro (n=46)	Malula / Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
	% of respondents			
Loss makers	10.9	66.7	17.5	27.6
Profit makers	89.1	33.3	82.5	72.4

X^2 = Significant at 0.001

This observation suggests also that crop insurance schemes should not be made compulsory to farmers but rather every one should enter voluntarily. An element of compulsion will unfairly force even the loss makers to buy the insurance only to increase their losses to the advantage of the insurance agency. Use of compulsory crop insurance schemes to create awareness of crop insurance to Tanzanian farmers on the eve of launching crop insurance has been suggested (Ravi, NIC Director, personal communication, 2002). However, given these observations the approach might not be a viable suggestion.

4.11 Suggested premium rates

In this study we also solicited information in respect to premium rates that farmers in the research area were willing to pay and those acceptable to insurers in case crop insurance scheme is launched. The results are summarized in tables 41 and 42.

Table 41: Farmer suggested premium rates by village

Suggested Premium rate (%)	Kwa Ugoro (n = 46)	Malula/ Kolila (n = 30)	Kikatiti (n= 40)	Overall (n = 116)
	% of respondents			
10	80	70	48.7	66.7
15	11.1	10.0	46.2	22.8
20	6.7	20.0	2.6	8.8
>20	2.2	0.0	2.6	1.8

Majority of farmers, about 66.7 percent, were willing to pay less i.e. 10 percent of their production costs as insurance cost (premium) while 22.8 percent were willing to pay up to 15 percent of their insurance costs. Rates beyond 15 percent were not attractive to farmers.

Table 42: Insurer suggested premium rates by village

Suggested Premium rate	Count frequency of Insurers (n=8)	Percent
15% of farmers production cost	1	12.5
10% of farmers production cost	1	12.5
Indifferent due to lack of expertise knowledge	1	12.5
Input cost should be the basis	1	12.5

On the other hand, insurers seemed to be indecisive on the possible acceptable premium rate and claimed that it has to be established after thorough study. The insurers

suggestions were very viable as premium rate determination requires interpretation of long time series of disaggregated agro climatic data which is surely a technical process requiring specialized expertise (Roberts and Dick, 1991). In the absence of an actuary, reliable data and qualified agronomists in agricultural insurance matters, initially, premium rates for a crop insurance scheme in Tanzania may base on estimate figures. This approach was successively used in the Indian comprehensive crop insurance scheme during its decade long pilot stage in the late 1970s and early 1980s (Mishra, 1994) and Mauritian Sugar crop insurance fund in late 1940s (Robert and Dick, 1991).

4.12 Farmers' wealth

The study also attempted to determine farmers' wealth status using asset index procedure discussed in chapter three. The results were important input in the regression analysis model. The results of the asset index were as summarized in table 43 below. Wealth status between villages was not statistically significant meaning that there was no difference in wealth status distribution between the villages.

Table 43: Wealth status of farmers by village

Wealth category* (Tsh)	Kwa Ugoro (n=46)	Malula/ Kolila (n=30)	Kikatiti (n=40)	Overall (n=116)
	% of respondents			
<0	28.3	40.0	37.5	34.5
1-50 000	8.7	0.0	7.5	6.0
50 001-100 000	4.3	3.3	2.5	3.4
100 001-500,000	30.4	40.0	22.5	30.2
>500 000	28.3	16.7	30.0	25.9

X^2 = significant at 0.571
* Arbitrary categorization

4.13 Regression analysis results

Regression analysis was adopted to assess the factors that affect farmers' preference for crop insurance in the research area. Preference for crop insurance was thus the dependent variable and the regressors were profitability, wealth (asset index), farming purpose/ objective, farm size, level of education, awareness to crop insurance and farmers' age (see section 3.5.4 of this report). After several running of the model, independent variables such as farming purpose, level of education, awareness, and age were dropped. These factors were dropped for two major reasons. First, they were all insignificant in the relationship and second; their inclusion was rendering the model insignificant at $p \leq 0.05$ level. Final results of parameter estimation are summarized in table 44 below.

Table 44: 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
Intercept	- 0.5309	0.7904

Chi square = 8.119 (significant at 0.0436)
* Significant at $p \leq 0.05$ level of significance

The estimated equation thus becomes $y = -0.5309 + 0.2039X1 + 0.2862X2 + 0.1284X3$
$(0.7904)\ (0.2204)\ (0.1406)\ (0.0789)$

Where; y = preference for crop insurance.

The negative intercept is meaningless in this regression equation. All independent variables affected the dependent variable positively but it is only asset index (farmers'

wealth) that affected it significantly. This observation contradicts the underlying theory that farmers become less averse to risk with increasing wealth and tend to be guided more by average performance indicators, and become less interested in any form of risk-reducing intervention (Hardaker *et al.*, 1997). This observation could probably be due to the prevailing little awareness on crop insurance and lack of alternative agricultural production risk management options, especially in terms of government promoted interventions, thus farmers are only overwhelmed by the idea of having one such intervention like crop insurance. Moreover, economic theory has been claimed not to apply to developing world economies in so many issues due to existence of various distortions and this is what has exactly been observed in this case. The model was quite strong as evidenced by its chi-square value, which was significant at 5% level.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

Major findings have emerged from this study in respect of the underlying objectives and hypotheses. The whole range of findings is however geared toward assessment of crop insurance potential in the research area. All conclusions presented thereafter, bear the same focus.

5.2 Conclusions

The first objective of the study was to assess natural hazard risks that farmers in the research area consider important and the available coping strategies to mitigate them. This objective was attended by answering a research question in respect of natural hazards affecting farmers and testing the related hypothesis that there is no difference in effectiveness of different coping strategies between the villages. According to the descriptive analysis results, pests and diseases were the major natural hazard risks facing the farmers followed by drought risks. Incidentally, pests and diseases risks are not supposed to be insurable thus it is fair to conclude that crop insurance potential in the research area is only on drought hazards which affect about 26 percent of the respondent farmers across the research area.

The hypothesis on the effectiveness of coping strategies in mitigating natural hazard risks was rejected in respect of strategies such as diversification to off-farm activities, spatial separation of farming plots, diversification to other crops, minimum investment, sale of assets, borrowing from neighbours, temporary wage employment, dependence on remittances and dependence on government relief. The criterion for the rejection was

that chi-square statistical test was highly significant at $p \leq 0.01$ in each case. The hypothesis was however accepted in respect of agro forestry coping strategy since chi-square test was insignificant. In general, the results suggest that the most common coping strategies used by farmers are neither perfectly effective nor totally ineffective in managing natural hazard risks. This suggests the need to supplement them with risk-transfer devices like crop insurance for better results. Partial effectiveness of these traditional coping strategies has been a major reason behind launching of many crop insurance schemes worldwide. The results are thus indicative of the same requirement for the farmers in the research area.

The second objective was to assess relative riskiness of various natural hazards. It was hypothesized that there is no difference in riskiness between various natural hazards in the research area. This hypothesis was rejected in respect of hazards such as floods, drought and pests and diseases and it was accepted in respect of windstorm and landslides and eruptions. The rejection was based on the fact that riskiness assessment between villages, as tested on a chi-square statistical test, was highly significant at $p \leq 0.01$ levels

These results attested to the earlier findings by NIC that natural hazards are locational specific. From this finding it can be concluded that planning for crop insurance should also be locational specific i.e. every location should be treated according to the specific hazard that is affecting farmers in that particular area. It was interesting to note that even over such a narrow expanse (only three villages with close proximity) there was enormous diversity in terms of hazard riskiness suggesting that if the whole country is to be considered, then extensive studies are necessary in establishing actual situations on the ground otherwise crop insurance planning in Tanzania might not be effective.

The third objective was to assess the potential of crop insurance in the research area. It was hypothesized that there is potential for crop insurance in the research area. This hypothesis was tested in two stages thus necessitating formulation of two sub-hypotheses. The hypotheses were 'A large section of farmers prefer crop insurance' and 'All farmers in the research area are profitable'. On preference, large sections of farmers in all villages were in favour of crop insurance though, paradoxically, awareness of the insurance itself was very low. Preference between villages was not statistically significant indicating that the situation was similar in all villages. The hypothesis was thus accepted. Moreover, crop insurance ranked second to traditional coping mechanisms in the assessment of the most preferred risk management strategy.

According to one way ANOVA test, farmer profitability between the villages was highly significant at $p \leq 0.01$ thus the hypothesis that there were no inter village differences was rejected. With exception of Malula/Kolila village, large sections of farmers in the other villages were profit makers. The proportions of profit making and loss making farmers across the villages were also statistically significant at $p \leq 0.01$ levels. The hypothesis that 'all farmers in the research area are profitable' was thus rejected. The GM means had very large deviations signifying that intra village differences were also large and that despite the negative margin for Malula/Kolila village, each village had both profit making and loss making farmers. This observation revealed that farmers who are capable of meeting insurance costs could thus be obtained from either of the villages.

On the strength of the findings of both sub- hypotheses of objective three, it is concluded that there is potential for crop insurance in the research area as large proportion of the respondents preferred it and majority of them (over 72 percent) are profitable and thus likely capable of meeting insurance costs.

The fourth objective was to determine the factors that influence preference for crop insurance amongst farmers in the research area. It was hypothesized that preference for crop insurance is neither affected by farm size, farmers' wealth nor farmers' profitability (see sections 1.14 and 4.13of this report). The hypothesis was tested on a multiple regression model using binary logistic model. The results suggest that all of the three factors affect positively the farmers' preference for crop insurance. However, farmers' wealth was the only factor that affected the preference significantly. This observation tends to suggest that wealthy farmers are more likely to go for crop insurance to manage natural hazard risks. Theoretically, this was not expected (see section 4.13). However, in the Tanzanian context, as discussed in chapter four, the results were quite natural given that crop insurance is normally based on commercial farming and wealthy farmers are most probable investors in that line.

The above farmers' potential for crop insurance is quite paralleled by the position held by insurers currently operating in Tanzania. The study has found them relatively sceptical about overall viability of crop insurance in the Tanzanian agriculture which is characterized by traditional farming methods, unorganised farms, poor farm record keeping, lack of land records (as most land area is unsurveyed) and the like. The study however concludes that the major fears on the part of the insurers emanate more from lack of requisite expertise in the field than inviability of the scheme itself. This lack of expertise is so serious since while agronomists are supposed to take a central role in the operation of such schemes, agricultural schools and colleges do not even have it in their teaching curricular. Elimination of this shortcoming from within the country in the near future is thus not envisaged.

5.3 Recommendations

Giving conclusive recommendations in respect of crop insurance potential in Tanzania basing on this single study, which covers an insignificant portion of this vast country, is tricky and less effective. However, the study has highlighted some very important clues which are worth noting, the first being the hidden potential for crop insurance in crops of even lower commercial importance like beans. The indication is that there could be much other unexplored potential in other crops as well. Crop insurance is thus seemingly a needed facility/service in the Tanzanian agricultural sector. In view of this anticipation, the study recommends the following:

(i) In harmonizing differing perceptions of farmers and insurers on the issue of crop insurance, there is a need to conduct a more comprehensive market study covering all the probable potential areas and potential crops for insurance in the country. These areas are those related to production of either cash crop or food crops on commercial bases. Multidisciplinary teams representing all stakeholders in the subject should carry out the study. The Planning Commission team of 1994 was a very good step in the right direction but lacking in its composition. It should be remembered that there are no experts in crop insurance at present in Tanzania thus there is no way that foreign expertise should not be sought. The team should thus comprise of a foreign expatriate to assist in the interpretation of the available data. Mauritian Sugar crop insurance fund has since been branded an advanced and a successful scheme by FAO with an experience of more than 50 years. Being an African country, foreign expertise from that end might be more relevant to the Tanzanian scenario.

The team's approach should rather target different ecological zones in the country than political boundaries of regions and districts as adopted in the NIC (1986) study. This is important because the current study has found out that even ecological zones that share very close proximity, radiate significant differences in terms of natural hazard incidences by type and severity thus calling for different remedial measures. Such information should thus be tapped for better results.

(ii) Experience worldwide suggests that initial stages of many crop insurance schemes face the problem of data availability from which appropriate decisions could be made. The remedy has always been similar in that promoters have always been compelled to start on very small scales as pilot schemes. This gives them time to acquire enough data and experience to assess due premium rates receivable and indemnities payable. Tanzanian case should thus not make a difference. It is recommended therefore that, after the research team has identified the potential crops in this respect, a pilot crop insurance scheme should be launched. The scheme should have the following features:

(a) The scheme should either be launched on an established private company on special arrangements with the government or as a separate new and autonomous agency under the parent Ministry of agriculture. The first option will be superior to the second in minimizing both administration costs and unfavourable political influences on the scheme.

(b) The scheme should cover specific risks rather than being an all risk scheme. The former will be effective in combating moral hazards on the part of the insured's.

(c) The scheme should be voluntary for eligible farmers to enter on their own accord. This underscores the importance of running the scheme on a purely commercial basis. A compulsory scheme will not only be politically motivated but will also be inefficient. An insurability thresh-hold (i.e. a minimum level of investment due for insurance) should be the only criterion, in terms of farmer type, to assess the eligibility of farmer(s) for insurance.

(d) The government should guarantee the initial reserve fund to enable the scheme meet its indemnity payment obligations. Disaster relief fund under the Prime Minister's office might be reoriented to serve this purpose.

(iii) Crop insurance thrives under situations of organized marketing or processing of the concerned crop. This eases data collection exercise in respect of yields and losses that are important in the continuous improvement of the scheme's estimates of premium rates and indemnity payments. In Tanzania therefore, efforts to strengthen cooperative movements should be given priority. The government will have its share of discouraging haphazard marketing of farm produce. Cooperatives should play the central role in marketing farm produce.

(iv) The government should speed up the implementation of the 1999 land reforms in respect of provision of title deeds to rural farmers whose land holdings are hitherto owned under customary law. This will have a significant multiplier effect in the country's economy.

(v) Tanzanian agricultural schools and colleges should introduce risk management training in crop insurance in their teaching curricular for academic and practical purposes. This will significantly enhance awareness of its benefits to both the farmers and technicians. It will also provide requisite expertise to agronomists on the modalities of operating such a scheme. It is only after achieving this awareness that we may realize the huge potential of revolutionalizing our agriculture we have since been neglecting.

REFERENCES

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.

Abada, J.C. (1991). Planning and Practices of crop Insurance. The case of the Philippines. In*: Proceedings of APO seminar on Agricultural insurance*, Tokyo, Japan, 21-31 August, 1990. pp 56-69.

Binswanger, H.P. (1986). Risk aversion, collateral requirement and the markets for credit and Insurance in rural areas. In: Mishra, P.K. (1994). Crop Insurance and crop credit: Impact of the comprehensive crop Insurance scheme on cooperative credit in Gujarat. *Journal of International Development*: 6 (5): 536.

Binswanger, H.P. and Rosenzweig, M.R. (1986). Behavioural and material determinants of production relation in agriculture. In: Mishra P.K. (1994). Crop Insurance and crop credit: Impact of the comprehensive crop Insurance scheme on cooperative credit in Gujarat. *Journal of International Development*: volume 6 (5) 536.

Bank of Tanzania (1991). Prudential guidelines on concentration of credit and Exposure limits. Unpublished circular. pp.11.

Chamber, R.G. (1989). Insurability and Moral hazard in agricultural insurance markets. In: Wright, B.D. and Hewitt, J.A. (1990). Crop insurance for Developing

Countries. In: *Food security and food inventories in Developing Countries. Wa*llingford (UK), CAB International. pp 113-116.

Crawford P.R. (1977). Crop insurance in developing countries: A critical appraisal. Master's Thesis, University of Wisconsin- Madison. In: Wright, B.D; and Hewith, J.A. (1990). Crop Insurance for Developing Countries. In*: Food security and food inventories in Developing Countries.* Walling ford (UK), CAB International, pp 107-130.

Falconer, J. (1990). Agro forestry and household food security. In: Senkondo, E. M. M. (2000). Risk Attitude and Risk Perception in Agro forestry Decisions: The case of Babati, Tanzania. Unpublished thesis for Award of PhD Degree at Wagenigen University, The Netherlands, pp.3.

Gudger, W.M. (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. pp 3-23.

Guggenheim and Spears, J. (1991). Sociological and environmental dimensions of social forestry projects. In: Senkondo, E. M. M. (2000). Risk Attitude and Risk Perception in Agro forestry Decisions: The case of Babati, Tanzania. Unpublished thesis for Award of PhD Degree at Wagenigen University, The Netherlands, pp 3

Hardaker, J.B; Huirne, R.B.M. and Anderson, J.R. (1997). *Coping with risk in Agriculture.* Wallingford UK. CAB International. 274 pp.

Hazell, P.B.R. (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, 21-31. pp. 21-32.

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

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

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

Lipton, M. (1979). Agricultural risk, rural credit, and inefficiency of inequality. In: Mishra, P.K. (1994). Insurance and crop credit. Impact of the comprehensive crop insurance scheme on cooperative credit in Gujarat. *Journal of International Development:* 6 (5): 536.

Lloyd, A.G. and Mauldon, R.G. (1986). Agricultural instability and alternative government policies: The Australian Experience. In: Crop Insurance for Agricultural Development, Issues and Experience. In: Wright, B.D; and Hewith, J.A. (1990). Crop Insurance for Developing Countries. In: *Food security and*

food inventories in Developing Countries. Walling ford (UK), CAB International. pp 107-130.

Lopes, M de R and Dias, G.L da S. (1986). The Brazilian experience with crop insurance programmes. In: Hazell, P., Pomerada, C. and Valdes, A. (eds), In: Crop Insurance for Agricultural Development, Issues and Experience. In: Wright, B.D; and Hewith, J.A. (1990). Crop Insurance for Developing Countries. In: *Food security and food inventories in Developing Countries.* Walling ford (UK), CAB International. pp 107-130.

Martin, S. and Mcleay. (1998). The Diversity of Farmers' Risk Management Strategies in a deregulated Newzealand Environment. *Journal of Agricultural Economics* 49 (2): 218-233.

Mehr, R.I. and Cammack, E. (1966). *Principle of Insurance.* Richer D. Irwin, Inc. Homewood, Illinois. pp 1-81.

Mishra, P.K (1994). Crop Insurance and crop credit: Impact of the comprehensive crop Insurance scheme on cooperative credit in Gujarat. *Journal of International Development:* 6 (5) 529-568.

Mosley, P. and Krishnamurthy, R. (1995). Can crop Insurance Work? The case of India. *Journal of Development Studies* 31 (3): 428-450.

Patrick, G.F; Lloyd, A.G. and Cary, J. W. (1985). Crop and rainfall insurance: Some results from the Victorian Mallee. Staff paper 85-14, Purdue University, West

Lafayette, Indiana. In: Wright, B.D; and Hewith, J.A. (1990). Crop Insurance for Developing Countries. In: *Food security and food inventories in Developing Countries.* Walling ford (UK), CAB International. pp 107-130.

Philip, D. (2001). Economic Analysis of Medium scale Agricultural Enterprises in predominantly Smallholder Agriculture Sector. Unpublished Dissertation for award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, pp. 1– 80.

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

Ranganathan, R; Fafchamps, M. and Walker, T.S. (1991). Evaluating biological productivity in inter-cropping systems with production possibility curves. Agricultural systems 36(2): 137—187. In: Senkondo, E. M. M. (2000). Risk Attitude and Risk Perception in Agro forestry Decisions: The case of Babati, Tanzania. Unpublished thesis for Award of PhD Degree at Wagenigen University, The Netherlands, pp.3.

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

Ray, P.K. (1967). *Agricultural Insurance: Principles and organization and application to developing countries.* Pergamon press pp. 1-39.

Robert, R.A.J and Dick, W.J.A (eds) (1991). Strategies for Crop Insurance planning. FAO Agricultural services Bulletin 86, Food and Agriculture Organization of the United Nations, Rome. pp 45-60,

Roberts, R.A.J; Gudger, W.M. and Gilboa, D. (eds). (1989). Crop Insurance. FAO Agricultural Services Bulletin 78, Food and Agriculture Organization of the United Nations, Rome.

Rugumamu, W. (1991). Towards Developing Environmental Disaster Relief coordination network in Tanzania. *Journal of the Geography Association of Tanzania* 26: 88-99.

Senkondo, E.M.M. (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. 208pp.

Silomba, L.B. (2000). Structure and Performance of the bean marketing in Tanzania. A case study of Kigoma Region. Unpublished Dissertation for award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, pp. 80.

Sud, S. (1999). Crop Insurance: Pros and Cons. *YOJANA*, pp 5-7.

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

Tanzania Ministry of Agriculture and National Bureau of Statistics (2000). Integrated Agricultural survey report 1997/98. Government Printer, Dar es salaam, Tanzania.

Tanzania National Insurance Corporation (1986). A report on Crop Insurance in Tanzania. In: Lema, J.L. (1987). Climatological Research in Support of Crop Insurance Scheme in Tanzania. Unpublished research paper, pp 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 1994/91, pp 1-5.

URT (2003). 2002 Population and housing census. Central Census office, Dar es salaam 2:59-60.

Wageningen University. (2003). Risk Management in Agriculture: Principles and applications. [http://www.wau.nl/phlo_crmia.htm] site visited on 11.06.2003.

Wright, B.D; and Hewitt, J.A. (1990). Crop Insurance for Developing Countries. In: *Food security and food inventories in Developing Countries.* Wallingford (UK), CAB International. pp 107-130.

APPENDIX 1: FARMER'S QUESTIONNAIRE

A: GENERAL CHARACTERISTICS

A1: Name of the respondent _____ Age .....

Gender _____Male=1 Female =2

Division .....

Village .....

A2: Role in the household .....

Head of the household =1

Housewife=2

Son/Daughter of the head of household=3

Others (specify)=4

A3: Level of education of the farmer.....

None=1

Adult education=2

Primary education =3

Secondary education =4

Others (specify)=5

B: LAND USE AND OWNERSHIP

B1: What are your major sources of income?

Sale of food crops=1

Sale of cash crops=2

Sale of livestock and its products=3

Wage employment =4

Off-farm income generating activities (not employment)=5

Remittance=6

Others (Specify)=7

B2: Total agricultural land owned

Name of land/plot	Crops grown	Total area (ha)	Ownership	Uncultivated area (ha)

Key for ownership: 1=Hired 2=Under customary law 3=Long time lease under land ordinance 4=Allocated by village government; 5=others (specify)_____

B3: The purpose of cultivating bean crop 1=Commercial 2=Subsistence

C: PRODUCTION RISKS AND THEIR MANAGEMENT

C1: What things do your consider/perceive as source of risk of loss of your bean crop?_____

_____

_____

_____

C2: Assess the riskiness of the following natural hazards:

Key 1: Riskiest: 2: Moderately risky; 3: Not risky 4: Do not occur here.

Floods _____

Drought _____

Diseases and pests _____

Windstorm _____

Landslides and eruptions _____

C3: How do you cope with risk in crop (bean) production?

_____

_____

_____

C4: If you are to manage a single natural hazard loss risk, which one would you select?

Floods = 1

Drought=2

Diseases and pests=3

Windstorm = 4

Landslides and eruptions =5

C5: Ever heard of crop insurance and its potential in crop production risk management? Yes =1 No=2

C6: If crop insurance is introduced, would your prefer to adopt it in managing crop production risks?

Yes=1 No2

C7: If yes, how much out of your total output/production cost would you like to pay as premium for insurance policy?

10%=1, 15%=2, 20%=3, Other (specify)

C8: Comment on the effectiveness of the prevailing risk coping and risk reducing measures/strategies in managing loss risks of your bean crop from natural hazards.

Key: Very effective=1, Moderately effective=2, Not effective=3, Not applicable=4

Diversification to off-farm activities .....

Agro-forestry (mixed cropping) .....

Spatial separation of plots .....

Diversification to other crops .....

Minimum investment .....

Sale of assets .....

Borrowing from neighbours .....

Wage employment .....

Dependence on remittances .....

Dependence on government relief .....

C9: Rank the following natural hazard risks management strategies according to your preference.

Traditional risk coping and risk reducing strategies = 1

Disaster relief from the Government =2

Use of insurance cover (crop insurance) =3

Minimum investment =4

Others (specify) =5

D: FARMER PROFITABILITY:

D1 Output/ha: Production and disposal of the products in 2000/2001 season

Products	Total Amounts (kg)	Amount Consumed(kg)	Amount Sold (kg)	Price/unit (TShs)	Total Revenue
Grain					
Straw					
			TOTAL		

D2: Production Cost /ha – 2000/2001 season

Activity	Month	Manual labour		Machinery		Total labour costs (TShs)
		Family (Man days Equivalent (Tshs)	Hired (Man days) Equivalent (Tshs)	Hired cost	Fuel purchase	
Ploughing						
Harrowing						
Planting						
Weeding						
Fertilizer application						
Harvesting						
Threshing						
Grading & Packing						
Permanent labour	Monthly					
					TOTAL	

D3: Marketing costs/ha – 2000/2001 season

Activity	Month	Cost/unit	Total cost/ha
Packing materials			
Transport to markets			
Storage costs			
Other statutory			
		TOTAL	

D4: Input purchases costs/ha – 2000/2001 season

Types of input	Amount used	Price/unit (TShs)	Total per input (TShs).
Seed			
Fertilizer			
Pesticides			
Farm land hire cost			
		TOTAL	

D5: Investment and equipment cost:

Item	Year purchased	Expected useful life(yrs)	Purchase price/cost TShs.)	Enterprise where used	Annual depreciation
Land					
Tractor					
Implements					
Hoe (s)					
W/Barrow (s)					
Oxen plough					
Others (Specify)					
			TOTAL		

D6: How do you assess the 2000/2001 season? 1=High, 2=Low, 3=Normal

E: CAPITAL

E1: Do you keep livestock? Yes=1 No-2

If yes answer the following questions:

Type	Number	Improved	Uses	Feeding system	Value TShs.
Bulls					
Cows					
Heifers					
Steers					
Calves					
Oxen					
Cattle subtotal					
Donkeys					
Goats					
Sheep					
Piglets					
Weaners					
Sows					
Boars					
Chicken					
Total					

Key for uses: Sell animals=1, Store of wealth for emergencies =2, For milk and manure =4, Others (Specify)=5

Key for feeding system: Zero grazing =1, Tethering =2, Paddocks=3, Grazing in communal area =4, Free grazing =5,

Others Specify)_____

E2: How much did you spend in the following:

	TShs	Year constructed	Useful life
Goat house			
Pig house			
Cattle house			

E3: Durable Assets: Indicate the assets you own:

No	Asset	Number	Year bought	Price/value TShs	Useful life
1	Tractor				
2	Oxen plough				
3	Bicycle				
4	Car				
5	Radio				
6	Radio cassette				
7	Spongy mattress				
8	House with corrugated iron sheet				
9	Cement floor				
10	Burnt brick or cement				
11	Hurricane lamp				
12	Charcoal stove				
13	Kerosene stove				
14	Torch				
15	Hoe				
16	Panga (machette)				
17	Axe				

F: AGRICULTURAL FINANCE:

F1: Do you borrow money from bank? Yes=1 No=2

F2: If yes explain the following:

Year borrowed	Amount	Reasons	Repayment including interest
1 2 3			

F3: If not, what are the reasons of not borrowing from banks?

Not need = 1

Lack of security = 2

Higher interest rates = 3

Lack of interested banks = 4

Others (Specify) = 5

_____

_____

_____

F4: Other Sources of external finance?

SACCOS = 1

Private money lenders = 2

NGOs (e.g. PRIDE) = 3

Others (specify) = 4

_____

_____

_____

APPENDIX 2. INSURERS' QUESTIONNAIRE

Module1: INSURER IDENTIFICATION VARIABLES:

Insurers Name _____ Location and Address _____

Specialization _____

Years of operation in Tanzania _____

Module 2: AGRICULTURAL INSURANCE

Do you operate any Agricultural (Insurance) Policy? 1= Yes; No=2

If yes, which are the policies? Livestock Insurance=1; Crop Insurance =2;

Both=3; 4= Not applicable

Module 3: LIVESTOCK INSURANCE

1.Is it viable in Tanzania? Yes=1 No=2

2.If No give reasons?

_____

_____

3. Do you operate the policy? Yes=1 No=2

4. If yes, how long have you been operating it?

5. How do you assess its performance? Very good=1; Moderate=2;

Poor=3; very poor = 4

6.If poor/very poor performance, give reasons

.....

.....

Module 4: CROP INSURANCE

1.Is it feasible in the Tanzania situation? Yes=1 No=2

If no give reasons;

Highly risky=1

Low agricultural production technology = 2

Inability of farmers to meet premium payment =3

Low demand on the farmers side = 4

Lack of re-insurers = 5

Fear of moral hazards = 6

Lack of expertise =7

Others (specify) = 8

_____

_____

2. Have you conducted a formal feasibility study on crop insurance in Tanzania?

In your opinion, what are the factors which lead to non-existence of crop insurance in Tanzania?

.....

.....

Module 5: FUTURE PROSPECTS OF CROP INSURANCE IN TANZANIA

1. Do you expect to add crop insurance policy in your portfolio in future?

Yes=1 No=2

If no give reason

_____

_____

If yes what are the necessary conditions to be fulfilled before introduction?

_____

_____

2. In case of introduction, what will be an indicative level of premium?

15% of farmers yield=1

10% of farmers yield =2

5% of farmers yield =3

Others (Specify)

_____

_____

_____