

**PERCEPTIONS AND MANAGEMENT OF RISK BY
COMMERCIAL FARMERS IN ERITREA**

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DECLARATION

I hereby certify that, unless specifically indicated to the contrary in the text, this dissertation is the result of my own original work.



M.A. Mohammed

As Research Supervisor, I certify that the above statement is correct.



Professor G.F. Ortman

DEDICATION

This dissertation is dedicated to my wife, Amira Salih and my children.

ABSTRACT

A survey of 186 commercial farmers from three Zobas (provinces) of Eritrea was conducted between November 2002 and February 2003 to examine farmers' perceptions of risk, to determine the most important sources of risk affecting farmers' decisions, to identify managerial responses to risks and to identify information use. As part of the main survey, 74 randomly selected commercial dairy farmers were also interviewed to identify factors that affect the purchase of livestock insurance.

Findings show that whilst some risks are of concern to most farmers, others are more enterprise or region specific. In general, changes in weather, changes in the labour force, and diseases, pests and weeds were identified as being important sources of risk for most farmers. Factor analysis was used to analyse heterogeneity amongst farmers' perceptions of various risks. Results indicate that programmes designed to assist farmers in Eritrea to manage production and price risks should vary between enterprises and between regions. Policy implications of this research include that the government of Eritrea should disseminate information to clarify agricultural tax and land policies, and its demobilization and rehabilitation programmes. Relaxing foreign exchange rate controls may reduce price risks in agricultural input markets.

Increased use of information sources, choice of production system, keeping production records, and diversification of farm enterprises were found to be the main production responses to risk. Important marketing responses included indirect selling (e.g. to the grain board or wholesalers) and use of marketing information, while important financial responses were keeping financial records and investing off-farm. Factor analysis was used to analyse heterogeneity amongst farmers' managerial responses to risk. Results indicate that farmers respond differently to different types of risk attributed to enterprise type. Policy implications of this research include that the government of Eritrea should create a more conducive environment for business, train farmers with appropriate record keeping skills and improve road and communication infrastructure.

Results also show that farmers' sources of information vary according to farm type. While poultry and dairy farmers depend largely on information provided by the government, horticulture and crop farmers rely mostly on their own sources of information or non-governmental sources. Policy recommendations include additional and appropriate record-keeping training for farmers, improving the road and communication infrastructure, promoting commercial information providers, and periodically publishing an agricultural magazine by the Ministry of Agriculture in a way that farmers can understand the information.

The results of a logit model of the adoption of livestock insurance indicate that formal education of the farmer and the farmer's awareness of livestock insurance increase the probability of insurance adoption, whereas farming experience, poor location and use of alternative risk management strategies, such as off-farm investments and farm enterprise diversification, reduce the probability of livestock insurance adoption. Further insight into the socioeconomic factors influencing farmers' adoption of livestock insurance may assist policy makers and the National Insurance Corporation of Eritrea in their future plans. Results of this study have some policy implications, such as the need for a variable rather than fixed insurance premium, improving the know-how of farmers concerning risk assessment, improving Zobas' infrastructure and a need for a thorough study to be conducted on the demand for agricultural insurance in Eritrea.

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INTRODUCTION

Agriculture is inherently risky (Gabriel and Baker, 1980; Antle, 1983; Hardaker *et al.*, 1997). Hardaker *et al.* (1997) maintain that the concern about risk in agriculture should be left not only to farmers but also to the whole society, as the risk averse character of farmers may result in misallocation of resources that lower overall welfare. Risk is generally viewed as a key matter to farmers' decision-making and to policies that affect these decisions (Anderson *et al.*, 1977; Anderson, 1982; Robison and Barry, 1987). Farmers' decisions are influenced by many factors, such as variable weather conditions, variability in input and product prices, rapidly advancing technology, farmers' indebtedness and external factors (e.g. government policies) (Ortmann *et al.*, 1992).

Hardaker *et al.* (1997) emphasized that risk is everywhere and is substantially unavoidable, and management of risk is part of farm management decisions. Although agricultural producers have little capacity to influence resource or commodity prices or the physical environment in which they operate, they do not simply accept changes. Instead, they may choose to respond by either attempting to control exposure to risk or controlling the impact of the effects of risk on the farm (Fleisher, 1990). Farmers use different strategies to manage risks at farm level. Farm risk management requires that research continues to assess farmers' exposure to risk, evaluate various risk management strategies, and analyse government programmes that address risk management. Identifying the sources of, and management responses to risk in agriculture is, therefore, of continuing interest to researchers, farmers and policy-makers, and a considerable volume of literature exists on this important topic.

Despite the fact that many similar studies have been conducted elsewhere, particularly in the United States of America (US) and South Africa, all of these studies focused on large-scale commercial farming. This study makes a contribution to risk analysis owing to differences in the business environment (economic, social and political) between Eritrea and the other study areas and the focus on small-scale commercial farmers.

Eritrea, situated in northeast Africa, is bordered by the Red Sea in the east, in the south by Djibouti and Ethiopia, and in the north and west by Sudan. It has an area of 121 320 square kilometres, six administrative provinces (Zobas) and a population of about 4.3 million people. Eritrea as a new state lacks many research outputs. Almost every field of economic activity is looking for researchers and studies on how problems can be identified and solutions proposed. The annual report of the Eritrean Ministry of Agriculture (2001) indicates that most private commercial farmers in Eritrea are currently struggling to survive. One of the possible reasons for this is risk. Droughts, labour shortages, poor credit facilities, shortage of underground water, plant and animal diseases and inadequate information appear to be the main sources of risk. The destructive three years of war (1998-2000) further changed the economic, social, political and environmental situations of Eritrea, which may affect farmers' decisions (Bekuretsion, 2002).

Information is vital for farmers to plan and make appropriate decisions. The more information the farmer has, the better he can manage risk. Whether or not risk aversion matters, better decisions in a risky world can always be made if more information is available (Hardaker *et al.*, 1997). The importance of information as a means to manage a risky environment, however, involves costs of obtaining and studying it. Most information sources in Eritrean agriculture come from government either at subsidized prices (newspaper, radio and television) or free of charge (extension and veterinarian services). The development of infrastructure in facilitating information flow is vital. The long war for independence and the recent border war with Ethiopia, however, have negatively affected Eritrean infrastructure.

Since production risk represents a major dimension of agricultural production, it can significantly affect the decision-making of risk averse producers (Liu *et al.*, 2003). Dillon (cited by Liu *et al.*, 2003), in examining the problems of uncertainty in livestock production, categorized inputs as controllable (e.g. ration and antibiotic use), predetermined (e.g. genetics of animals and farm location) and uncontrollable (e.g. weather, prevalence of a specific disease pathogens). This uncontrollable part of inputs mainly affects farmers' decision-making.

Although livestock production is prominent in the lowlands of Eritrea, it is carried out on a subsistence and traditional way with limited marketing of beef and raw milk in local markets. The relatively modern dairy farms are largely located in the highlands of Eritrea where land is scarce due to population pressure. Animal disease is a severe problem faced by commercial dairy farmers. Problems that are associated with traditional livestock farming (poor management and housing) were further aggravated by the border war with Ethiopia and repeated drought.

Since independence in 1993, the government of Eritrea has been attempting to build up the nation's economy by directly investing in all sectors of the economy. The National Insurance Corporation of Eritrea (NICE), which was established after independence, is one of the state-owned financial institutions that is serving the country. There is no private insurance company in Eritrea at present. Although NICE plans to provide insurance cover for more farm enterprises, it presently focuses on covering the risk associated with livestock on dairy farms.

The objectives of the study, therefore, are to identify the main sources of risk commercial farmers in Eritrea are faced with, to examine managerial strategies used by these farmers to respond to risk, to identify the main sources of information that commercial farmers in Eritrea considered for their decision making, and to identify factors that affect livestock insurance adoption by commercial dairy farmers in Eritrea. The policy implications of the results are also considered as the recommendations may guide and assist policy-makers, researchers, consultants and farmers.

The dissertation is structured as follows: After describing the Eritrean economy and policy issues in Chapter 1, a literature review illustrating the relevance of risk, information and insurance to agricultural management is presented in Chapter 2. Socioeconomic factors, such as farmer's age, farming experience, level of education, family size, income level, and farm size are some of the prevalent conditions that affect farmers' risk perceptions, use of

information and insurance adoption. Chapter 3, therefore, presents the sources of data for this study and the socioeconomic characteristics of respondents.

“Decision-making under uncertainty is characterised by risk, because typically not all possible consequences are equally desirable. Although uncertainty and risk are ubiquitous, in agriculture they constitute an essential feature of the production environment and arguably warrant a detailed analysis” (Moschini and Hennessy, 2001: 89). Since, to the author’s knowledge, no research has been conducted so far in Eritrea on sources and management of risk in farming, Chapters 4 and 5 identify the types of risk that Eritrean farmers are faced with and the risk management strategies used by sample farmers in Eritrea.

Identifying sources of risk in farming helps farmers and policy-makers address the most important strategies for managing risk, and aids in circumventing extreme outcomes, such as bankruptcy (Harwood *et al.*, 1999). The outcome of these chapters could assist policy-makers in Eritrea to understand the main sources of risk for farmers. The Ministry of Agriculture of Eritrea (MoA) could also benefit from this study when planning for farmers’ training, providing farm extension services, launching new projects, compiling information packages and providing consultations. Additional knowledge about farmers’ risk perceptions may also assist economists and researchers in planning education and information packages. Private consultants and lenders could also benefit from this study since they will be aware of the major sources of risk in providing services such as consultation and loans.

Owing to the imperfect knowledge, farmers make decisions in a world of uncertainty. The immediate implication of this uncertainty for economic agents is that many possible outcomes are usually associated with any chosen action (Moschini and Hennessy, 2001). Use of information by farmers minimises risk since access to relevant information enables them to measure, evaluate, control and improve the performance of their farm businesses (Barry *et al.*, 1988). In Chapter 6, therefore, sources of information used by commercial farmers in Eritrea are identified.

Several types of insurance covering livestock are widely available to reduce losses from animal diseases and market prices. The National Insurance Corporation of Eritrea (NICE) has established dairy livestock insurance with the aim of expanding its product to poultry and horticulture farmers. Dairy livestock insurance in Eritrea was basically established with a subsidized premium to help farmers manage risk. Despite the intention, only a few farmers have so far adopted insurance cover for their livestock. Chapter 7, therefore, identifies socioeconomic factors that influence livestock insurance adoption. This may help NICE in the investigation of problems of low participation and in its plans to provide additional agricultural insurance coverage.

A concluding section of the dissertation provides some recommendation that might assist policy makers, researchers, insurers and others to identify sources of risk faced by farmers and help farmers better manage risk.

CHAPTER 1

ERITREAN AGRICULTURE AND POLICY ISSUES

This chapter presents major agricultural and policy issues of Eritrea. Country's background, location, area, population, economic conditions and brief description of the study areas are some of the points discussed.

1.1 Country Background

The modern history of Eritrea is traced back to 1889, when Italy started to colonize the country for more than 50 years. The subsequent years under British military administration (1941-1951) created a society and economy more advanced than in the semi-feudal Ethiopian empire. Following the Second World War, Ethiopia, which historically considered Eritrea as its 14th province, intensified its claim to sovereignty. UN Resolution 390 A (V) created an autonomous Eritrea within Ethiopia in 1952. But in 1962 the Eritrean autonomy was systematically stifled, which led to 30 years of war for independence. On 24 May 1991 Eritrea was liberated by the Eritrean People's Liberation Front and declared an independent and sovereign state after an internationally supervised referendum was conducted in April 1993 with 99.8% of residents voting for independence (Rake, 2002).

1.1.1 Location, area and population

Eritrea is a country of northeastern Africa bordered on the east by the Red Sea, in the south by Djibouti and Ethiopia, and in the north and west by Sudan. It is located between latitudes 12^o 42' N to 18^o 2' N and longitudes 36^o 30' E to 43^o 20'E. The total area of the country is 121 320 square kilometres, which includes 1 083 square kilometres of 354 islands of the Dahlak Archipelago (CIA, 2002). Administratively, Eritrea is divided into six provinces referred as Zobas with 54 sub-Zobas and about 2 685 villages (Ghebreyohanes, 2000). The population is estimated at about 4.3 million with a 3.84% growth rate per year. About 43% of the

population is between the ages of zero and 14, 53% between the ages of 15 and 64, and 4% above the age of 65 (CIA, 2002).

1.1.2 Economic situation

The Eritrean economy, once relatively advanced, did not experience economic growth during the liberation war. Real gross domestic product (GDP) in 1991/1992 amounted to Birr 634 million, or about 4% lower than the output levels of 1988/1989 (FAO, 1995). (In 1997, when the Nakfa¹ replaced the Birr, 1US dollar was equivalent to 7.2 Birr (Rake, 2002)). The IMF estimated Eritrea's GDP at factor cost in 1999 at 5 321 million Nakfa. With a substantial proportion of Eritreans leaving outside the country, remittances play a key role in the economy. Domestic and IMF figures indicated an inflow of private remittances of almost US\$ 200 million in 1999. Total GNP in 1999 at current market prices was estimated at 6 817 million Nakfa (Rake, 2002). The liberation war resulted in considerable damage to the infrastructure and major macro-economic disruptions, as Ethiopia was Eritrea's main economic and commercial partner. A steady increase in inflation, marked depletion of foreign reserves, increased fiscal deficit, labour shortages and a decline of GDP characterized the year 2000 (EU, 2000).

IMF (2003) reported "the Eritrean macroeconomic performance has been seriously weakened by the drought and the lingering effects of the border conflict with Ethiopia (1998-2000), which has resulted in large-scale destruction of infrastructure and dislocation of the population. Due to these factors the economic growth in 2002 was negative at -1.2 percent as compare to 8.7 percent in 2001. This in turn led to a sharp acceleration of inflation, with consumer prices rising by 24 percent by end 2002, against 8 percent at end 2001".

Because of Eritrea's unstable international reserves position and the practical fixing of the official exchange rate, a dual exchange rate system has emerged in which the discrepancy

¹ Nakfa is the Eritrean currency that replaced the Birr (Ethiopian currency) in 1997. The rate in December 2000 was 1USD = 10.10 Nakfa (EU, 2000), in March 2001 it was 1USD = 10.20 Nakfa, and since September 2001 1 USD = 14.5 Nakfa

between the official and parallel market rates has risen markedly. Under the system, official transactions and other priority needs are being conducted in the official market, while the vast majority of private transactions, including bona fide current transactions, are being channelled through the parallel market. While the official rate has been kept largely unchanged at some NKF 14.5 per US dollar since September 2001, the rate in the parallel market has lately moved up to between NKF 22 and NKF 24 per US dollar (IMF, 2003). Eritrea apparently has important natural resources, including gold, potash, zinc, copper, salt, fish, and possibly petroleum. The service sector contributes 57% to GDP followed by the industrial sector with 27% (CIA, 2002).

1.2 Agricultural Sector

The agricultural sector contributes around 16% of the GDP. In 1999 this sector employed an estimated 77.8% of the economically active population (Rake, 2002).

The main natural hazards challenging farming are frequent droughts and locust swarms. Animal diseases are the most important sources of risk in dairy farming. A labour shortage is another threat farmers will face in the coming years since about 270 000 people, most of them farmers, are currently in the military, and will most probably not go back to agriculture even if they are demobilized. This is because of the knowledge and work experience they acquire will enable them to work in other sectors of the economy. The main crops grown in Eritrea include wheat, barley, sorghum, millet, taff and maize. Fruits grown in Eritrea include banana, papaya, apricot, orange, lemon and guava. Commercial horticulture farmers in Eritrea commonly grow cabbage, tomatoes, potatoes, onions, carrots, hot pepper, pumpkin, cucumber, lettuce and Swiss chard. Crop rotation is widely used by subsistence farmers to cope with risk.

For a farmer to be classified as a commercial farmer in Eritrea he/she must have a farming licence and be registered. Commercial farmers are also characterized by the mode of acquiring their lands (concessions), the right to get loans from the Development and

Investment Bank, and the obligation to pay sales tax. Subsistence or traditional farmers have the right to use their land for a lifetime, have a limited capacity to produce only for subsistence purposes, and, therefore, are exempted from paying any taxes.

1.3 General Agricultural Policy Issues of Eritrea

Food security has been at the top of the government's agenda since independence. Policy guidelines are released concerning the best strategy for diminishing food insecurity in the short term and achieving food security in the long term. However, Eritrea, even during the best harvest years of 1992 and 1995, could not meet the basic nutritional requirements of the people (Ghebreyohanes, 2000). Generally, of the 12% of arable land, only 1% is under permanent cropping leaving the rest uncultivated (CIA, 2002). Since independence, Eritrea has demonstrated a strong dedication to the goals of nation building, economic reconstruction and recovery as well as the support for the introduction of a pragmatic and liberal market economy. As a result, out of 43 state-owned enterprises 29 have been privatised by the National Agency for the Supervision and Privatisation of Public Enterprises, as of December 2000. The remaining enterprises are also under the process (EU, 2000). The government of Eritrea is actively participating to alleviate poverty by launching many programmes aimed at food security. The government is directly involved in the provision of inputs (selected seeds and fertilizers), tractor hire services, tools and oxen at subsidized prices.

As per Proclamation No. 58/1994 of 24th August 1994, Proclamation No. 95/1997 of 19th May 1997 and Legal Notice No. 31/1997 of 19th May 1997, land is owned by the government and only the right to use it is granted to commercial farmers. Land cannot be sold or hired, therefore there is no active land market in Eritrea. It is policy that land left idle may be taken by the state to be reallocated to another farmer. But the implementation is not as effective as it should be since such a policy needs considerable resources, including human and financial resources. Commercial farmers get land on request on the basis of concessions in the western lowlands of Eritrea where there are relatively large suitable but uncultivated land areas (FAO, 1995). The land, which is rotated between subsistent farmer families every seven years, is

extremely fragmented, and it is commonplace for subsistence farmers to cultivate 3-4 parcels of land kilometres apart.

Environmental considerations involve concern over severe land degradation, desertification, deforestation and over-grazing. As a result, Eritrea has signed a number of environment related international agreements such as the convention on Biological Diversity, the UN Framework Convention on Climate Change, and the UN Convention to Combat Desertification (Mesghena, 2002).

The scope of cover of NICE's livestock insurance policy is limited to 75% of the sum insured. It indemnifies the insured in respect of death to the insured animal(s) (due to accidents, illness, diseases and epidemics) during the period of insurance at the location specified in the master schedule or loss due to permanent total disability suffered by the animal during the period of insurance. Emergency slaughter of the animal(s) as a result of accident, illness, diseases or epidemics is also included if it is based on the advice of a qualified veterinary surgeon. Animals to be insured must be healthy, well nourished, disease free and between six months and ten years of age. This policy does not cover loss due to injury, death or liability directly or indirectly caused by disease arising out of external parasites, theft, clandestine sale, pollution, war and invasion (NICE, undated).

1.4 Brief of the Study Areas

The three Zobas that were selected for this study are Meakel, Debub and Gash-Barka. These Zobas were selected because most of the agricultural activities in Eritrea are conducted in these Zobas. The main commercial agricultural practices in Zoba Maekel are poultry and dairy production, with some limited horticultural activities. The total area of this Zoba is only 1 400 square km and is too small, relative to its population, to be used for large-scale horticultural or field crop farming (Ghebreyohanes, 2000). Few farmers in Zoba Maekel produce vegetables to be marketed in the capital city Asmara.

Zoba Dehub's commercial agricultural activities are dairy (mostly diversified with vegetable farming), poultry, irrigated horticultural farming, and field crop production. The main field crops grown in this Zoba include barley, maize, wheat and taff, while the main fruits produced include oranges, lemons, apricots, guavas and papaya.

In Zoba Gash-Barka, the largest Zoba, field crop and horticultural production dominates. Farmers in this Zoba practice large-scale rainfed cultivation of millet, sorghum and sesame, and irrigated production of fruits (banana, papaya and citrus) and vegetables for local consumption. Dairy farming in this Zoba produces milk for the informal local market. Poor infrastructure, a very hot climate and the distance from the capital city, where processing plants are available, make formal commercial milk production financially unattractive. Poultry farming in this Zoba is in its infant stage.

CHAPTER 2

LITERATURE REVIEW

Relevant literature on sources of risk and risk management issues, theories of information and insurance are reviewed in this chapter.

2.1 Sources and Effects of Risk

The sources of risk in agriculture are numerous, ranging from weather and pests to the policymaking process (Fleisher, 1990; Boehlje and Lins, 1998; Patrick, 1998). These sources of risk affect the producer's decision-making process. Therefore, agricultural managers need to consider the impacts of risk so that they can make more effective decisions.

2.1.1 The concept of risk and uncertainty

There is no generally accepted definition of risk (Fleisher, 1990; Hardaker *et al.*, 1997). Some authors consider risk and uncertainty as synonymous terms (Anaman, 1985), while others treat risk as a consequence of uncertainty (Fleisher, 1990).

It was Frank Knight who first tried to distinguish risk from uncertainty (Barry, 1984). He argued that in an uncertain environment, possible outcomes and their respective probabilities of occurrence are not known. In a risky environment, both the likely outcomes and the probabilities of occurrence are known. Hardaker *et al.* (1997) and Harwood *et al.* (1999) defined uncertainty as imperfect knowledge and risk as uncertain consequences, particularly exposure to unfavourable consequences. Furthermore, Fleisher (1990) defined risk as a situation in which the result of uncertainty will affect the well-being of a firm or decision-maker and which involves the chance of gain or loss. "These arguments base on that risk arises when the stochastic elements of a decision problem can be characterized in terms of numerical objective probabilities and uncertainty refers to decision settings with random

outcomes that lack such objective probabilities. However, with the widespread acceptance of probabilities as subjective beliefs, the distinction between risk and uncertainty is virtually meaningless” (Moschini and Hennessy, 2001: 91). Therefore, in this study the terms risk and uncertainty are used interchangeably.

Various studies examining sources and management of risk in agriculture have been conducted in the US, on large-scale commercial livestock and crop farms (Boggess *et al.*, 1985; Ortmann *et al.*, 1992; Patrick *et al.*, 1993). Similar studies also have been conducted in South Africa on large-scale commercial farms (Woodburn *et al.*, 1995; Stockil and Ortmann, 1997), on extensive beef farms in the north-western Transvaal Bushveld (Swanepoel and Ortmann, 1993) and more specific research on commercial vegetable farmers in KwaZulu-Natal (Bullock *et al.*, 1994). Many of these studies conducted factor analysis to identify the main sources of risk faced by farmers and the managerial responses to risk.

2.1.2 Sources of risk in agriculture

Farmers face many uncertainties (Eidman, 1990). The question is not the presence or absence of risk in agriculture, but rather the degree or importance. Variability in crop and livestock production and prices were found to be the most important sources of risk in a study by Ortmann *et al.* (1992) and Swanepoel and Ortmann (1993). Woodburn *et al.* (1995) and Stockil and Ortmann (1997) found the most important source of risk to be changes in costs of farm inputs. Stockil and Ortmann (1997) added that tax legislation and variability in livestock prices, followed by changes in labour legislation and the Rand exchange rate, were the most important sources of risk among a sample of commercial farmers in KwaZulu-Natal agriculture.

Sources of risk in agriculture can be classified as either business risk or financial risk.

2.1.2.1 Business risk

According to Hardaker *et al.* (1997), business risk is the risk facing the firm independent of the way in which it is financed. They further define business risk as the aggregate effect of production, market, institutional and personal risks. Sonka and Patrick (1984: 97), while evaluating farmers' risk responses, considered sources of business risk as (1) production or technical risk; (2) market or price risk; (3) technological risk; (4) legal and social risk; and (5) human or personal risk.

Production or Technical risk is related to weather (rainfall, temperature, hail), plant and animal diseases, fire, wind and theft. Production risk is explained in terms of yield variability. The unpredictable nature of the weather and uncertainty about the performance of crops or livestock causes production or technical risk (Hardaker *et al.*, 1997). Production risk is smaller in the livestock sector for most producers, as weather has a smaller effect on production. Boggess *et al.* (1985) found that farmers in north Florida and south Alabama rated production risk as the most important risk source followed by marketing and financial risks.

Market or Price risk is due to the fact that prices can only be predicted during the planning period, with the expected movement of input and output prices affecting farmers' decisions. Therefore, market or price risk emanate from falling output and/or rising input prices after a production decision has been taken. Increasingly, farmers almost the world over are being exposed to unpredictable competitive markets for inputs and outputs, so that market or price risk is often significant and may increase over time (Hardaker *et al.*, 1997: 6). Sonka and Patrick (1984) stated that a major source of concern for farmers is the variability of commodity prices. They also added that even though there was information on seasonal price patterns for commodities, in the 1970s increasing price instability became a greater source of risk to farmers. Uncertainty about the availability of inputs is also another source of market risk. Output price variability was rated as the most important source of risk by a sample of commercial vegetable farmers in KwaZulu-Natal (Bullock *et al.*, 1994). Crop and livestock

price variability was an important source of risk for a sample of commercial farmers in KwaZulu-Natal (Woodburn *et al.*, 1995).

Technological risk refers to changes in machinery, biological and chemical technologies. The farmer can hardly predict these changes. Obsolescence in machinery is a depreciation cost that may be incurred because of the introduction of new machines, making old ones relatively more costly to use (Anaman, 1988). Improvements in monitoring devices to measure residual additives in livestock products cause concern for livestock producers and lead to changes in production practices. Technological developments in transportation, processing and other non-farm sectors can also affect farm incomes (Sonka and Patrick, 1984). A sample of commercial farmers in KwaZulu-Natal perceived technological change as a relatively less important risk source (Woodburn *et al.*, 1995).

Institutional and Legal risk includes government price and income programmes, and tax, trade, credit and environmental policies, all of which have impacts on the operating environment (Sonka and Patrick, 1984). It also involves factors such as contracts regarding purchases and land leases, and political instability caused by internal and/or external factors (Anaman, 1988).

Human or Personal risk relates to death, illness or injury of the farm operator and/or the farmer's labour force. These risks are common to all business operators and employees. Hardaker *et al.* (1997) stated that human or personal risk can be caused by major life crises such as the death of the owner, or the divorce of a husband and wife owning a farm in partnership, prolonged illness of one of the principals, and carelessness by the farmer or farm workers, for example in handling livestock or using machinery, causing injury.

2.1.2.2 Financial risk

Financial risks include rising costs of capital, exchange rate fluctuations, insufficient liquidity and potential loss of equity. In addition to the financial risks associated with leverage, there

are financial risks in using credit. “The most significant of these are unexpected rises in interest rates on borrowed funds, the unanticipated calling-in of a loan by the lender, and the possible lack of availability of loan finance when required” (Hardaker *et al.*, 1997: 6; Barry *et al.*, 2000: 219). Financial risk multiplies the business risk from the equity holder’s viewpoint via the effect of leverage; the larger the portion of debt capital to total capital, the higher the multiplicative factor applied to business risk (Hardaker *et al.*, 1997).

2.1.3 Effects of risk in agriculture

“Risk comes into all aspects of farm management, and all risk involves an unavoidable cost in adverse outcomes or in costs incurred to reduce or avert the consequences of risky outcomes” (Makeham and Malcolm, 1993: 274). Fleisher (1990) wrote that the costs incurred in the presence of risk are direct and indirect. Direct costs are the values of the resources (cash, management time, etc.) allocated to manage the risk, and the indirect costs resulting from incorrect predictions that affect producers and society as a whole due to the misallocation of scarce resources. Furthermore, the capacity of individual farmers to influence resource or commodity prices is limited, which makes their risk bearing abilities weak and thereby hamper farmers’ efficiency and welfare positions (Barry, 1984).

Bankruptcy is a final consequence of risk at a farm level. Swanepoel *et al.* (1998) reported that the number of bankrupt maize farms and extensive beef farms in South Africa rose sharply over the period 1970 to 1994. Financial risk factors (higher lagged aggregate farm leverage and lagged real interest rates) and business risk factors (lower annual rainfall) were the main reasons for the bankruptcy.

The effects of risk on agriculture can be viewed from the farmers’ attitudes toward risk. Risk averse farmers, although they carefully analyse the chances of success, still lose because they miss economic opportunities for including greater profits. Risk-averse individuals are willing to sacrifice a larger amount of expected income to reduce the chance of low or adverse

outcomes (Anaman, 1988). On the other hand, risk-preferring farmers tend to get involved in riskier farm ventures and may fail because they refuse to take precautions (Anaman, 1988).

2.2 Risk Management

2.2.1 Risk-bearing ability

Profit is the reward for risk-taking, therefore anyone in the business of farming, or in any other business, must be prepared to bear some risk (Hardaker *et al.*, 1997). Risk-bearing ability is related to the solvency and liquidity of an individual's financial position.

Solvency is the relationship among total assets, liabilities and owner equity. A low debt to asset ratio would indicate good solvency. Liquidity is the ability to satisfy financial obligations when they fall due without disrupting the farm business. Liquid assets can be converted to cash quickly with little or no loss of value.

Risk-bearing ability is also affected by cash flow requirements. These requirements are the obligations for cash costs, taxes, loan repayment, and family living expenses that must be met each year. The higher these obligations as a percentage of total cash flow, the less able the farm firm can assume risk.

2.2.2 Factors affecting risk preferences

It is generally argued that producers are somewhat risk averse for risks associated with agriculture (Fleisher, 1990). Ortmann *et al.* (1992) found that large Cornbelt farmers were generally more willing to take risks in production than in marketing, and even less in financial decisions. Woodburn *et al.* (1995) found that farmer's age was negatively related to his willingness to take risks, while education level and percentage of land rented were positively related.

Anaman (1988) wrote that farmers with high income and long years of experience tend to undertake more risk than others, whereas higher family responsibilities discourage risk taking as failure in such a case affects the whole family.

2.2.3 Risk management tools

“Risk management strategies are developed to provide some shield in situations in which the consequences of a decision are not known when the decision is made. Risk management strategies consist of a variety of responses, which may reduce the probability of an unfavourable event occurring and/or reduce the adverse consequences if the event occurs. However, in gaining protection from a possible loss, part of the potential gain is generally given up” (O’Toole, 1998: 8). In other words, most responses to risk have a cost associated with them, even if it is not explicit. Generally, farmers would like to avoid major losses, but would also like to be in a position to benefit from favourable events. The aim is to effectively manage risk without excessively sacrificing gains. Barry *et al.* (2000) summarized that the first phase in risk management is to identify strategies to cope with risks and it entails the choice of methods for reducing, transferring, and/or bearing business and financial risks.

There are two approaches in classifying risk responses or methods of dealing with variability. The first approach is to distinguish risk management strategies as: (1) strategies concerning on-farm measures, and (2) risk sharing with others (Hardaker *et al.*, 1997).

On-farm tools: These include selecting products with low risk exposure (e.g. products benefiting from public intervention), choosing products with short production cycles, diversifying production programmes or holding sufficient liquidity.

Risk-sharing tools: These include marketing contracts, production contracts, vertical integration, hedging on futures markets, and insurance.

Another popular approach is to categorize a farmer’s actions to reduce risk by the production, marketing, and financial organizational areas of the farm business (Boehlje and Trede, 1977;

Sonka and Patrick, 1984; Eidman, 1990; Barry *et al.*, 2000). As the names imply, production and marketing responses deal directly with the production and market types of risk. Production responses generally act to reduce risk by reducing the variability in production. Marketing responses may also reduce risk by narrowing the range of possible outcomes or may involve transferring price risks to other individuals or institutions. In contrast, financial responses generally emphasize the firm's capacity to bear risk and do not reduce the probability of an unfavourable event. Financial responses, such as insurance, may also transfer risks to others and provide the means with which the firm can withstand adverse consequences should they occur.

2.2.3.1 Production responses to risk

There are a number of production responses to yield variability that can be made by farmers. These responses generally involve trading a reduction in the level of average income for reduced year-to-year variability of income. Production responses such as diversification, selecting risk reducing inputs, etc., have traditionally been very important in risk management, but they have declined in relative importance as farms have become larger, more specialized, and more capital intensive (Hardaker *et al.*, 1997).

According to the study by Ortmann *et al.* (1992), the most important production responses considered by large US Cornbelt farmers were: having timely access to machinery, being a low cost producer, and diversification of farming enterprises. Bullock *et al.* (1994) found a similar result except that commercial vegetable farmers considered irrigation as the most important production response, followed by being a low cost producer, having timely access to machinery, and diversification respectively. The following are some possible production responses:

Selecting less risky inputs and technology:- Farmers frequently select the technical inputs and the system of production to reduce risk. Irrigation is frequently cited as an input that reduces production risk in arid regions. It is evident that some farming activities give more

stable returns over time than others. For example, intensive livestock production is likely to be more stable, at least in terms of level of production achieved, than is extensive grazing, since the latter is more exposed to the effect of climatic variability (Hardaker *et al.*, 1997).

Sonka and Patrick (1984) stated that farmers often might invest in excess machinery capacity to offset unfavourable weather, and some livestock producers maintain feed reserves to offset drought. But the cost of additional machinery, carrying feed reserves, and feed deterioration must be compared with the possible loss due to risk. Eidman (1990) agreed that practices like antibiotics in livestock feed, insecticides in crop production and other chemicals may be routinely used, though not always required. Planting several varieties of a crop may reduce possible losses from weather, insects and diseases.

Use of relevant information:- Whether or not risk aversion matters, better decisions in a risky world can always be made if more information is available (Hardaker *et al.*, 1997). Such information may include improved varieties of crops and livestock, production techniques, fertilizer application rates, procedures for getting credit, land acquisition procedures, price trends, and weather forecasts.

Enterprise and/or geographical diversification:- Diversification is a strategy long used by farmers to deal with price or weather induced production variability. Producers can diversify by engaging in many different activities in one time period, engaging in the same activity in many different physical environments or locations, or engaging in the same activity over many successive periods of time (Fleisher, 1990). The idea behind a diversification strategy is to let profits from one type of livestock or crop enterprise more than offset losses in another enterprise (Debertin, 1986). However, there may be a trade-off with cost-increasing effects linked to this strategy, i.e. a higher cost for additional equipment and costs in terms of forgone economies of size, which would alternatively be achievable with higher degrees of specialization. Eidman (1990) reported that the variability of average gross income from a combination of corn, soybeans and wheat on Indiana farms was lower than either a corn and soybean combination or specialization in corn.

Geographic dispersion of cropland is another form of diversification. This strategy involves operating cropland located over a wide geographic area to minimize losses associated with highly localized, severe storms and other hazardous events (Sonka and Patrick, 1984).

2.2.3.2 Marketing responses to risk

The increased variability of commodity prices has increased farmers' awareness of price risks and placed a premium on good marketing skills. Many farmers have attempted to improve their knowledge of marketing and developing new marketing skills. New marketing responses to price variability, like options trading and minimum price contracts, are being developed. Some marketing responses reduce risk by reducing price variability, but other marketing responses involve the transfer of risks to others (O'Toole, 1998). Commonly, producers utilize a combination of the marketing responses in their farm operations. Marketing orders, commodity programmes and government action in input and product markets may significantly alter the amount of price risk and the opportunities to reduce it (Eidman, 1990).

In a survey conducted among commercial farmers in KwaZulu-Natal, selling on the free market, use of market information, and keeping marketing records were ranked as the most important marketing responses (Woodburn *et al.*, 1995). On the other hand, Ortmann *et al.* (1992) found that government farm programme participation, forward contracting and hedging the selling price of crops were the three most important marketing responses on large US Cornbelt farms.

Farmers may be able to identify commodities with relatively low price variability. In many countries, low price variability has often been associated with commodities facing substantial regulation of the market (Eidman, 1990). Farmers also have the opportunity to contract both for future delivery of some inputs and the future sale of many livestock and crop commodities (Eidman, 1990). In an Indiana study, 64 percent of the sample farmers partially forward contracted their soybean crop (Sonka and Patrick, 1984).

The use of futures contracts or hedging is another marketing response, which could reduce risk. Most futures contracts are offset by opposite trades before delivery time, with each party to the transaction selling or buying futures contract that was initially bought or sold. Ninety-five percent of futures contracts are liquidated by offsetting trades before delivery is due. When producers and users of agricultural commodities use future markets to act as a temporary substitute for a future-intended cash transaction, they are exercising the use of hedging (Fleisher, 1990). A hedge differs from a forward contract because the basis is not fixed. Basis is the difference between the futures price and the local market price. The main disadvantages of hedging are basis risk, the limited availability of contracts, their discrete size, brokerage fees and the money required for margin calls (Eidman, 1990).

Options differ from the two forms of forward contracts, they convey the right, but not the obligation, to buy or sell at a specified price during a specified period of time. Moreover, the good traded in the market is not the actual agricultural commodity; if an individual chooses to exercise the option, a future contract is received (Fleisher, 1990).

“The value of an option reflects the expected return from exercising the right before it expires and disposing of the futures position obtained. If the future prices change in favour of the option holder, a profit may be realized either by exercising the option or selling the option at a price higher than paid. If prices move so that exercising the option is not favourable, the option may be allowed to expire” (Harwood *et al.*, 1999: 36).

Evidence suggests that hedging on the futures market is not used much by farmers, even in the USA. Only 12% of a sample of Indiana soybean farmers hedged part of their product (Sonka and Patrick, 1984). The South African Futures Exchange (SAFEX) currently trades in contracts for a number of agricultural commodities such as yellow maize, white maize and wheat (Van Zyl *et al.*, 1999). “ The trend toward increased producer desired use of SAFEX implies that farmers are moving toward finding an optimal hedging strategy as their

experience with hedging increases from using hedging to account for current price relationships” (Bown *et al.*, 1999: 298).

Marketing decisions also involve learning because new information becomes available during the marketing period. In highly efficient commodity markets the new information is quickly reflected in commodity prices (Sonka and Patrick, 1984). Information can be obtained from both the public and private sectors.

2.2.3.3 Financial responses to risk

Use of marketing responses to reduce price risk has increased with the greater variability of commodity prices, but price variability has not been eliminated. As a result, the importance of financial responses to risk has increased (Sonka and Patrick, 1984). Financial responses to risk generally affect the firm's solvency (debt/equity ratio) or liquidity positions.

Studies conducted by Swanepoel and Ortmann (1993) and Woodburn *et al.* (1995) suggest that the most important financial responses to risk were financial record keeping, debt management, and maintaining financial/credit reserves. The use of insurance as financial response was perceived as less important in both studies. Some financial responses of farmers to risk include the following (Eidman, 1990).

Holding assets for sale to meet cash demands:- It may be highly worthwhile for farmers to hold liquid assets, which can be switched to other uses easily without incurring more time and cost. Farmers typically hold cash and some liquid assets (e.g. grain, forage, livestock ready for slaughter) that can be converted to cash without impairing the ongoing operation.

Maintaining liquid credit reserves:- A credit reserve is the difference between the total loan amount available to the farmer and amount actually used. Holding credit reserves as a source of liquidity provides a means of generating cash that avoids the costs associated with liquidating productive assets to meet cash demands and then reacquiring assets later when

adverse conditions have passed. However, the costs of maintaining and borrowing from credit reserves must be considered (Barry *et al.*, 1981). The direct costs of holding credit reserves are in most cases low, whereas the opportunity costs, in terms of the return on the foregone investment, may be substantial.

2.3 Theories of Information

Information is defined as the screening, editing and evaluation of data in the context of a particular decision-making process (Caspari, 1968 cited by Chavas and Pope, 1984). Information is an investment since the cost of obtaining it aims to achieve benefits, such as better decision-making. The probability of a farmer reducing the impact of risk is positively correlated with the quality of information he has.

2.3.1 The Value of information

Information has become a critical input into the production, marketing and distribution process of farm and farm-related firms. Its critical role evolves from a need for more effective management strategies as agriculture copes with rising instability and change (Jones *et al.*, 1989). The link between information, decision and firm performance is well established and has been a major topic of research for several generations of economists (Ford and Babb, 1989). Barry *et al.* (1988) reported that information reduces uncertainty at all stages of production by allowing a farmer to measure, evaluate and improve the performance of his business.

The value of information is measured in terms of its impact on the profitability of a business. The provision of information can be effective and productive only if it is aimed at the requirements of those who utilise the information for decision-making (Frick and Groenewald, 2001). The more appropriate the information a farmer has the better he can decide on his business strategy.

2.3.2 Demand for information

Changing times also bring changes in the need for information. Ortmann *et al.* (1993) stated that farmers' demand for information has increased in recent years with increased market instability, more complex production technologies and greater need for financial planning and control. Although it is true that information is vital for decision-making, the demand for it depends on the cost of acquiring and the benefits of using the information. What the farmer has to decide is whether the benefits of the additional information outweigh the costs of obtaining it. When farmers have alternatives to choose among many information sources, they select those sources that yield the highest marginal benefit (Jones *et al.*, 1990). Since different types of enterprises face different types of risk, the demand for information also differs from enterprise to enterprise. Schnitkey *et al.* (1992) found that farm type was an important variable in explaining the differences in information preferences.

2.3.3 Information sources

“Historically much of the needed information has come from extension and university outlets. However, in the new information age, commercial sources of information have developed to serve agriculture” (Ford and Babb, 1989: 465). Information sources can be grouped into many ways. Some classify them as internal and external Brown (1989) and Joubert and Laubscher (1989) or formal and informal (Hildebrand and Ortmann 1994). Farm record system is the main internal sources of information (Brown, 1989). External information can be obtained from public or private sectors (Joubert and Laubscher, 1989). Hildebrand and Ortmann (1994) indicated that formal information sources include, for instance, media, specialists and conferences, while informal sources include own farm records. Computerization has improved the quality and quantity of information available so that farmers with less time can access to more sources of information.

2.4 Formal Insurance

2.4.1 The concept of insurance

Alfred Manes (cited by Jarvie and Nieuwoudt, 1988) defines insurance as “the elimination of the uncertain risk of loss for the individual through the combination of a large number of similarly exposed individuals who each contribute premium payments sufficient to make good the loss caused to any one individual”. Thus, the idea behind insurance is that of risk pooling, which involves combining the risks faced by a large number of individuals who contribute through premium payments to a common fund that is used to cover the losses incurred by any individual in the pool (Hardaker *et al.*, 1997). Insurance, in general, provides protection against adverse economic losses experienced by individuals and firms, including fire, drought, excess moisture, frost, pests, and diseases.

2.4.2 Value of insurance

The decision to buy insurance against risk in agriculture should be an economic one. In making that decision, two factors are critical: 1) Capacity to bear risk without insurance? 2) What are the trade-offs between insurance costs and potential losses? (Casavant and Infanger, 1984). Therefore, insurance is more attractive to risk-averse farmers and in situations where risks warrant paying a premium significantly higher than the expected loss without insurance (Hardaker *et al.*, 1997). However, in some countries government subsidises premiums, making the purchase of insurance more attractive (Eidman, 1990).

2.4.3 Problems in insurance

In a study of insurance there are two basic concepts that should be addressed by both the insurer and insured. They are asymmetric information and systemic risk.

Asymmetric information relates to the problem that the insurer and the insured may not have the same information as regards the probability of losses occurring. The problem could arise due to either adverse selection or moral hazard. Adverse selection occurs if those more at risk purchase more insurance than others, without the insurer being aware of this. As a result, the insurer's expected indemnity outlays exceed total premium income, and, in the long run, the insurance operation loses money (Nieuwoudt, 2000:277). The insurer's effort to avoid these losses by raising premiums only results in a smaller and more adversely selected pool of participants (Miranda, 1991). A common tool that insurance companies use to minimize adverse selection is to ask the insured to disclose any factors that may lead to above normal risk (European Commission, 2001). Moral hazard refers to an individual's change in behaviour after having taken out an insurance policy. Moral hazard problems occur because the insured can take actions, which affect the probability of losses and cannot be observed by the insurer (Nelson and Loehman, 1987).

Systemic risk refers to a situation where a large number of people suffer a loss at the same time. It stems primarily from the impact of geographically extensive unfavourable weather events, such as drought or extreme temperature, which induce significant correlation among individual farm-level yields. As a result, many people make a claim at the same time, with the result that the premium paid into a pool is not sufficient to cover the loss incurred, thereby threatening the solvency of the insurance pool (Nieuwoudt, 2000). One possible reason why the National Insurance Corporation of Eritrea (NICE) is not planning to promote crop insurance is due to the high probability of systemic risk that crop farmers face as a result of unfavourable weather conditions.

2.4.4 Livestock insurance

There are three types of livestock insurance cover. The first, livestock production insurance, would protect farmers from loss and business interruption due to illness or death, as well as recovery of veterinary costs due to on-farm diseases (similar to NICE's livestock insurance policy). The second, net revenue insurance, would protect farmers against losses from the

market place. The third, catastrophe insurance, would protect farmers against extreme price losses due to the emergence of a disease that correlates with rapid decreases in market prices. The first two policies arise from the statistical independence between market prices and farm disease, while the third arises from the remote probability of a catastrophic epidemic of a disease that will be negatively correlated with the market price of livestock (Turvey, 2003).

Following the discussion on sources of risk, management of risk, information and insurance, the next chapter will deal with data sources and respondents' characteristics.

CHAPTER 3

DATA SOURCES AND CHARACTERISTICS OF RESPONDENTS

The aim of this chapter is to explain the design of the questionnaire used, sources of data, data collection methods and farm and respondents' characteristics.

3.1 Questionnaire Design

The questionnaire used was based on the study by Woodburn *et al.* (1995). A pilot survey was conducted on ten farmers in Eritrea to test the relevance of the questionnaire to Eritrea's current situation. As a result, certain changes have been made to the original questionnaire and the farmers that were participated in the survey were also interviewed owing to changes made later on. After considering the valuable feedback, the final questionnaire, which has six main parts, was used. The first part deals with general information about the farm, e.g. location, business type, amount of land actually used, etc. The second part identifies various sources of risk in crop, horticulture (fruits and vegetables), livestock and poultry production. Several suggested management responses to risk are listed and briefly described in the third part of the questionnaire. The fourth part deals with livestock insurance, while information required for farm decisions is dealt with in the fifth part of the questionnaire. Finally, in the last section of the questionnaire information on the socioeconomic characteristics of farmers, such as age, experience in farming, level of education, etc., is elicited. The questionnaire is presented in appendix A.

3.2 Data Collection Method

Face-to-face interviews were used to get responses to the questionnaire. A face-to-face interview was preferred for a country like Eritrea, which has a low literacy rate. "Due mainly to the relatively low level of literacy of the South African population, face-to-face interviews are the most common method to collect survey data in national surveys in South Africa"

(Babbie and Mouton, 2001: 249). Although a postal survey is efficient in terms of covering a large number of people simultaneously with limited funds and its assurance of remaining anonymous, the fact that many commercial farmers in Eritrea have no access to postal services limits the use of a postal survey in this study. The most important advantage of face-to-face interviews over other methods is that the researcher has the opportunity to personally observe, be flexible and clarify questions so as to encourage the farmer to respond as much as possible. The researcher and two assistants, who were familiarized with the nature of the questionnaire, fully participated in the interview process. Approximately four to five farmers were interviewed daily. Because of the perception of farmers that students and researchers are government's information suppliers, farmers in Eritrea are reluctant to provide genuine information. Therefore, every effort was made to convince these farmers that the aim of the study was solely for research purposes and that the results would finally benefit them.

3.3 Data Source

Data for this study were collected from three Zobas of Eritrea, namely Maekel, Dehub and Gash-Barka, between November 2002 and February 2003. Farmers to be interviewed were randomly selected from a list that was provided by the Ministry of Agriculture. A summary of the sample proportions is presented in Table 3.1.

Table 3.1: Sample proportions in Eritrean study

Enterprise	Zoba									Total		
	Maekel			Dehub			Gash-Barka			N	n	%
	N*	n**	%	N	n	%	N	n	%	N	n	%
Poultry	180	16	8.9	210	22	10.5	12	2	16.7	402	40	10.0
Dairy	300	23	7.7	320	40	12.5	62	11	17.7	682	74	10.9
Horticulture	26	2	7.7	58	5	8.6	305	24	7.9	389	31	8.0
Crop	12	1	8.3	60	5	8.3	420	35	8.3	492	41	8.3
Total	518	42	8.1	648	72	11.1	799	72	9.0	1965	186	9.5

* N represents the number of the total population

** n represents the number of farmers in the sample.

The number of sample farmers involved in four enterprises and three Zobas are roughly proportional to the number of farmers in the population. The sample of 186 farmers, of whom 42 are from Zoba Maekel and 72 from each of the Zobas Debub and Gash-Barka, was interviewed. Of the sample, 40 are poultry farmers, 31 horticultural, 74 dairy, and 41 crop farmers. Four poultry, three horticultural, and six crop farmers did not wish to be interviewed, and six poultry, five horticultural, and ten commercial crop farmers were also not available during the data collection time. These farmers were replaced with other randomly selected farmers to keep the sample size unchanged.

3.4 Characteristics of Respondents

Respondents' characteristics, such as farmers' age, education and farming experience, and business type and its arrangements, farm and off-farm income are some of the socioeconomic variables that affect decision-making. Except for two poultry and three dairy farmers, the sample farmers are male. Moreover, all sample farmers were married.

3.4.1 Business arrangements and farm size

The average size of farms in Zoba Maekel is 1.1 hectares (median 1 hectare), 4.3 hectares in Zoba Debub (median 4.6) and 96 hectares in Zoba Gash-Barka (median 75.5 hectares, due to large scale crop and horticulture farming). The average area operated by sample poultry farms is 1.46 hectares, dairy farms 2.08, horticulture farms 102 hectares, and 87.9 hectares for crop farms.

Individual ownership² of the land accounts for over 74% of the sample farmers, followed by family ownership³ (22%), while the remaining 4% comprises association ownership (Table 3.2). There are similarities in the pattern of the percentage of land ownership between poultry and horticulture farms. The percentage of individual ownership of crop commercial farms is 100%. Family ownership is high on dairy farms as compared to other types of farms.

² Ownership implies the right only to use the land and not the right to hire, transfer or sell it.

³ Family ownership, unlike individual ownership, involves partnership between family members.

Table 3.2: Frequency of types of business arrangements in Eritrean study (n=186)

Business Arrangement	Number of respondents					Percentage
	Poultry	Dairy	Horticulture	Field Crop	Total	
Individual Owner	29 (72%)	45 (61%)	23 (74%)	41 (100%)	138	74.2
Family Partnership	9 (22%)	26 (35%)	6 (19%)	0 (0%)	41	22.0
Association	2 (5%)	3 (4.1%)	2 (6.5%)	0 (0%)	7	3.8
Total	40	74	31	41	186	100.0

3.4.2 Farmers' age, experience and education

About 20% of sample farmers (mostly poultry farmers) were between 40 and 50 years of age (Table 3.3). The age of the majority of sample farmers (56%) lies between 51 and 60 years. Forty two percent of sample dairy farmers were between 61 and 70 years old.

Table 3.3: Age (in years) of sample commercial farmers, Eritrea (n=186)

Years	Number of respondents					Percentage
	Poultry	Dairy	Horticulture	Field Crop	Total	
40-50	22 (55%)	6 (8%)	5 (16%)	5 (12%)	38	20.4
51-60	18 (45%)	37 (50%)	19 (61%)	30 (73%)	104	55.9
61-70	0 (0%)	31 (42%)	7 (23%)	6 (15%)	44	23.7
	40	74	31	41	186	100.0

With an average and median age of farming experience of 14 and 13.8 years respectively, 65% of the commercial farmers sampled had less than 15 years of farming experience. Only 12% had more than 20 years of farming experience.

In Table 3.4 about 29% of sample farmers, mostly poultry farmers, had a farming experience of less than ten years. About 60% of sample dairy producers and 36% of crop farmers had over 16 years of farming experience.

Table 3.4: Farming experience (in years) of sample commercial farmers, Eritrea (n=186)

Years	Number of respondents					Percentage
	Poultry	Dairy	Horticulture	Field Crop	Total	
4-10	33 (82.5%)	7 (9.5%)	11 (35%)	3 (7.3%)	54	29.0
11-15	7 (17.5%)	24 (32%)	12 (39%)	24 (59%)	67	36.0
16-20	0 (0%)	30 (41%)	5 (16%)	7 (17%)	42	22.6
21-25	0 (0%)	10 (14%)	2 (6.5%)	6 (15%)	18	9.7
> 25	0 (0%)	3 (4.1%)	1 (3.2%)	1 (4.1%)	5	2.7
Total	40	74	31	41	186	100.0

About 58% of the respondents (mostly dairy and field crop farmers) had completed primary and junior school, 32% reached secondary school, and 8% completed either technical school or college. Only 1% and 2% of the respondents (poultry and horticulture farmers) were graduates with diplomas and first degrees, respectively (Table 3.5).

Table 3.5: Educational level of sample commercial farmers, Eritrea (n=186)

Formal Education	Number of respondents					Percentage
	Poultry	Dairy	Horticulture	Field Crop	Total	
Primary and Junior	11 (27.5%)	50 (68%)	12 (39%)	34 (83%)	107	57.5
Secondary	19 (47.5%)	18 (24%)	15 (48%)	7 (17%)	59	31.7
College/technical school	6 (15%)	6 (8.1%)	2 (6.5%)	0 (0%)	14	7.5
2 years graduated (diploma)	1 (2.5%)	0 (0%)	1 (3.2%)	0 (0%)	2	1.1
4 years graduated (degree)	3 (7.5%)	0 (0%)	1 (3.2%)	0 (0%)	4	2.2
Total	40	74	31	41	186	100.0

Generally, sample dairy and crop farmers, as compared to horticulture and poultry farmers, are relatively older, less educated and more experienced.

3.4.3 Farm income

About 75% of the sample farms had an annual gross income of less than 450 000 Nakfa, 21% between NKF451 000 and NKF750 000, and only 4% had a turnover of more than NKF751 000 (Table 3.6). Sample dairy farmers appear to have the highest turnover on average, indicating relatively greater liquidity, compared to other farmers.

Table 3.6: Farm business turnover of sample commercial farmers, Eritrea (n=186)

Nakfa (1000)	Number of respondents					Percentage	Cumulative Percentage
	Poultry	Dairy	Horticulture	Crop	Total		
< 150	21 (52%)	0 (0%)	0 (0%)	19 (46%)	40	21.51	21.5
151 - 300	14 (35%)	12 (16%)	5 (16%)	16 (39%)	47	25.27	46.8
301 - 450	4 (10%)	31 (42%)	12 (39%)	5 (12%)	52	27.96	74.7
451 - 600	0 (0%)	18 (24%)	8 (26%)	1 (2.4)	27	14.52	89.3
601 - 750	0 (0%)	10 (14%)	2 (6.5%)	0 (0%)	12	6.45	95.7
> 751	1 (2.5%)	3 (4%)	4 (1.3%)	0 (0%)	8	4.30	100.0
	40	74	31	41	186	100	

About 38 percent of respondents (most of them field crop farmers) had a zero mean debt to asset ratio (Table 3.7). Thirty respondents (16.1 percent) indicated debt-asset ratios greater than one. About 54% of respondents had debt-asset ratios of less than 0.5, indicating that half of the respondents are solvent. A debt-asset ratio of 0.5 or less is generally accepted as safe and a ratio of 1.0 or higher indicates that the farm is insolvent (Van Zyl *et al.*, 1999; Barry *et al.*, 2000).

Table 3.7: Frequency distribution of farm debt-asset ratio of sample commercial farmers, Eritrea (n=186)

Mean D/A (percentage)	Number of respondents					Percentage	Cumulative Percentage
	Poultry	Dairy	Horticulture	Crop	Total		
0	12 (30%)	23 (31%)	6 (19%)	30 (73%)	71	38.2	38.2
0.1-9.9	1 (2.5%)	0 (0%)	0 (0%)	0 (0%)	1	0.5	38.7
10-19.9	2 (5%)	0 (0%)	0 (0%)	0 (0%)	2	1.1	39.8
20-29.9	1 (2.5%)	3 (4%)	2 (6%)	0 (0%)	6	3.2	43.0
30-39.9	5 (12.5%)	4 (5%)	0 (0%)	0 (0%)	9	4.8	47.9
40-49.9	2 (5%)	4 (5%)	3 (10%)	3 (7%)	12	6.5	54.3
50-69.9	5 (12.5%)	8 (11%)	4 (13%)	4 (10%)	21	11.3	65.6
70-99.9	7 (17.5%)	17 (23%)	6 (19%)	4 (10%)	34	18.3	83.9
≥100	5 (12.5%)	15 (20%)	10 (32%)	0 (0%)	30	16.1	100.0
Total	40	74	31	41	186	100	

3.4.4 Off-farm income

As shown in Table 3.8, about 60% of the sample farmers engage in off-farm businesses (e.g. shops, trucks, buses, flour-mills, import-export trade), 11% partner their spouses in off-farm

businesses, 3% of the farmers' spouses had off-farm income, and 26%, mainly dairy farmers, were not involved in any other activities. About 90% of sample field crop farmers (due to the highly risky nature of crop farming), 65% of poultry farmers, 47% of dairy producers and 45% of horticulture farmers had off-farm investments. While 39% of sample horticulture farmers partner their spouses in off-farm investments, about 39% of dairy farmers had no off-farm income.

Table: 3.8 Off-farm investments of sample commercial farmers, Eritrea (n=186)

Investor	Number of respondents				Total	Percentage
	Poultry	Dairy	Horticulture	Field Crop		
Self	26 (65%)	35 (47%)	14 (45%)	37 (90.2%)	112	60.2
Spouse	2 (5%)	2 (3%)	1 (3%)	0 (0%)	5	2.7
Both	7 (17.5%)	1 (1%)	12 (39%)	1 (2.5%)	21	11.3
None	5 (12.5%)	36 (49%)	4 (13%)	3 (7.3%)	48	25.8
Total	40	74	31	41	186	100.0

Having presented the relevant literature review, followed by the data sources and characteristics of respondents, the next chapter will analyse perceptions of risk by the respondents. This will include identifying the main sources of risk that sample farmers in Eritrea are faced with, and then grouping farmers' risk perceptions into other dimensions using factor analysis.

CHAPTER 4

PERCEIVED SOURCES OF RISK

Farmers are exposed to risk that affects their decisions. Due to many factors, such as risk-bearing ability, access to relevant information, availability of risk management strategies, farm type and location, and farmers' characteristics, farmers' perception of risk varies. This chapter presents the distribution of perceptions, as rated by farmers, and explains interrelationships amongst farmers' perceptions of various risks.

4.1 Mean Ratings of Perceived Risk Sources

As part of the survey interview, each respondent was requested to rate 22⁴ sources of risk on a Likert-type scale, ranging from 1 (not important) to 5 (very important) in terms of their influence in farm decision-making. Table 4.1 indicates the mean ratings of various sources of risk for the whole sample of farmers, for all three Zobas, and for each of the four farm types. Over the total sample of farmers, weather and climate (rainfall, wind and temperature) had the highest mean rating (4.32), followed by change in the labour force (4.10), and diseases, pests and weeds (3.98). Changes in the Nakfa exchange rate (3.79), government's demobilization and rehabilitation programmes (3.74) and changes in agricultural tax policy (3.58) also had relatively high mean ratings.

The problem of inadequate rainfall over much of the country, which is compounded by uneven distribution, war that created deployment of large numbers of workers to the military, the inability to control the spread of field crop weeds (particularly *Striga hermonthica*), and imported poultry diseases, could be the main reasons for respondents to consider the first three sources of risk as important (Bekuretsion, 2002).

⁴ The number of risk sources considered in this study was determined by the pilot survey results.

Table 4.1: Relative importance of various sources of risk for sample commercial farmers in three Zobas of Eritrea, 2002/03.

Source of Risk*	Overall** (n=186)	Zoba			Enterprise			
		Maekel (n=42)	Debub (n=72)	Gash-Barka (n=72)	Horticulture (n=31)	Poultry (n=40)	Dairy (n=74)	Crop (n=41)
Weather and climate	4.32(1)	3.80(4)	4.21(1)	4.98(1)	4.35(4)	3.95(7)	4.38(2)	4.59(3)
Change in labour force	4.10(2)	3.08	4.20(2)	4.92(2)	4.87(1)	2.40	4.41(1)	4.73(2)
Disease, pests and weeds	3.98(3)	4.14(2)	3.10	4.60(3)	4.16(5)	4.53(2)	2.88	4.34(4)
Change in Nakfa exchange rate	3.79(4)	4.02(3)	4.08(3)	3.29	4.06(6)	3.65(9)	3.65(5)	3.80(6)
Government's demobilization and rehabilitation programmes	3.74(5)	3.60(6)	3.64(4)	3.97(5)	4.74(3)	4.48(3)	3.08	2.66
Changes in agricultural tax policy	3.58(6)	3.62(5)	3.49	3.56(7)	3.30	4.10(5)	4.09(4)	2.83
Change in input cost	3.40	4.19(1)	3.54(5)	3.05	3.45	3.30	3.22	3.61(7)
Crop yield variability	3.37	3.21	3.29	3.54(8)	1.00	3.93(8)	3.58(6)	4.98(1)
Change in agricultural land policy	3.34	2.24	2.39	4.35(4)	4.85(1)	2.00	2.55	3.95(5)
Insecurity (threat of war)	2.98	2.14	2.97	3.80(6)	3.48	1.95	3.23	3.27
Change in capital cost	2.87	2.60	2.36	2.88	3.42	3.22	2.36	2.46
Change in family relationship	2.80	3.21	3.11	1.69	3.24	2.03	2.47	3.46
Change in availability of credit	2.73	3.17	3.13	1.43	3.55(7)	3.33	2.25	1.80
Crop price variability	2.61	2.31	2.28	2.58	1.00	3.63(10)	2.81	3.00
Availability of inputs	2.50	2.45	2.01	2.56	1.55	4.00(6)	2.63	1.80
Vegetable/Fruit price variability	2.30	1.00	2.17	2.67	4.87(1)	1.00	2.31	1.00
Poultry price variability	1.96	2.62	2.26	1.35	1.00	4.83(1)	1.00	1.00
Technological change	1.93	1.00	1.00	3.36	2.83	2.53	1.30	1.05
Livestock yield variability	1.82	2.45	2.28	1.00	1.00	1.00	4.27(3)	1.00
Poultry production variability	1.79	2.21	2.04	1.00	1.00	4.15(4)	1.00	1.00
Vegetable/Fruit yield variability	1.68	1.00	1.39	1.99	3.29	1.00	1.44	1.00
Livestock yield price variability	1.54	1.48	1.49	1.46	1.00	1.00	3.14	1.00

* The sources of risk are listed in order of their importance in the overall ratings.

** The mean ratings (1= not important and 5 = very important) should be roughly interpreted to give an overall view of the perceived importance of risk sources since the data are ordinal.

*** Figures in parentheses indicate the rankings of risk sources with ratings of 3.5 or above.

Regarding the risk rating in three Zobas and four enterprises, changes in weather and labour force were rated as relatively high by sample farmers in Zobas Debub and Gash-Barka, where relatively large variations in temperature and rainfall occur. In Zoba Maekel, where poultry and dairy farms dominate, farmers considered changes in input costs and animal diseases to be relatively important sources of risk.

The government's plan to introduce receipt-based sales taxes for all business (television-broadcasted interview with the head of Inland Revenue Department, December 2002) was found to have created an additional important source of financial risk for farmers. Farmers in Zobas Maekel and Debub who have relatively better access to television (due to relatively better infrastructure) than farmers in Zoba Gash-Barka, rated changes in agricultural tax policy as an important source of risk. Changes in the labour force, however, was not much of a concern for poultry farmers because of the relatively capital-intensive nature of their business. Most dairy farms in Zoba Debub are diversified, as are horticultural farms, which demand more casual labourers and are therefore more labour intensive. Availability of inputs was considered as an important source of risk only by poultry farmers, possibly because poultry feed is scarce and its supply is monopolized by the government. Most dairy farmers sell their milk to the government-owned milk processing plant to secure feed, which otherwise is difficult to obtain.

Changes in agricultural land policy appears not to concern sample farmers in Zobas Maekel and Debub, possibly because the farmers have not left land idle, and therefore, are not at risk of their land being taken away and redistributed by the state. Crop and horticultural farmers, however, are concerned that implementation by the government of its proposed agricultural land policy shall impact on their land holdings. Sample dairy farmers rated changes in weather and climate (which includes rainfall variability) as the second most important source of risk because they strongly associate drought with livestock yield variability. Sample horticulture and poultry farmers had seven and ten sources of risk with values greater than 3.5 respectively, indicating that farmers perceive that these enterprises are exposed to greater number of risks than dairy and crop farms. While commercial poultry and horticulture farmers consider price variability more important than yield variability (due to high price competition with subsidized farms), dairy and crop farmers rated yield variability higher than price variability.

Owing to political, economic and social differences, between geographic regions and over time, it is not unexpected that results of this study differ from previous studies, which used a similar study approach. Common findings between this study and previous studies include that Boggess *et al.* (1985) and Bullock *et al.* (1994) also identified production and product price risks as being important to farmers in North Florida and South Alabama and KwaZulu-Natal respectively. Moreover, these results also concur with the conclusion reached by Ortmann *et al.* (1992), Bullock *et al.* (1994) and Woodburn *et al.* (1995) that technological change was not perceived as an important source of risk by KwaZulu-Natal farmers. A notable difference is that changes in the labour force is rated as an important source of risk by respondents in this study. An explanation is that many Eritrean farmers expect that many of the large number of Eritreans currently serving in the Defence Force will not return to farming activities once they are demobilized. The government intends to equip people in the military with some knowledge and work experience which will enable them to work in other sectors of the economy.

4.2 Factor Analysis of Risk Sources

Results from means and standard deviations show only the distribution of perceptions for each source of risk. Factor analysis identifies any interrelationships amongst farmers' perceptions of various risks. These relationships may be explained or coincidental. Knowledge of these relationships and an understanding of why heterogeneity exists amongst farmers' perceptions of risks may be useful to policy makers. If orthogonal factors are elicited, this use of factor analysis may be described as an analysis of the dimensionality of risks (Woodburn, *et al.*, 1995). However, some correlation between farmers' perceptions of risk sources may be coincidental and not necessarily related.

From Table 4.1 it is evident that some sources of risk are common to all farmers, whilst others are more specific to particular enterprises. Factor analysis of pooled data (see Appendix D) revealed that indeed the primary sources of heterogeneity amongst farmers' perceptions of risks are attributable to farm type. In order to focus on more meaningful relationships between sources

of risk, it was decided to conduct factor analysis for each farm type separately. Sources of risk for which farmers did not vary in their responses were excluded from these analyses.

Use of principal component analysis was made from the outset to determine how many factors should be included in the analysis. Varimax rotations were also used to transform the provisional factors into new factors that are easier to interpret (Manly, 1994).

4.2.1 Model specification

“FA is a multivariate method that has as its aim the explanation of relationships among several difficult-to-interpret, correlated variables in terms of a few conceptually meaningful, relatively independent factors” (Kleinbaum and Kupper, 1978: 376). FA mathematically can be represented as:

$$X_i = a_{i1}F_1 + a_{i2}F_2 + \dots + a_{im}F_m + e_i$$

Where X_i is the i th observation with a mean of zero and unit variance; $a_{i1}, a_{i2}, \dots, a_{im}$ are the factor loadings for the i th variable, F_1, F_2, \dots, F_m are m uncorrelated common factors, each with mean zero and unit variances; and e_i is a factor specific only to the i th variable, which is uncorrelated with any of the common factors and has mean zero. Since the variance of X_i and F_i is unitary, then:

$$\text{Var}(X_i) = 1 = a_{i1}^2 + a_{i2}^2 + \dots + a_{im}^2 + \text{Var}(e_i)$$

where $a_{i1}^2 + a_{i2}^2 + \dots + a_{im}^2$ is called the communality of X_i (Manly, 1994).

Manly (1994: 95) described three stages to factor analysis:

Step 1: Determining initial factors by principal-components analysis (PCA). PCA provides a technique by which the set of X observed variables could be expressed as a linear combination of a smaller set of Z principal components, which are linearly independent. These principal components are not observable in general, but PCA yields information on these component variables. The first principal component is calculated so that it explains the greatest part of the variation in the sample observation; the second principal component explains the next largest part of the variation, and so on. PCA can be written as:

$$PC_i = w_{i1}X_1 + w_{i2}X_2 + \dots + w_{ip}X_p$$

where PC_i is the score on the i th principal component

$X_1 \dots X_p$ are standardized independent variables

$w_{i1} \dots w_{ip}$ are the component loadings or weights.

Even though the number of principal components (PC_i) is equal to the number of variables (X_i), only few variables (with high Eigen values, normally greater than one) will be used for factor analysis.

Step 2: Rotation of initial factors. The provisional factors are transformed in order to find new factors that are easier to interpret. “The idea behind rotation is the concept of simple structure. A factor structure is considered to be simple if each of the original variables relates highly to only one factor and each factor can be identified as representing what is common to a relatively small number of variables. Thus, simple structure is said to be achieved when, for each factor, the factor loadings for most variables are near zero and the remaining factor loadings are relatively large” (Kleinbaum and Kupper, 1978: 392).

Step 3: Determination of the factor scores. A factor score is a numerical value of a factor F obtained by substituting specific values for the standardized original variables (X 's) into the expression

$$F = w_1X_1 + w_2X_2 + \dots + w_pX_p$$

Based on the factor weights for a number of sources of risk and managerial responses to risk, different dimensions of sources of risk and managerial responses will be identified.

Results of this analysis are presented in Tables 4.2 to 4.5. Only factor loadings with an absolute value greater than 0.4 are shown. Sources of risk with ratings of one (not important) in all observations are excluded from the factor analysis. Mean factor scores were computed for each Zoba. In addition, correlation matrices were computed for elicited factors and a selection of socioeconomic variables including farm size, education, leverage and farming experience to examine if grouping of risk sources in elicited factors can be explained better by considering these variables than by only considering differences between geographic regions. The results of correlation matrices are presented in appendix B.

4.2.2 Poultry farms

The poultry farmers' perceptions of risk varied for 18 of the 22 sources of risk considered. Eighteen sources of risk were included in a factor analysis (Table 4.2). Six components, all with eigenvalues greater than one, were retained. All communalities are greater than 0.5, indicating that most of the variation in each source of risk is accounted for by the six common factors (Manly, 1994). Crop yield variability and poultry production variability are the only sources of risk with the absolute value of loadings exceeding 0.4 in more than one factor.

In Table 4.2, the first factor is the primary source of heterogeneity in poultry farmers' perceptions of sources of risk, accounting for over 24 percent of variations in farmers' responses. It identifies that poultry farmers who are relatively more concerned about animal diseases, are likely to be relatively more concerned about changes in agricultural tax policy but relatively less concerned about crop yield variability, weather and climate changes, and insecurity than other poultry farmers.

On average, farmers in Zoba Gash-Barka have negative scores for this factor, whereas farmers in Zoba Maekel have positive scores and farmers in Zoba Debub have positive but close to zero scores. Reasons include the fact that the climatic and security conditions in Zobas Maekel and Debub are relatively stable. Poultry farmers in Zoba Gash-Barka give less importance to changes in agricultural tax policy, which could be due to them being less aware of tax rate changes (e.g. recent televised government's plan to change the sales tax rate).

Factor 2, which accounted for fourteen percent of the variation in the poultry farmers' perceptions of risk sources, signifies that poultry farmers who are relatively more concerned about changes in input costs seem to be relatively more concerned about crop price variability and changes in the Nakfa exchange rate. Although, on average, farmers in Zobas Maekel and Debub have positive scores and farmers in Zoba Gash-Barka have negative factor scores, the three factor scores are not significantly different from zero. The results of correlation analysis produced a significant positive relationship between this factor and leverage. It follows that

poultry farmers with a relatively high debt to asset ratio are more concerned about sources of risk appearing in this factor than farmers with low leverage.

Table 4.2: Rotated factor loadings* of risk sources and factor scores for sample commercial poultry farmers in three Zobas of Eritrea, 2002/03 (n=40).

		Factor					
		1	2	3	4	5	6
Eigenvalues		4.38	2.57	1.90	1.54	1.18	1.15
Percentage of variance explained		24.33	14.26	10.56	8.57	6.57	6.39
Bartlett's test of sphericity:		Chi-Square = 283.252		Sig. 0.00			
Sources of risk	Communalities**						
Changes in agricultural tax policy	0.826	0.862					
Insecurity (war threat)	0.815	-0.748					
Disease, pests and weeds	0.730	0.757					
Crop yield variability	0.709	-0.686		0.442			
Weather and climate	0.665	-0.616					
Change in input cost	0.783		0.860				
Crop price variability	0.673		0.653				
Change in Nakfa exchange rate	0.555		0.573				
Change in agricultural land policy	0.689			0.805			
Change in labour force	0.615			0.585			
Change in availability of credit	0.657			-0.442			
Technological change	0.716				0.820		
Change in capital cost	0.852				0.764		
Poultry price variability	0.673					0.863	
Government's demobilization and rehabilitation programmes	0.744					0.704	
Change in family relationship	0.737						0.770
Availability of inputs	0.577						-0.673
Poultry production variability	0.616			-0.438			-0.488
Zoba		Factor Scores					
Maekel		2.42	0.83	-0.46	1.16	-0.01	-1.09
Debub		0.80	0.38	-0.34	0.81	0.35	-0.60
Gash-Barka		-4.57	-0.16	1.21	-0.09	-2.08	2.49

* All factor loadings with absolute value > 0.4 are shown.

** Part of the variable's variance that is related to the common factors.

Factor 3, which accounts the next largest proportion of variations in poultry farmers' perceptions of sources of risk, indicates that sample poultry farmers with a relatively high concern for changes in agricultural land policy are likely to be relatively more concerned about changes in the labour force but relatively less concerned about crop yield variability and changes in the availability of credit. On average, farmers in Zoba Gash-Barka have positive scores for this factor, while farmers in Zobas Maekel and Debub have negative scores. Possible reasons for this include that farmers in Zoba Gash-Barka have relatively bigger farm sizes, which are more exposed to the land policy, and are, therefore, reluctant to use credit as a means of funding their farm.

Factor 4 indicates that sample poultry farmers who place relatively more emphasis on technological changes are those who are relatively more concerned about changes in capital costs. The negative correlation between this factor and farm size and the positive factor scores attached to Zobas Maekel and Debub, particularly Zoba Maekel, show that poultry farmers with relatively smaller farm sizes (as is the case of most poultry farms in Zoba Maekel) are relatively more concerned about the introduction of incubators and new poultry houses designed by some poultry farmers, in their effort to be more capital intensive, than other farmers. In factor 5 positive signs for the sources of risk indicate that poultry farmers who are also relatively more concerned about poultry price variability are relatively more concerned about government's demobilization and rehabilitation programme. A positive correlation between this factor and leverage suggests that highly leveraged poultry farmers are particularly concerned about these two sources of risk, possibly because these farmers are most threatened by government-subsidized poultry projects that sometimes sell eggs at below the cost of production on commercial farms (as per discussion with farmers).

The final retained factor indicates a negative correlation between sample poultry farmers' concerns regarding changes in family relationships and the concerns about input availability and poultry production variability. On average, farmers in Zoba Gash-Barka have positive scores for this factor, whereas farmers in Zobas Maekel and Debub have negative scores. This relationship may reflect that in Zoba Gash-Barka malaria is relatively more prevalent and health facilities are relatively poor compared to Zobas Maekel and Debub.

4.2.3 Dairy farms

Twenty⁵ of the 22 sources of risk were considered in a factor analysis of sample commercial dairy farmers. Six components with eigenvalues greater than one were retained (Table 4.3). Except for changes in family relations and changes in agricultural tax policy all communalities are greater than 0.5. This means that most of the variation in each source of risk is accounted for by the six common factors (Manly, 1994). Crop yield variability is the only source of risk with the absolute value of loadings exceeding 0.4 in more than one factor.

Factor 1 shows that sample dairy farmers with relatively more concern for crop price variability are likely to be relatively more concerned about insecurity, change in the labour force, horticulture price variability, weather and climate, crop yield variability and animal disease but relatively less concerned about livestock yield price variability and technological change.

On average, negative scores are attached to farmers in Zoba Maekel for this factor, whereas farmers in Zoba Debub and Gash-Barka have positive scores. The fact that sample dairy farms in Zoba Debub and Gash-Barka are typically diversified and were victims of the recent war with Ethiopia may explain their relatively greater emphasis on insecurity, change in labour force, animal disease, changes in weather, and crop and horticulture price variability compared to farms in Zoba Maekel.

Factor 2 reflects that sample dairy farmers who are relatively more worried about government demobilization and rehabilitation programmes are also those who are relatively more concerned about changes in family relationships but relatively less worried about changes in agricultural tax policy than other farmers. On average, positive and negative factor scores are attached to farmers in Zoba Gash-Barka, and Zoba Debub and Maekel respectively. A correlation analysis indicates that differences in farm size may also contribute in explaining this relationship. The fact that dairy farmers in Zoba Gash-Barka operate in a hot and malaria area may explain why they are relatively more concerned about changes in family relationships than farmers in the other Zoba.

⁵ Poultry yield and poultry price variability were rated as being not important by all dairy farmers surveyed, and were excluded from the analysis

Table 4.3: Rotated factor loadings* of risk sources and factor scores for sample commercial dairy farmers in three Zobas of Eritrea, 2002/03 (n=74).

		Factor					
		1	2	3	4	5	6
Eigenvalues		5.01	2.33	1.82	1.53	1.33	1.15
Percentage of variance explained		25.02	11.66	9.11	7.65	6.66	5.74
Bartlett's test of sphericity: Chi-Square = 607.143		Sig. 0.00					
Sources of risk	Communalities**						
Crop price variability	0.774	0.826					
Insecurity (war threat)	0.719	0.764					
Livestock yield price variability	0.671	-0.706					
Change in labour force	0.729	0.741					
Horticulture price variability	0.831	0.720					
Weather and climate	0.687	0.655					
Crop yield variability	0.728	0.659					0.431
Disease, pests and weeds	0.812	0.507					
Technological change	0.597	-0.493					
Government's demobilization and rehabilitation programmes	0.515		0.641				
Change in family relationship	0.472		0.645				
Changes in agricultural tax policy	0.332		-0.539				
Change in capital cost	0.706			0.782			
Livestock yield variability	0.574			-0.585			
Horticulture yield variability	0.706			-0.581			
Change in Nakfa exchange rate	0.605				0.766		
Change in input cost	0.694				0.715		
Change in agricultural land policy	0.662					0.791	
Change in availability of credit	0.615					-0.591	
Availability of inputs	0.742						0.826
Zoba		Factor Scores					
Maekel		-5.67	-1.91	0.63	-0.99	-1.40	-0.37
Debab		1.51	-0.42	-0.43	0.24	0.34	-0.10
Gash-Barka		0.14	0.10	0.73	-0.21	0.21	0.07

* All factor loadings with absolute value > 0.4 are shown.

** Part of the variable's variance that is related to the common factors.

The main dairy farming areas of Zobas Maekel and Debub give relatively less emphasis to governments' rehabilitation and demobilisation programme because such programmes currently are focusing on poultry and horticulture projects.

Factor 3 is not closely related to geographical region, however, a correlation analysis shows that it is negatively related to farm size (correlation coefficient = -0.484). It follows, therefore, that dairy farmers with relatively smaller farm sizes tend to be relatively more concerned about changes in capital cost but relatively less concerned about livestock yield variability and horticulture yield variability than other farmers. Since dairy farmers with relatively larger farm sizes (Zoba Debub) tend to be diversified (mostly horticulture), it is not surprising that they are relatively more worried about changes in horticulture yield variability than others. In factor 4, although in the correlation analysis the variable Zoba is significant, leverage may better explain this factor positively. This factor identifies that sample dairy farmers with high leverage are relatively more concerned about changes in the Nakfa exchange rate and are more likely to be relatively more concerned about changes in input costs as compared to other dairy farmers.

Factor 5 of this analysis shows that sample dairy farmers who place relatively more emphasis on changes in agricultural land policy are likely to be less concerned about changes in the availability of credit as compared to other farmers. Farm size, the significant variable in the correlation matrix, indicates that dairy farmers operating relatively larger farm sizes (positive scores for Debub and Gash-Barka) are relatively more worried than small farm owners with regard to changes in agricultural land policy. The last factor shows that dairy farmers who are relatively more concerned about the availability of inputs are possibly also more concerned about crop yield variability.

4.2.4 Horticulture farms

Sixteen sources of risk were included in the factor analysis of sample commercial horticultural farmers (Table 4.4). Six components with eigenvalues greater than one were retained. Since all communalities are greater than 0.5, most of the variation in each source of risk is accounted for by the six common factors (Manly, 1994). Changes in weather and climate and change in

agricultural land policy are the only sources of risk with absolute value of loadings exceeding 0.4 in more than one factor.

In Table 4.4, factor 1, which accounts for 33.6 percent of the variation in the data, indicates that sample horticulture farmers that place relatively more emphasis on changes in agricultural tax policy tend to be relatively less concerned about changes in family relationships, insecurity, changes in agricultural land policy and weather and climate changes as compared to other horticulture farmers.

On average, farmers in Zobas Dehub and Maekel have positive scores for this factor, whereas farmers in Zoba Gash-Barka have negative scores. The possible reason could be the relatively secure, stable weather conditions, better health facilities and the relative smaller farm sizes these farmers have as compared to farms in Zoba Gash-Barka.

Factor 2 indicates that sample horticulture farmers who are relatively more concerned about horticulture price variability are likely to also be relatively concerned about government's demobilization and rehabilitation programme, weather and climatic changes and changes in the labour force than other horticulture farmers. As the effect of Zoba is weak, the significant variables in the correlation analysis, namely experience (negative) and leverage, were used to explain this factor. It is apparent that commercial horticulture farmers with less farming experience and higher leverage have relatively less capacity to confront the unfair market competition caused by the subsidization of certain horticulture farmers.

From the correlation analysis, leverage and Zoba were significant variables in explaining factor 3. Horticulture farmers who are relatively more concerned about changes in the Nakfa exchange rate seem to be relatively more concerned about changes in input costs, changes in availability of credit and changes in agricultural land policy than other horticulture farmers. These sources of risk are of greater concern for farmers who are relatively more leveraged and specifically operate in Zobas Dehub and Gash-Barka (main horticulture areas). Factor 4 indicates that sample horticulture farmers who are relatively more concerned about changes in capital cost are likely to be also more concerned about technological change.

Table 4.4: Rotated factor loadings* of risk sources and factor scores for sample commercial horticulture farmers in three Zobas of Eritrea, 2002/03 (n=31).

		Factor					
		1	2	3	4	5	6
Eigenvalues		5.38	1.95	1.59	1.30	1.22	1.10
Percentage of variance explained		33.62	12.20	9.92	8.14	7.59	6.74
Bartlett's test of sphericity: Chi-Square = 256.145		Sig. 0.000					
Sources of risk	Communalities**						
Changes in agricultural tax policy	0.923	0.955					
Change in family relationship	0.908	-0.940					
Insecurity (war threat)	0.880	-0.863					
Change in agricultural land policy	0.728	-0.641		0.474			
Horticulture price variability	0.790		0.791				
Government's demobilization and rehabilitation programmes	0.813		0.760				
Weather and climate	0.753	-0.463	0.683				
Change in labour force	0.832		0.557				
Change in Nakfa exchange rate	0.733			0.826			
Change in input cost	0.732			0.758			
Change in availability of credit	0.656			0.530			
Change in capital cost	0.814				0.893		
Technological change	0.723				0.789		
Horticulture yield variability	0.899					0.934	
Disease, pests and weeds	0.858					0.914	
Availability of inputs	0.620						0.511
Zoba		Factor Scores					
Maekel		2.30	-6.81	-2.19	-0.42	-1.02	-0.29
Debub		7.21	0.75	0.12	-0.03	0.06	-0.15
Gash-Barka		-3.69	1.66	0.76	0.11	0.28	0.18

* All factor loadings with absolute value > 0.4 are shown.

** Part of the variable's variance that is related to the common factors.

The result of the correlation analysis indicates that farmers with relatively large farm sizes (Zoba Gash-Barka) are relatively more concerned than other horticulture farmers about changes in capital cost and technological change, which may be due to the very hot climatic conditions,

lower supply of labour and the need to compete with government subsidized horticultural farms using capital-intensive technologies.

Factor 5 identifies that sample horticulture farmers that place relatively more emphasis on horticultural yield variability are likely to be relatively more concerned about plant diseases and pests than other horticulture farmers. Farm size was found to be a significant variable in the correlation analysis to explain factor 5. It follows that sample horticulture farms with relatively larger farm sizes are more exposed to yield variability and plant diseases and pests than smaller farms since larger farms require more capital and labour than smaller farms with regard to crop protection. Availability of inputs is relatively of more concern for farmers in Zoba Gash-Barka than other horticulture farmers, due to poor infrastructure (factor 6).

4.2.5 Crop farms

Sixteen sources of risk were considered in the factor analysis of sample commercial crop farmers (Table 4.5). Only five components with eigenvalues greater than one were retained. Since all communalities are greater than 0.5, most of the variation in each source of risk is accounted for by the five common factors (Manly, 1994). Government's demobilization and rehabilitation programme is the only source of risk with absolute value of loadings exceeding 0.4 in more than one factor.

Factor 1, the primary source of variations in crop farmers' perception of risk source, accounts for 32.65 percent of the variation in the data. It shows that sample crop farmers that are relatively more concerned about changes in agricultural tax policy are those who are relatively less concerned about changes in agricultural land policy, insecurity, changes in family relationships, and disease, pests and weeds than other crop farmers. For this factor, on average, farmers in Zobas Maekel and Debub have positive scores, whereas farmers in Zoba Gash-Barka have a negative score. These concerns are similar to sample horticulture farmers in the same Zoba (see Table 4.4).

Table 4.5: Rotated factor loadings*of risk sources and factor scores for sample commercial crop farmers in three Zobas of Eritrea, 2002/03 (n= 41)

		Factor				
		1	2	3	4	5
Eigenvalues		5.22	2.20	1.64	1.35	1.14
Percentage of variance explained		32.65	13.71	10.24	8.44	7.10
Bartlett's test of sphericity: Chi-Square = 352.956		Sig. 000				
Sources of risk	Communalities**					
Changes in agricultural tax policy	0.868	0.926				
Change in agricultural land policy	0.886	-0.920				
Insecurity (war threat)	0.884	-0.918				
Change in family relationship	0.793	-0.871				
Disease, pests and weeds	0.809	-0.856				
Change in input cost	0.838		0.903			
Change in Nakfa exchange rate	0.732		0.766			
Change in capital cost	0.755		0.744			
Crop yield variability	0.789			0.872		
Weather and climate	0.716			0.785		
Crop price variability	0.721				0.821	
Change in availability of credit	0.715				-0.733	
Change in labour force	0.489				0.452	
Technological change	0.507					0.672
Availability of inputs	0.521					0.543
Government's demobilization and rehabilitation programmes	0.516		-0.468			0.491
Zoba	Factor Scores					
Maekel		9.74	-4.32	-7.93	-0.88	0.41
Debub		7.36	-0.81	-0.65	-0.85	-0.01
Gash-Barka		-2.52	0.49	0.68	0.28	-0.03

* All factor loadings with absolute value > 0.4 are shown.

** Part of the variable's variance that is related to the common factors.

Factor 2, which is the second largest source of heterogeneity in the data, identifies that sample crop farmers that are relatively more concerned about changes in input costs also seem to be relatively more concerned about changes in the Nakfa exchange rate and change in capital cost, but relatively less worried about government's demobilization and rehabilitation programme than other crop farmers. As the negative factor score attached to Zoba Debub and the positive factor score for Zoba Gash-Barka are close to zero, a significant variable from the correlation

analysis, farm size, is included in explaining this factor. Therefore, since bulk purchase of inputs is difficult (availability, hard currency, storage costs) sample crop farmers with relatively larger farm sizes are relatively more concerned about changes in fertilizer, machinery, pesticide and other input costs than farmers with relatively smaller farm sizes.

In factor 3 the positive factor loadings for sources of risk indicate that crop farmers that are relatively more concerned about crop yield variability are also relatively more concerned about weather changes than other crop farmers. In a correlation analysis the significant variables, farm size and Zoba, indicate that crop farmers who own relatively large farms (mainly in Zoba Gash-Barka) are relatively more concerned about crop price variability and are possibly relatively more concerned about changes in the labour force but relatively less concerned about change in the availability of credit (factor 4). This could be due to the highly risky nature of crop farming in Zoba Gash-Barka with farmers being reluctant to use credit knowing that loan repayment is difficult. The last factor indicates that sample farmers who are relatively more concerned with technological change, seem to be relatively more concerned about the availability of inputs and government's rehabilitation and demobilization programme. This relationship could, however, only be coincidental.

Chapter 4 discussed main sources of risk as perceived by sample commercial farmers in three Zobas of Eritrea. Without identifying risk management strategies used by the same respondents, the knowledge of risk sources alone is not of much importance for policy-makers, consultants and researchers. Therefore, the next chapter will discuss managerial tools used by sample farmers in Eritrea in response to the risks they face.

CHAPTER 5

MANAGERIAL RESPONSES TO RISK

The types of risk that farmers in Eritrea are faced with have a major impact on the choice of risk management strategies. Similar to the risk analysis, mean ratings and factor analyses were used to identify the main risk management tools used by sample farmers and to group these managerial responses into various dimensions.

5.1 Mean Ratings of Managerial Responses to Risk

The set of managerial responses included in this study are those considered relevant to Eritrean agriculture. Previous studies, such as Ortmann *et al.* (1992) and Woodburn *et al.* (1995), included alternative sets of risk responses because those studies were conducted in a different institutional environment to that which currently exists in Eritrea. For example, agricultural insurance and future markets are poorly developed or absent in Eritrea and farmers in Eritrea do not have good access to credit, which precludes Eritrean farmers from using risk responses such as purchasing crop insurance, hedging and maintaining credit reserves. Survey respondents were requested to rank the importance of each risk response using a Likert-type scale with a range from one (not important) to five (very important). The mean respondent's rankings of the importance of their production, marketing and financial responses to risk are presented in Table 5.1. The mean ratings are given for the whole sample, for the three Zobas and for four enterprise types.

Only 19 managerial responses were considered in the study, including ten production, five marketing and four financial responses. Increasing sources of information with an average rating of 4.12 was ranked overall as the most important production response followed by choice of production system (3.92), keeping production records (3.41), diversification of farm enterprise (3.22) and being a low cost producer (3.07).

In the study by Woodburn *et al.* (1995), keeping production records, choice of production system, being a low cost producer and diversification of enterprises were ranked highly. In the studies by Ortmann *et al.* (1992), Swanepoel and Ortmann (1993) and Bullock *et al.* (1994), being a low cost producer and diversification were among the highly rated production responses.

Generally, fewer marketing and financial strategies were considered to manage risk in agriculture compared to production responses. Use of marketing information was the highest ranked (3.98) marketing response overall by sample farmers and was also highly rated in the Zobas, and for the four enterprises. Indirect selling, which includes selling to wholesalers, grain board and processing plants, with a mean rating of 3.87, was rated as the next most important marketing response. Horticultural products, particularly vegetables, are marketed by both direct and indirect means because most sample horticulture farmers own retail and/or wholesale businesses. On average, keeping financial records (4.05) and off-farm investments (3.39) are the two most important financial responses that sample commercial farmers in Eritrea use to cope with financial risk in agriculture.

Horticulture farms reflected nine production responses with mean ratings of three or higher. The production responses considered by field crop farmers include increasing sources of information, choice of production system, decrease farm size (labour shortage and/or to minimize losses from bad seasons), increase labour force, timely use of machinery and diversification of farm enterprises. The emphasis of poultry and horticulture farmers on increasing sources of information was on the technical aspects of production, whereas field crop farmers focused on information about weather forecasts and availability of new varieties of seeds.

Choice of production systems used by field crop farmers includes selection of appropriate varieties of crops and timing of seeding. Discussions with extension agents and farmers indicate that farmers grow high-yield crop types (sesame and sorghum) when they expect a good rainy season, otherwise they prefer low-yielding or fast-growing crops to resist drought. Because of the highly risky nature of crop production, field crop farmers rated off-farm investments (e.g. in truck, bus, hotel and shop businesses) as their most important financial response.

Table 5.1: Relative importance of production, marketing and financial responses to risk for sample commercial farmers in three Zobas of Eritrea, 2002/03.

Managerial Responses*	Overall** (n=186)	Maekel (n=42)	Zoba			Enterprise		
			Dehub (n=72)	Gash-Barka (n=72)	Horticulture (n=31)	Poultry (n=40)	Dairy (n=74)	Crop (n=41)
Production responses								
Increase source of information	4.12(1)***	4.27(1)	3.50(4)	4.60(1)	4.65(2)	4.35(1)	2.91	4.56(1)
Choice of production system	3.92(2)	3.20(3)	3.98(1)	4.58(2)	4.68(1)	3.18(5)	3.30(2)	4.51(2)
Keeping production records	3.41(3)	2.80	3.82(2)	3.60(4)	4.23(5)	4.28(2)	3.46(1)	1.90
Diversification of farm enterprise	3.22(4)	2.00	3.78(3)	3.75(3)	4.30(4)	2.20	3.20(3)	3.17(6)
Being low cost producer	3.07(5)	3.62(2)	2.60	3.02(8)	4.32(3)	3.30(4)	3.00(2)	1.60
Increase labour force	2.97	2.60	3.04(6)	3.26(5)	3.40(9)	2.30	2.40	3.74(4)
Increase use of capital items	2.90	2.90	2.80	2.98	3.52(7)	3.80(3)	2.24	2.00
Making timely use of machinery	2.79	2.21	2.90	3.22(6)	3.50(8)	2.23	2.30	3.20(5)
Decreasing farm size	2.50	1.20	3.09(5)	3.20(7)	4.10(6)	1.00	1.00	3.80(3)
Having back-up management	2.30	2.85	2.60	1.60	2.40	2.60	2.80	1.32
Marketing responses								
Use of marketing information	3.98(1)	3.80(2)	3.50(2)	4.60(1)	4.20(1)	4.55(1)	3.80(2)	3.30(2)
Indirect selling	3.87(2)	4.18(1)	4.20(1)	3.20(3)	2.80	4.23(2)	4.20(1)	4.30(1)
Keeping marketing records	2.98	2.98	2.89	3.10(4)	3.35(3)	3.35(3)	2.80	2.39
Speculation	2.28	1.00	2.50	3.30(2)	3.23(4)	1.00	1.65	3.20(3)
Direct marketing to consumer	2.22	1.80	2.10	2.80	3.60(2)	1.40	2.60	1.37
Financial responses								
Keeping financial records	4.05(1)	4.80(1)	4.60(1)	2.80	4.55(1)	4.40(1)	4.31(1)	2.93
Off-farm investments	3.39(2)	2.31	3.22(2)	4.60(1)	4.45(2)	2.48	2.45	4.20(1)
Debt management	2.88	3.40(2)	2.56	2.65	3.60(2)	3.40(2)	2.90	1.40
Insurance	1.33	1.80	1.32	1.00	1.00	1.00	2.28	1.00

* Managerial response to risk are listed in order of their importance in the overall ratings

** The mean ratings (1= not important and 5 = very important) should be roughly interpreted to give an overall view of the perceived importance of managerial response to risk since the data are ordinal.

*** Figures in parentheses indicate the rankings of managerial response to risk with ratings greater than 3.0.

Farmers managing other enterprises placed more emphasis on financial records, although off-farm investments were also rated highly by horticulture farmers. Most sample dairy farmers in Zoba Debub have relatively large farms compared to sample farmers in Zoba Maekel and they incorporate horticultural activities on their farm to reduce income variability. Only a few highly skilled poultry farmers had two types of chickens (high-yield but sensitive to disease, and low-yield but resistant to disease) on their farm, but the remainder keep one type of chicken since different chicken breeds (diversification) demand different management and production systems.

Farmers show large variation in their use of some risk strategies, such as decreasing farm size, off-farm investment and debt management. Since crop and horticulture farmers have relatively larger farm sizes (hectares) and mainly operate in Zoba Gash-Barka, the relatively more risky area (poor infrastructure, war sensitive area, great variation in weather, relatively high incidence of animal and plant diseases), they tend to focus more on decreasing farm size and having off-farm investments as risk management strategies than poultry and dairy farmers who own relatively smaller farms and operate in a relatively stable area.

Use of marketing information was also rated as an important marketing response to risk in the studies by Woodburn *et al.* (1995), Bullock *et al.* (1994), and Boggess *et al.* (1985). In the studies by Woodburn *et al.* (1995) and Bullock *et al.* (1994), keeping financial records was rated as the most important financial response to risk.

5.2 Factor Analysis of Managerial Responses to Risk

Similar to the analysis of risk sources, use of factor analysis was also conducted for managerial responses to risk according to the four enterprises instead of the pooled data (see appendix D). Use of principal component analysis was essential to identify the initial components (with eigenvalues greater than one) to be used for the factor analysis. A varimax rotation was then applied to get factors that were easier to interpret (Manly, 1994). Results of the analysis are presented in Tables 5.2 to 5.5. Only factor loadings with an absolute value greater than 0.4 are shown. In addition to factor scores attached to Zobas, an attempt has been made to run a correlation matrix (for each enterprise) of the retained factors and socioeconomic variables such as farm size, education,

leverage and farming experience to examine if factors can be explained better by these variables than by Zobas. Similar to risk sources, correlation matrices were computed for elicited factors and a selection of socioeconomic variables including farm size, education, leverage and farming experience to examine if grouping of risk strategies in elicited factors can be explained better by considering these variables than by only considering differences between geographic regions. The results of correlation matrices are presented in appendix C.

5.2.1 Poultry farms

Since sample poultry farmers indicated that managerial risk responses such as insurance, decreasing farm size and speculation are not important (see Table 5.1), only 16 managerial responses to risk were included in a factor analysis of sample poultry farmers (Table 5.2). Six components had eigenvalues greater than one, and accounted for 67.30 percent of the variance in all 16 responses to risk. After rotation, all communalities were above 0.5, implying that the six common factors explain most of the variation in the managerial responses to risk (Manly, 1994). Being a low cost producer was the only risk response with loadings exceeding 0.4 in more than one factor.

The first factor, which explains the largest part of the variation (20.35 percent), identifies that sample poultry farmers who perceived having back-up management as relatively important are likely to be those who considered making timely use of machinery and being a low cost producer as relatively important. Possible reasons could be that poultry farms in Zobas Maekel and Dehub are less diversified, and relatively more capital-intensive as compared to poultry farms in Zoba Gash-Barka. Factor 2 shows that sample poultry farmers who prefer selling to wholesalers are most likely those who are relatively concerned with the choice of production system but less involved in direct selling to consumers than other poultry farmers. The results of a correlation matrix indicated that poultry farmers with relatively smaller farm sizes prefer direct marketing to consumers than to wholesalers.

Factor 3 reveals that sample poultry farmers who have diversified their farm enterprises are those who considered debt management as an important managerial response but were relatively less involved in off-farm investments than others. The positive factor scores for farmers in Zoba Gash-

Barka also shows that sample poultry farmers in this Zoba have diversified their farms relatively more than other poultry farmers.

Table 5.2: Rotated factor loadings* and factor scores of managerial responses to risk for sample commercial poultry farmers in the three Zobas of Eritrea, 2002/03 (n=40).

		Factor					
		1	2	3	4	5	6
Eigenvalues		4.66	2.68	1.68	1.59	1.38	1.33
Percentage of variance explained		20.35	12.53	11.03	9.61	7.30	6.47
Bartlett's test of sphericity		Chi-Square = 171.305		Sig. 001			
Managerial responses	Communalities**						
Having back-up management	0.784	0.835					
Making timely use of machinery	0.537	0.671					
Being a low cost producer	0.817	0.660					0.504
Increase labour force	0.647	-0.584					
Indirect selling	0.852		0.875				
Direct marketing to consumer	0.739		-0.807				
Choice of production system	0.630		0.579				
Diversification of farm enterprise	0.652			0.719			
Off-farm investment	0.587			-0.717			
Debt management	0.732			0.715			
Keeping production records	0.875				0.921		
Keeping financial records	0.834				0.857		
Increase source of information	0.760				0.639		
Keeping marketing records	0.831					0.847	
Use of marketing information	0.710					0.567	
Increase use of capital items	0.770						0.778
Zoba		Factor Score					
Maekel		1.88	0.84	-0.27	0.13	-0.15	0.02
Debub		0.05	-0.33	-0.60	0.25	0.18	0.42
Gash-Barka		-2.87	-0.44	1.44	-0.25	-0.19	-0.93

* Only factor loadings with an absolute value greater than 0.4 are shown.

** Part of the variable's variance that is related to the common factors.

Farm size, the significant variable in the correlation matrix, shows that sample poultry farmers with relatively large farm sizes tend to diversify their farms more than poultry farmers with relatively small farm sizes. On average, the positive factor scores for farmers in Zobas Maekel and Debub in factor 4 indicate that sample poultry farmers in these Zobas who considered keeping financial records as relatively important also indicated the importance of increasing the use of information as a managerial response to risk. Reasons could be that since farmers in these Zobas are relatively more involved in off-farm investments and are more sensitive to tax policy changes, they focus relatively more on record keepings than others. In factor 5 the average positive score for farmers in Zoba Debub shows that poultry farmers in this Zoba who place relatively more emphasis on keeping marketing records are also those who considered using more information for marketing decisions as relatively important. The significant variable in the correlation analysis for factor 6, leverage, indicates that relatively leveraged farmers, particularly in Zobas Maekel and Debub, use relatively more capital in their endeavour to be low cost producers than other poultry farmers.

5.2.2 Dairy farms

Excluding decreasing farm size (with a mean rating of 1), 18 managerial responses to risk were included in a factor analysis of sample dairy farmers. Six components had eigenvalues greater than one and accounted for 70.31% of the variance in all 18 responses to risk (Table 5.3). After rotation, all communalities were above 0.5, implying that the six common factors explain most of the variation in the managerial responses to risk (Manly, 1994). Diversification of farm enterprise and keeping financial records were the only two risk responses with loadings exceeding 0.4 in more than one factor.

Factor 1 in Table 5.3, which is the primary source of variation in the data, indicates that sample dairy farmers who considered increasing the labour force as relatively important also considered farm enterprise diversification and speculation as important risk response tools but perceived increasing use of capital items and having management back-up as relatively less important. On average, farmers in Zobas Debub and Gash-Barka have positive scores in this factor, whereas farmers in Zoba Maekel have negative scores.

Table 5.3: Rotated factor loadings* and factor scores of managerial responses to risk for sample commercial dairy farmers in the three Zobas of Eritrea, 2002/03 (n=74).

		Factor					
		1	2	3	4	5	6
Eigenvalues		3.66	3.01	2.32	1.39	1.31	1.04
Percentage of variance explained		20.37	16.72	12.91	7.27	7.26	5.78
Bartlett's test of sphericity	Chi-Square = 560.810	Sig. 000					
Managerial responses	Communalities**						
Increase labour force	0.708	0.827					
Increase use of capital items	0.657	-0.773					
Diversification of farm enterprise	0.888	0.764			0.485		
Speculation	0.605	0.612					
Having back-up management	0.525	-0.518					
Insurance	0.852		0.893				
Off-farm investment	0.803		-0.839				
Debt management	0.575		0.795				
Keeping financial records	0.570		0.540				0.469
Direct marketing to consumer	0.831			0.887			
Indirect selling	0.753			-0.733			
Choice of production system	0.670				0.715		
Increase source of information	0.633				0.722		
Use of marketing information	0.531				-0.550		
Making timely use of machinery	0.679					0.805	
Being a low cost producer	0.730					0.619	
Keeping production records	0.774						0.843
Keeping marketing records	0.769						0.842
Zoba		Factor Scores					
Mackel		-4.28	1.25	-0.26	-2.25	-0.25	0.38
Debub		2.08	-0.39	-0.70	2.50	0.24	0.26
Gash-Barka		0.67	-1.13	3.50	0.88	-0.46	-0.27

* Only factor loadings with an absolute value greater than 0.4 are shown.

** Part of the variable's variance that is related to the common factors.

The reason could be that most dairy farms in Zoba Debub and Zoba Gash-Barka are diversified with horticultural activities and therefore demand more labour.

Factor 2 shows that sample dairy farmers who purchased livestock insurance considered debt management and keeping financial records as relatively important managerial responses to risk but off-farm investments as relatively less important. The formal education level of the farmer, which was a significant variable in the correlation matrix, indicates that better education helps farmers assess the importance of insurance and record keeping to manage their debt.

On average, a positive score is attached to farmers in Zoba Gash-Barka in factor 3, whereas farmers in Zoba Maekel and Debub have negative scores. Factor 3 shows that sample dairy farmers in Zoba Gash-Barka who sell their milk directly to customers are relatively less involved in indirect selling when compared to other dairy farmers. Since there is no milk processing plant in this Zoba, farmers sell their raw milk directly to consumers on a daily basis.

Factor 4 indicates that sample farmers who considered choice of production system as a relatively important risk response tool are also likely to use more sources of information for production and diversify their farm but they considered marketing information to be relatively less useful than other dairy farmers. On average, the positive factor scores for Zoba Debub and Gash-Barka, particularly Zoba Debub, suggest that farmers in these Zoba use information largely for diversification and choosing the appropriate production systems.

Respondents in Zoba Debub, specifically farmers with relatively higher leverage (correlation matrix result), appear to be relatively cost conscious with their emphasis on timely use of machinery and striving to be low cost producers than other dairy farmers (factor 5). The last factor reveals the relative importance of record keeping as a risk management strategy for sample farmers in Zoba Maekel and Debub owing to positive scores for farmers in these Zoba. Moreover, in the correlation matrix, the level of education of a dairy farmer was positively related with this factor to indicate that relatively better educated farmers use more record keeping than relatively less educated farmers.

5.2.3 Horticulture farms

Eighteen managerial responses to risk (excluding insurance) were included in a factor analysis of sample horticulture farmers. Seven components had eigenvalues greater than one, and accounted for 72.98% of the variance in all 18 responses to risk (Table 5.4). After rotation, all communalities were above 0.5, implying that the six common factors explain most of the variation in the managerial responses to risk (Manly, 1994). Increasing sources of information, diversification of farm enterprise and keeping financial records were the only three risk responses with loadings exceeding 0.4 in more than one factor.

Factor 1 in Table 5.4, which is the main source of variation in the data, identifies that sample horticulture farmers who sell their products directly to consumers are more likely to speculate and use relatively more marketing information, but use indirect selling relatively less than other horticulture farmers. Farmers in Zoba Gash-Barka, on average, have positive scores in this factor, whereas farmers in Zoba Maekel and Debub have negative scores. The fact that most horticulture farmers in Zoba Gash-Barka own outlet shops may explain why they prefer to sell directly to consumers than to wholesalers.

The second factor shows that farmers who considered increasing use of capital as relatively important are most probably those who are increasing use of information and striving to be low cost producers compared to other horticulture farmers. Results of a correlation matrix indicate that this factor is best explained by the variable leverage than by Zoba. This means that farmers who are relatively less leveraged seek more information and intensify use of capital items to be low cost producers.

In factor 3 farmers in Zoba Gash-Barka have positive scores, on average, whereas farmers in Zoba Maekel and Debub have negative scores. It follows that horticulture farmers in Zoba Gash-Barka who place relatively more importance on record-keeping are likely to be those who seek to decrease their farm sizes compared to other horticulture farmers. Farmers with market outlets in Zoba Gash-Barka require more information and record-keeping as compared to farmers without market outlets.

Table 5.4: Rotated factor loadings* and factor scores of managerial responses to risk for sample commercial horticulture farmers in the three Zobas of Eritrea, 2002/03 (n=31).

	Factor							
	1	2	3	4	5	6	7	
Eigenvalues	4.48	2.88	1.68	1.46	1.33	1.19	1.13	
Percentage of variance explained	24.90	10.42	9.33	8.08	7.40	6.58	6.27	
Bartlett's test of sphericity Approx. Chi-Square = 189.678 Sig. 0.023								
Managerial responses	Communalities**							
Direct marketing to consumer	0.778	0.851						
Speculation	0.805	0.862						
Indirect selling	0.720	-0.753						
Use of marketing information	0.729	0.560						
Increase use of capital items	0.831		0.832					
Increase source of information	0.622		0.565	0.444				
Being a low cost producer	0.755		0.556					
Keeping marketing Records	0.917		0.856					
Keeping production records	0.800		0.820					
Decrease farm size	0.585		0.467					
Debt management	0.657			0.780				
Increase labour force	0.684			0.686				
Off-farm investment	0.689			0.617				
Diversification of farm enterprise	0.768				0.854	0.403		
Choice of production system	0.614				0.730			
Making timely use of machinery	0.799					0.871		
Having back-up management	0.785						0.645	
Keeping financial records	0.601		0.431				0.432	
Zoba		Factor Scores						
Mackel		-1.99	-1.14	-1.93	-0.69	-0.58	-1.05	-0.68
Debub		-1.20	0.57	-0.29	-0.44	0.32	-0.83	0.21
Gash-Barka		2.93	0.71	0.79	0.49	0.38	0.84	0.08

* Only factor loadings with an absolute value greater than 0.4 are shown.

** Part of the variable's variance that is related to the common factors.

A correlation analysis for factor 4 indicates that farmers with higher leverage struggle relatively more to manage their farm debts and appear to use relatively more labour and are relatively more involved in off-farm investments than other horticulture farmers. The significant variable farm size in the correlation analysis shows that farmers with relatively larger farm sizes are relatively more diversified and have a relatively better chance to manage machinery and choose appropriate production systems than other horticulture farmers (factors 5 and 6). The last factor identifies that, owing to positive scores, farmers in Zobas Dehub and Maekel who have relatively more back-up management seem to be more focused on keeping financial records than other horticulture farmers.

5.2.4 Crop farms

In a factor analysis of sample crop farmers, 18 managerial responses to risk were included. Six components with eigenvalues greater than one accounted for 72.98% of the variance in all 18 responses to risk (Table 5.5). After rotation, all communalities were above 0.5, implying that the six common factors explain most of the variation in the managerial responses to risk (Manly, 1994). Off-farm investment, diversification of farm enterprise and keeping financial records were the only risk responses with loadings exceeding 0.4 in more than one factor.

The first factor in Table 5.5 shows the relative importance of decreasing farm size, off-farm investments and timely use of machinery, and the relative less importance of being a low cost producer to sample crop farmers in Zoba Gash-Barka compared to crop farmers in other Zobas. The unpredictable amount and distribution of rainfall and the yet uncontrolled weed infestations make crop farming in Zoba Gash-Barka a highly risky business. Therefore, it is expected that farmers in this Zoba respond by investing off-farm, temporarily decrease the cultivable area (to reduce loss) and make timely use of machinery (for cultivation). In factor 2, on average, the positive factor score for Zoba Gash-Barka and the negative factor scores for Zobas Maekel and Dehub indicate that sample farms in Zoba Gash-Barka that tend to be relatively labour intensive (weeding) appear to be relatively more diversified but use relatively less capital as compared to farmers in the other Zobas. Crop farmers in Zoba Gash-Barka hire more casual workers to clear weeds as this Zoba is highly affected by weed infestation.

Table 5.5: Rotated factor loadings* and factor scores of managerial responses to risk for sample commercial crop farmers in the three Zobas of Eritrea, 2002/03 (n= 41).

	Factor						
	1	2	3	4	5	6	
Eigenvalues	4.95	3.26	1.77	1.22	1.11	1.03	
Percentage of variance explained	27.51	18.10	9.85	6.79	6.16	5.72	
Bartlett's test of sphericity	Chi-Square = 367.286		Sig. 000				
Managerial responses	Communalities**						
Decrease farm size	0.819	0.866					
Off-farm investment	0.654	0.704			0.564		
Making timely use of machinery	0.634	0.584					
Being a low cost producer	0.861	-0.539					
Increase labour force	0.681		0.855				
Increase use of capital items	0.812		-0.735				
Diversification of farm enterprise	0.638		0.668		0.423		
Indirect selling	0.802			0.890			
Direct marketing to consumer	0.849			-0.868			
Speculation	0.765			-0.566			
Use of marketing information	0.580			-0.538			
Increase source of information	0.517				0.875		
Choice of production system	0.772				0.820		
Having back-up management	0.634					0.711	
Debt management	0.810					-0.526	
Keeping production records	0.808						0.739
Keeping marketing records	0.771						0.512
Keeping financial records	0.865					-0.454	0.466
Zoba		Factor Scores					
Maekel		-1.62	-0.84	-0.63	-1.51	-1.69	0.05
Debub		-1.67	-1.61	0.35	0.40	-0.78	0.37
Gash-Barka		0.54	1.99	3.13	4.46	0.31	-0.10

* Only factor loadings with an absolute value greater than 0.4 are shown.

** Part of the variable's variance that is related to the common factors.

Diversifying the farm enterprise is important for crop farmers in this Zoba because it reduces the weed problem and income variability.

Factor 3 shows that sample crop farmers who sell their crops indirectly are likely to consider direct marketing, speculation and use of marketing information as relatively less important strategies than other crop farmers. On average, farmers in Zobas Debub and Gash-Barka have positive scores in this factor, whereas farmers in Zoba Maekel have negative scores. Most farmers in Zobas Debub and Gash-Barka sell their crops to the grain board (indirect selling), while sample crop farmers in Zoba Maekel sell directly to consumers and also engage in speculation. The presence of increasing sources of information along with choice of production systems and farm enterprise diversification in factor 4 could imply that crop farmers in Zobas Debub and Gash-Barka, particularly in Zoba Gash-Barka, who use relatively more sources of information are also those who diversify and are relatively concerned about implementing the appropriate production systems. Farmers who are better informed about weather forecasts and rainfall distribution can decide better on the type and timing of cropping.

Factor 5 indicates that crop farmers who considered having back-up management also considered off-farm investments as relatively important, but debt management and keeping financial records as relatively less appropriate. The significant variable experience in the correlation analysis shows that less experienced crop farmers rely more on off-farm investments and having back-up management than other crop farmers. In factor 6, education was a more significant variable to explain this factor than Zoba. It follows that better educated crop farmers use relatively more production, marketing and financial records to manage risk than less educated farmers, particularly in Zoba Debub.

The results of this study support the studies by Patrick *et al.* (1993), Bullock *et al.* (1994) and Woodburn *et al.* (1995), suggesting that farmers view managerial responses to risk in various dimensions but not as many as the individual responses.

Further to the analysis of risk management strategies in chapter 5, the next two chapters will deal with specific risk management strategies, namely use of information (chapter 6) and livestock insurance (chapter 7). The next chapter will explain the sources and use of information by respondents from three Zobas of Eritrea. Mean ratings and discriminant analysis are used to identify the main sources of information used in Eritrean agriculture as a risk response strategy.

CHAPTER 6

SOURCES AND USE OF INFORMATION

Farmers were asked to rate the importance of 13 sources of information for making production, marketing and financial decisions on a Likert-type scale ranging from one (not important) to five (very important). Farmers were also asked about their annual cash costs for each information source and the relative importance of additional information required for their businesses.

6.1 Ratings of Information Sources

Overall, own farm records were given the highest ratings for production (3.98), marketing (3.87) and financial (3.90) decisions. This concurs with the results of the studies by Ortmann *et al.* (1993), Woodburn *et al.* (1995), Hildebrand and Ortmann (1994) and Bullock *et al.* (1994) that found that farmers rely mostly on their own farm records for decision-making.

6.1.1 Information sources for production decisions

The result of mean ratings by sample respondents of the various sources of information for production decisions is shown in Table 6.1. Overall, own farm records (3.98), own farm workers (3.75), local veterinarian (3.44), radio and television (3.28), and extension agents (3.17) were the most important sources of information for production decisions.

Generally, sample poultry and dairy farmers highly rated information from government veterinarians followed by own farm workers. These farmers also rated own farm records, and radio and television as important sources of information. Since these farmers deal with animals, relevant and up-to-date information concerning the health of their animals is obtained primarily from veterinarians in the Ministry of Agriculture. Sample horticulture farmers gave government extension agents, own farm records, own farm workers, salesmen and private consultants high ratings for production information. Sample crop farmers rely on information from government extension agents, other farmers and own farm records for their production decisions.

The Ministry of Agriculture extension agents focus on providing information to farmers on how they can protect their crops against plant diseases and weeds. Some information, which is vital for production decisions, includes fertilizer application rates, animal and plant disease prevention measures, antibiotic-spray techniques, weather forecasts, breed selection, soil fertility and new production techniques. The fact that sample farmers in Zobas Maekel and Debub (mainly poultry and dairy farmers), which have relatively better infrastructure, have more access to television than horticulture and crop farmers implies that these farmers benefit more from the weekly agricultural programmes.

Table 6.1: Mean ratings of information sources for production decisions, sample commercial farmers, Eritrea, 2002/03.

Sources of information*	Mean ratings**				
	Overall (n=186)	Poultry (n=40)	Dairy (n=74)	Horticulture (n=31)	Crop (n=41)
Own farm records	3.98 (1)***	3.70 (4)	3.68 (3)	4.23 (2)	3.61 (3)
Own farm workers	3.75 (2)	4.50 (2)	4.30 (2)	4.10 (3)	1.78
Local veterinarian	3.44 (3)	4.88 (1)	4.85 (1)	1.29	1.10
Radio and television	3.28 (4)	4.08 (3)	3.18 (4)	2.94	2.95
Extension agents	3.17 (5)	1.70	2.80	4.29 (1)	4.61 (1)
Salesmen	2.96	2.93	2.92	3.77 (4)	2.46
Other farmers	2.75	2.93	2.49	2.10	4.44 (2)
Consultants	2.24	1.83	2.58	3.19 (5)	1.32
Lenders (Banks)	2.23	2.18	2.80	2.29	1.22
Newspapers	2.22	2.35	2.50	1.87	1.85
Local government	1.80	2.18	2.16	1.26	1.20
University specialists	1.76	1.18	2.28	2.00	1.22
Non-governmental organizations	1.70	1.20	1.12	2.16	2.88

* The sources of information are listed in order of their importance in the overall ratings

** The mean ratings (1= not important and 5 = very important) should be roughly interpreted to give an overall view of the importance of information sources since the data are ordinal.

*** Figures in parentheses indicate the rankings of information sources with ratings of 3.0 above.

6.1.2 Information sources for marketing decisions

Only two sources of information for marketing decisions have ratings greater than 3.0 (Table 6.2). Except for crop farmers, own farm records were rated highly by sample poultry (4.45), dairy (4.05) and horticulture (4.16) farmers for marketing decisions.

Table 6.2: Mean ratings of information sources for marketing decisions, sample commercial farmers, Eritrea, 2002/03.

Sources of information*	Mean ratings**				
	Overall (n=186)	Poultry (n=40)	Dairy (n=74)	Horticulture (n=31)	Crop (n=41)
Own farm records	3.87 (1)***	4.45 (1)	4.05 (1)	4.16 (2)	2.83
Salesmen	3.50 (2)	3.18 (2)	3.49 (2)	4.29 (1)	3.05 (2)
Other farmers	2.39	2.13	2.18	1.90	3.34 (1)
Radio and television	1.95	2.73	2.45	1.55	1.05
Newspaper	1.90	2.73	1.16	1.84	1.85
Own farm workers	1.81	2.65	2.24	1.13	1.20
Lenders (Banks)	1.64	1.40	1.15	2.58	1.44
Local government	1.55	1.73	1.93	1.19	1.34
Consultants	1.35	1.13	1.35	1.81	1.10
Extension agents	1.33	1.23	1.34	1.42	1.34
Local veterinarians	1.24	1.28	1.55	1.06	1.05
Non-governmental organizations	1.13	1.05	1.19	1.19	1.10
University specialists	1.08	1.20	1.04	1.03	1.05

* The sources of information are listed in order of their importance in the overall ratings

** The mean ratings (1= not important and 5 = very important) should be roughly interpreted to give an overall view of the importance of information sources since the data are ordinal.

*** Figures in parentheses indicate the rankings of information sources with ratings of 3.0 above.

The fact that many horticulture farmers own market outlets implies that these farmers give more value to the information provided by salesmen for their marketing decisions. Information sources from salesmen include information from wholesalers, processing plants and grain boards. Sample crop farmers rely more on information from salesmen (grain board) and other farmers for their marketing decisions. The few information sources for marketing decisions could be due to the unavailability of commercial information sources on prices of inputs and outputs, limited marketing alternatives and government market intervention (semi-regulated market). Ortmann *et*

al. (1993), Woodburn *et al.* (1994) and Bullock *et al.* (1995) also found that respondents rated relatively few information sources (not more than three) for marketing decisions.

6.1.3 Information sources for financial decisions

Table 6.3 shows that own farm records (3.90), radio and television (3.49) and lenders (3.07) were the most important sources of information for financial decisions.

Table 6.3: Mean ratings of information sources for financial decisions, sample commercial farmers, Eritrea, 2002/03.

Sources of information*	Mean ratings**				
	Overall (n=186)	Poultry (n=40)	Dairy (n=74)	Horticulture (n=31)	Crop (n=41)
Own farm records	3.90 (1)***	4.43 (1)	4.07 (1)	4.42 (1)	2.68
Radio and television	3.49 (2)	4.10 (2)	3.64 (2)	3.45 (2)	2.78
Lenders (Banks)	3.07 (3)	3.96 (3)	2.92	3.42 (3)	1.98
Private consultants	2.54	3.48 (4)	1.65	3.32 (4)	1.68
Newspaper	2.36	3.30 (5)	2.11	2.55	1.49
Local government	1.50	1.10	1.76	2.10	1.02
Own farm workers	1.24	1.35	1.46	1.10	1.05
Other farmers	1.22	1.23	1.54	1.03	1.06
Local veterinarians	1.13	1.05	1.35	1.06	1.07
Salesmen	1.12	1.15	1.26	1.03	1.02
Non-governmental organizations	1.09	1.00	1.15	1.10	1.10
Extension agents	1.07	1.00	1.15	1.06	1.05
University specialists	1.06	1.00	1.11	1.06	1.05

* The sources of information are listed in order of their importance in the overall ratings

** The mean ratings (1= not important and 5 = very important) should be roughly interpreted to give an overall view of the importance of information sources since the data are ordinal.

*** Figures in parentheses indicate the rankings of information sources with ratings of 3.0 above.

Own farm records and daily foreign exchange rate information via radio and television are considered to be important information sources by poultry, dairy and horticulture farmers. Information from banks (about the availability of medium and short-term loans, collateral and interest rates) and private consultants are also important for sample poultry and horticulture farmers for financial decisions. Most poultry and horticulture farmers stated that they acquire

information on financial record keeping from private consultants since no government officials support them in this matter. Crop farmers did not rate any of the information sources very highly.

6.2 Cost of Information

Table 6.4 shows the mean annual cash costs of various sources of information. Many sample farmers could not exactly specify the actual costs incurred for obtaining information.

Table 6.4: Mean annual cash costs of various sources of information, sample commercial farmers, Eritrea, 2002/03.

Sources of information*	Mean annual cost 1** (NKF)	Range (NKF)	Mean annual cost 2*** (NKF)
Own farm records	819 (145)	120-4500	740
Radio and television	49 (90)	10-350	34
Private consultants	1173 (60)	350-4500	555
Newspaper	54 (125)	10-250	36
TOTAL			1365

* Sources of information that are reported to have actual cash costs.

** Average cost for farmers who incurred the cash cost. Figures in parenthesis are number of farmers who reported costs for this source.

*** Average cost for all 186 farmers who attempted to answer this question with cost reported in at least one of the information sources.

It was also not possible to ascertain the opportunity cost of time spent to study the information. Information that is obtained from extension agents, veterinarians, lenders, local government, non-government organizations, salesmen, other farmers, own farm workers and university specialists involves no cash costs. On average, the respondents spent NKF1365 per year, of which 41% was spent on consultants. While Ortmann *et al.* (1993) reported that large US Cornbelt farmers spent, on average, \$2578 per year on information sources, Woodburn *et al.* (1994) and Bullock *et al.* (1995) reported that the average amount spent by sample farmers in KwaZulu-Natal on sources of information was R3504 and R2745 respectively.

6.3 Additional Information Requirement

Farmers were also asked to rate their need for additional information for farm production, product marketing, farm finance and overall farm management on a Likert-type scale ranging from 1 (low importance) to 5 (highly important). The results are presented in Table 6.5.

Table 6.5: Mean ratings of the relative importance of additional information, sample commercial farmers, Eritrea, 2002/03.

Management Area	Overall* (n=186)	Mean ratings**			
		Poultry (n=40)	Dairy (n=74)	Horticulture (n=31)	Crop (n=41)
Farm production	4.34 (1)***	4.38 (1)	4.31 (2)	4.39 (2)	4.32 (1)
Farm finance	3.90 (2)	4.43 (2)	4.32 (1)	4.29 (3)	2.34
Product marketing	2.91	4.08 (4)	2.28	4.65 (1)	1.61
Overall farm management	2.73	4.13 (3)	2.26	3.13 (4)	1.90

* The management areas are listed in order of their importance in the overall ratings

** The mean ratings (1= not important and 5 = very important) should be roughly interpreted to give an overall view of the importance of information sources since the data are ordinal.

*** Figures in parentheses indicate the rankings of more information with ratings of 3.0 or above.

Over the whole sample, farm production (4.34) and farm finance (3.90) were the two management areas where farmers need more information for their management decisions. On average, sample poultry and horticulture farmers indicated the need for more information in all management areas as compared to dairy and crop farmers. While poultry and crop farmers focus on more information on farm production, dairy and horticulture farmers demand more information on farm finance and product marketing respectively. The fact that poultry and horticulture farmers use more loans and are involved in fierce competition with government-subsidized projects, may lead these farmers to seek more information than other farmers. The less importance given to additional information on product marketing and overall farm management by dairy and crop farmers could be due to the relatively greater farming experience of these farmers, which may have made them to believe that they had accumulated sufficient management skills.

Farmers were also asked to specify the type of additional information they need for production, marketing and financial decisions. Most poultry farmers indicated the need for more information on chicken health issues and breeds for production decisions. Additional information for marketing decisions include information about alternative feed (input) and output markets, while tax rate calculations and appropriate record keeping were considered essential for financial decisions. While horticulture farmers find the usefulness of information on the technical side of production (plant disease control, seed selection, machinery selection and rotation type), crop farmers seek more information on weather forecasts and effective and appropriate weed control systems. Dairy farmers focussed on the importance of additional information on genetic selection and ration mix for production decisions. Generally, all sample farmers regarded additional information on appropriate record keeping systems as important.

6.4 Discriminant Analysis of Information Sources

Analysis of means and standard deviations in Tables 6.1 to 6.3 show only the distribution of farmers' perception on sources of information. Discriminant analysis identifies that different types of farms use different information sources, which can be useful for extension workers to provide relevant information to specific types of farm. An attempt was made, therefore, to discriminate between groups of farmers on the basis of their ratings of information sources for production, marketing and financial decisions. Grouping farmers was done on the basis of enterprises, namely poultry, dairy, horticulture and crop farming. The number of components in this analysis was three (number of groups (four) minus one) (Manly, 1994; SPSS, 1994).

The purpose of LDA is to statistically separate two or more groups of individuals on the basis of the given measurements for these individuals on several variables. The basic assumptions underlying LDA are the normality distribution of discriminant function scores, and the within-group covariance matrix should be the same for all groups (Manly, 1994). The discriminant function can be put as:

$$D_i = b_{i1}X_1 + b_{i2} X_2 + \dots + b_{ip} X_p$$

where D_i is the score of i th discriminant function, the X 's are the standardized discriminant variables, and the b 's are the weighting coefficients. In this study, LDA will be used to identify factors that separate adopters and non-adopters of livestock insurance.

The results of a canonical discriminant analysis are presented in Table 6.6. The significance tests for dimensionality indicate that the dimensionality is greater than zero, but not significantly greater than one. This means that there are differences between the four enterprises, which is explained by a single canonical variate (canonical discriminant) that accounts for 85.7 percent of the variation in all sources of information for production decisions between the four enterprises. In the same manner, the differences between the enterprises is described by single canonical variates which account for 76.6 percent and 47.1 percent of the variation in marketing and financial sources of information respectively. The null hypothesis that the means of the canonical variates are equal is rejected because the value of Wilks' Lambda and its associated chi-square for all the three areas of decisions are significant.

Sources of information in favour of poultry are those with positive loadings for production and financial decisions and negative loadings for marketing decisions. Sources of information with relatively high positive loadings for all decision areas were highly rated by dairy farmers, while crop farmers rated sources of information with high negative loadings for all decision areas. Horticultural farmers rated sources of information with high negative loadings for production decisions but high positive loadings for marketing and financial decisions respectively. The means of the four enterprises show that these enterprises use different sources of information for their decisions with dairy and crop farmers being the furthest apart.

The first function, which explains 85.7 percent of the variation in the sources of information for production decisions, discriminates poultry and dairy farmers from horticulture and crop farmers. For their production decisions, poultry and dairy farmers use information mainly from veterinarians, lenders and own farm records. Horticulture and crop farmers regarded non-government organizations, own farm workers and extension agents as important sources of information for their production decisions.

Table 6.6: Discriminant analysis of ratings of information sources for production, marketing and financial decisions by enterprise, Eritrea, 2002/03.

Sources of information	Production	Marketing	Finance
Veterinarians	0.897	0.172	0.118
Non-government organizations	-0.170	0.121	0.036
Own farm workers	-0.117	0.250	0.274
Private consultants	0.030	0.007	0.216
Other farmers	-0.048	-0.258	0.306
Lenders (Banks)	0.112	-0.079	0.306
Newspaper	0.055	-0.154	0.628
Local government	0.006	0.153	0.118
Own farm records	0.261	0.181	0.636
University specialists	0.069	0.012	0.084
Extension agents	-0.241	-0.005	0.078
Radio and television	0.075	-0.370	0.343
Salesmen	0.001	0.567	0.141
Percentage variation	85.7	76.6	47.1
Wilk's Lambda	0.003	0.018	0.090
Chi-square	1049.87***	712.083***	430.492***
Means Poultry	5.578	-2.187	0.026
Dairy	4.419	0.356	0.781
Horticulture	-4.304	2.102	0.794
Crop	-7.863	-4.000	-2.502
Correct allocation (Percent)	98.9	97.3	83.9
Correct allocation (Percent)			
Poultry	95	97.5	72.5
Dairy	100	95.9	89.2
Horticulture	100	96.8	71.0
Crop	100	100	95.1

*** Significant at the 1 percent level.

Sample poultry and crop farmers considered other farmers, newspapers, and radio and television as relatively important sources for their marketing decisions. Sample horticulture farmers in particular (higher mean) regarded own farm workers and salesmen as relatively more important sources for their marketing decisions. Crop farmers were discriminated from other farmers by the last function that explains 47.1 percent of the variation in the data of sources of information for financial decisions. None of the listed sources were important for crop farmers for their financial decisions. However, most of them were relatively important for dairy and horticulture farmers.

Sources of information that were rated relatively highly by poultry farmers in all three decision-making areas are lenders (banks), newspapers, and radio and television. Veterinarians, private consultants, own farm records, university specialists and local government are relatively important information sources for dairy farmers in all three decision-making areas. While non-governmental organizations and own farm workers were relatively more useful sources of information for horticulture farmers in all three areas of decision-making, other farmers and extension agents were important sources for crop farmers in production and marketing areas of decision-making.

It seems that sample poultry and dairy farmers depend more on government-provided information but horticulture and crop farmers tend to favour either non-governmental or their own information sources. The relatively better access that dairy farmers have to information provided by the local government could be due to the fact that they supply milk to the state-owned milk processing plant. Although information via daily newspapers and television programmes is considered to be efficient in covering a large area in a short period of time, the distribution seems to be limited to farmers around the capital city, who have better access to television. This suggests that government is less involved in providing information to farmers in Zoba Gash-Barka due to the relatively poor infrastructure in the Zoba.

Since the overall percentage of cases classified correctly is the sum of the number cases classified correctly in each group divided by the number of cases, 184 respondents (98.9 percent) were correctly allocated for production decisions, 181 respondents (97.3 percent) and 156 respondents (83.9 percent) were allocated correctly for marketing and financial decisions respectively.

As a risk management strategy, commercial dairy farmers have an option of insuring their livestock against loss. Despite the option with a subsidized premium, only few farmers have adopted the policy. Therefore, the next chapter identifies factors affecting livestock insurance adoption by commercial dairy farmers in three Zobas of Eritrea.

CHAPTER 7

FACTORS INFLUENCING ADOPTION OF LIVESTOCK INSURANCE

Dairy livestock insurance in Eritrea was basically established with a subsidized premium to help farmers manage risk. Despite the intention, only a few farmers have so far adopted insurance cover for their livestock. Since risk pooling of a large number of individuals is a cornerstone idea in insurance, it will not be viable for a policy to provide insurance services to only a few farmers. Since few farmers have adopted insurance, this chapter is aimed at identifying the main factors that affect insurance adoption on Eritrean farms.

7.1 Model Specification

In explaining a dichotomous dependent variable (Y_i), where one represents insured and zero not insured, different regression methods can be used (e.g. discriminant analysis, linear probability model, logit and probit). The assumption of multivariate normality that discriminant analysis is based on limits its use as the assumption may be violated. The most important criticism for using the linear probability model is that the marginal probability is assumed to be constant. Although it is not expected that different results will be obtained using a logit or probit model, a logit model is used to examine factors affecting livestock insurance participation in Eritrea due to disproportionate incidence of insurance in the sample (24 insured and 50 non-insured). A logit model is also generally preferred to the probit model due to its simpler structure. The logit model is based on the cumulative distribution function and yields results that are not sensitive to the distribution of sample attributes when estimated by maximum likelihood. If the aim is to examine which variables are significant in explaining a dependent dummy variable using the logit model, disproportionate sampling is not a problem as it only affects the constant term and not the estimated slope coefficients (Maddala, 1992). The mathematical form of the model used in this study is:

$$\ln p_i/(1-p_i) = \beta_0 + \sum_{j=1}^k \beta_j X_{ij} \dots\dots\dots(1)$$

where p_i is the probability of the i th farmer being insured and X_{i_k} the k th explanatory variable. The dependent variable, $\ln p_i/(1-p_i)$, in equation (1) is the log-odds ratio in favour of purchasing livestock insurance (Gujarati, 1995).

7.2 Consideration of Model Variables

Results of a correlation analysis of the initially considered variables indicated high collinearity between some variables, namely farmers' age (AGE) and years of experience (YRS), and farm size in hectares (FSZ) and farm turnover (TURN). The correlation coefficient of the former was 0.670, significant at the one percent level, indicating a potential multicollinearity problem. To remedy this problem, a common factor (a weighted representation of the original variables), experience index (EXP), was extracted using principal component analysis. EXP⁶ has an eigenvalue of 1.670 and explains 83.5% of the variation in the data. Similarly, using principal component analysis, an income index (SIZE⁷) was extracted from TURN and FSZ since the correlation coefficient of these variables was 0.779 (significant at the one percent level). SIZE, with an eigenvalue of 1.779, explains 88.9% of the variation in the data. The definitions of the most important variables expected to influence the adoption of livestock insurance are presented in Table 7.1.

The expected sign for EDU could be positive or negative. Education may promote an understanding of the effects of risk and hence may increase the demand for insurance; on the other hand, increasing education levels are associated with an increase in transferable human capital, facilitating greater risk taking by individuals with lower risk aversion (Szipiro and Outreville, cited by Esho *et al.*, 2003). FAMS is expected to have a positive sign; as the number of family members dependent on the farm increases the responsibility of the farmer to avoid potential losses increases and with it the demand for insurance. As farmers participate in off-farm investments as a risk management strategy, the probability of using insurance may decrease. Therefore, OFF is expected to have a negative sign. DAR is hypothesized to have a positive sign since it is expected

⁶ EXP = 0.914 (AGEs) + 0.914 (YRSs), where s = standardized variate.

⁷ SIZE = 0.943 (TURNs) + 0.943 (FSZs), where s = standardized variate

that a farmer with a high debt-asset ratio may be required to secure part of the debt payments by adopting insurance.

Table 7.1: Definition of variables expected to influence livestock insurance purchase, Eritrea.

Variable	Definition	Expected sign
EDU	Formal education of the farmer (e.g. primary = 6 years, secondary = 12 years).	+/-
FAMS	Family size (number of family members who are dependent on the farm).	+
OFF	A dummy variable = 1 if a farmer has off-farm investments, 0 otherwise.	-
DAR	Debt to asset ratio.	+
DIVERS	Farm enterprise diversification: A dummy variable = 1 if a farm is diversified, 0 otherwise.	-/+
EXP	Years of farming experience (an index extracted from age of farmers (AGE) and farming years (YRS)).	-
SIZE	Farm size (an index extracted from farm size in hectares (FSZ) and farm turnover (TURN)).	+
INFO	A dummy variable = 1 if a farmer is aware of the importance of livestock insurance, 0 otherwise.	+
LOCAT1	A dummy variable = 1 for Zoba Debub, 0 otherwise.	-
LOCAT2	A dummy variable = 1 for Zoba Gash-Barka, 0 otherwise.	-

Although DIVERS is an alternative risk management strategy, it does not necessarily mean that DIVERS and insurance always have a negative relationship. In a situation where one of the two tools (insurance or farm diversification) is not available, the other is used, but when both insurance and farm diversification are available, both could be considered but separate decisions are made (Blank and McDonald, 1996). EXP is expected to have a negative impact on the likelihood of livestock insurance adoption because as farmers get more farming experience, they become more

aware of various risk management strategies, which lowers the probability of adopting insurance. SIZE is expected to have a positive sign as wealthier farmers (usually with larger farms) may be more likely to purchase insurance to secure their asset.

INFO, which captures information or awareness about the importance of livestock insurance, is expected to have a positive sign since the probability of adopting may increase the more a farmer understands insurance. LOCAT1 and LOCAT2 are included in the model to determine whether a farm location (Zoba) has an impact on the insurance participation decision. The distance from Zoba Maekel, where the main insurance activities of NICE take place, and additional transaction costs due to poor infrastructure are expected to affect livestock insurance purchases negatively in the other two Zobas. Following these arguments, the following logit model was postulated:

$$\ln p_i/(1-p_i) = \beta_0 + \beta_1 \text{EDU}_i + \beta_2 \text{FAMS}_i + \beta_3 \text{OFF}_i + \beta_4 \text{DAR}_i + \beta_5 \text{DIVERS}_i + \beta_6 \text{EXP}_i + \beta_7 \text{SIZE}_i + \beta_8 \text{INFO}_i + \beta_9 \text{LOCAT1}_i + \beta_{10} \text{LOCAT2}_i \dots\dots\dots(2)$$

7.3 Logit Model Results

Since the conventional R² measure of the goodness of fit is inappropriate when the dependent variable takes on only two values, the Chi-square test is used instead (Gujarati, 1995). The Chi-square, which tests the joint significance of the explanatory variables, is statistically significant at the one percent level of probability (Table 7.2). The estimated model correctly classified 91.9 percent of respondents. The success rates for predicting insured and non-insured respondents are 84.6 percent and 95.8 percent, respectively.

Except for the variable DAR (not significant) all coefficient estimates have signs that were initially hypothesized. The positive signs attached to the estimated coefficients of the variables EDU, FAMS, SIZE, and INFO indicate that the greater the values of these variables the higher the tendency for farmers to participate in livestock insurance. The negative signs of OFF, DAR, DIVERS, EXP, LOCAT1 and LOCAT2 indicate that the greater the value of these variables the lower the probability that the farmers will insure.

Table 7.2: Logit model results for dairy livestock insurance participation in Eritrea, 2002/03 (n=74).

Variable	Coefficient estimate	Standard error	t- statistic	Wald statistic	Significance level
EDU	0.767	0.392	1.955*	3.333	.065
FAMS	0.193	0.330	0.586	0.452	.356
OFF	-4.336	1.661	-2.611**	6.536	.014
DAR	-0.039	0.147	-0.265	0.241	.652
DIVERS	-2.540	1.235	-2.056**	5.321	.041
EXP	-1.637	0.654	-2.503**	6.023	.020
SIZE	1.281	1.456	0.880	0.654	.221
INFO	6.359	1.425	4.462***	9.560	.001
LOCAT1	-4.152	3.225	-1.287	1.484	.184
LOCAT2	-1.425	0.428	-3.330***	7.325	.005
Constant	-0.613	0.244	-2.512	6.339	.012
Model Chi-square	79.440*** on 10 degrees of freedom				
Correct prediction (percent)					
Total	91.9				
Insured	84.6				
Non-insured	95.8				

Note: *, ** and *** indicate statistical significance at the 10 percent, 5 percent and 1 percent levels of probability, respectively.

The formal education level (EDU) has a positive coefficient estimate indicating that, *ceteris paribus*, the probability of purchasing livestock insurance increases as the level of formal education of the farmer increases. Esho *et al.* (2003) used education (completing secondary school) as a proxy for risk aversion following the argument by Outreville (cited by Esho *et al.*, 2003) that improving cognition enables a better assessment of risk and hence an increased demand for insurance. Bullock *et al.* (1994) found that education was negatively related to a farmer's willingness to take risk. In the study by Woodburn *et al.* (1995), however, education was positively related to a farmer's willingness to take risk. Vandevveer (2001) also found that farmers with more education were less likely to buy insurance.

Off-farm investment (OFF) (including investments in shops, trucks, buses, flour-mills, and the import-export trade) has a negative coefficient estimate implying that the more farmers engage in off-farm investment the less the probability of purchasing livestock insurance. Off-farm

investment thus seems to be a substitute method of risk management. Moscardi and Janvry (1977), in their study of attitudes toward risk among peasants in Mexico, found that the higher the off-farm income the higher the capacity to assume risk in agricultural production. Moreover, Mishra and Goodwin (1997) found a positive correlation between off-farm employment and farm income variability, indicating that off-farm investment helps many farm households to diversify their income risks. Farm enterprise diversification (DIVERS) has a negative, statistically significant coefficient estimate indicating that diversified dairy farmers are less likely to purchase livestock insurance. Dairy farmers, who are diversified, may experience lower income variability than non-diversified farmers because the income loss in one enterprise may be compensated for by a higher income from another enterprise. Jarvie and Nieuwoudt (1988) reported that use of other strategies, particularly diversification and off-farm income, may reduce the use of insurance as a means of risk management. Blank and McDonald (1996) reported that more diversification is used in the absence of insurance.

The experience index (EXP) is negatively related to the decision to purchase livestock insurance. It appears, therefore, that aged and more experienced dairy farmers are less willing to purchase insurance. Farmers with such characteristics might have acquired enough knowledge through time to deal with income risk without insurance (e.g. selection of technical practices). Results of the studies by Jarvie and Nieuwoudt (1988) and Vandevier (2001), however, indicate that younger farmers, or those with less experience, were less likely to buy insurance. Information or knowledge about insurance (INFO) is a highly significant variable. The positive coefficient suggests that the more information a farmer has about insurance the more likely he will use livestock insurance. The negative estimated coefficient for LOCAT2 is significant at the one percent level. Farms in Zoba Gash-Barka are a long way from the main insurance office and relatively poor infrastructure increase transaction costs and thus lower livestock insurance participation. Although LOCAT1 is not statistically significant its absolute t-value is greater than one. The negative coefficient suggests that as the distance from Zoba Maekel towards Zoba Dehub increases, the probability of adopting insurance by farmers in Zoba Dehub decreases. The variables family size (FAMS), debt-asset ratio (DAR) and income index (SIZE) were also not statistically significant.

CONCLUSIONS AND POLICY IMPLICATIONS

Owing to the imperfect knowledge of future events, farmers operate in a risky environment. The effects of uncertainties about weather variability, input and output price changes, changes in government policies and regulations, advances in technology and changes in human relationships compel farmers to use appropriate risk management strategies. The essence of information as risk management tool lies in its formation of expectations about what is likely to happen. Insurance, as a means of risk sharing (transfer) and building the risk-bearing ability of farmers, plays an important role in minimizing risk and providing a source of liquidity.

The results of mean ratings of risk sources show that, on average, weather changes, changes in the labour force, diseases and weeds, changes in the Nakfa exchange rate, government's demobilization and rehabilitation programme, and changes in agricultural tax policy were the six main sources of risk as rated by sample commercial farmers in Eritrea.

In the factor analysis of risk sources, factors which are the primary sources of heterogeneity are strongly related (linked) to geographical location. The first factor for poultry farms shows that, compared to farmers in Maekel, farmers in Gash-Barka are relatively more concerned about insecurity, crop yield variability, and weather and climate, and relatively less concerned about changes in tax policy, and diseases, pests and weeds. Similarly, the first factor for dairy farmers shows that, compared to farmers in Debub and Gash-Barka, farmers in Maekel are relatively more concerned about livestock yield price variability and relatively less concerned about crop price variability, insecurity, change in labour force, weather and climate, crop yield variability, and diseases, weeds and pests. The first two factors for horticulture farmers and the first three factors for crop farmers are strongly linked to geographical location. This shows that suitable policies and programmes to assist farmers to manage risk should vary across the Zobas studied.

Other factors are less strongly linked to geographical location and relationships in these factors are probably attributable to characteristics of the farmers and their farm business as well as some coincidental relationships. The analyses of both poultry and horticulture results show that farmers who are relatively concerned about technological change also tend to be relatively concerned

about change in capital cost. This probably reflects that new technologies in poultry and horticulture tend to be capital intensive. For all farmers there is a positive correlation between concerns over change in input cost and concerns over changes in the Nakfa exchange rate. This may indicate that some inputs are imported and their prices are subject to exchange rate risks. In all analyses variation amongst farmers' perception of changes in agricultural tax policy feature prominently. This is true for poultry, horticulture and crop farmers in the first factor, and for dairy farmers in the second factor. Furthermore, in all analyses factor scores show that farmers in Zoba Meakel are relatively more concerned about changes to tax laws than farmers from the other Zobas.

Production risk also features prominently in all four analyses. Factor scores show that poultry, dairy, horticulture and crop farmers in Zoba Maekel tend to be relatively less concerned about weather and climate than farmers in Zobas Debub and Gash-Barka. For crop farmers weather and climate was positively correlated with crop yield variability; for horticulture farmers horticulture yield variability was related with diseases, pests and weeds; for dairy livestock yield variability was not related either to weather and climate or diseases, pests and weeds; and for poultry farmers production variability seems to be related to input availability rather than to weather and climate or diseases, pests and weeds.

Results of mean ratings of risk sources imply the need for policy makers to consider the potential impacts of agricultural and economic policies on farmers, and to create a favourable and transparent policy environment in which commercial farmers can operate to better manage risks and to grow their businesses. A continuous campaign by the Ministry of Agriculture against animal and plant disease, and weeds could minimize systemic risk that might affect many farmers. Although the Ministry of Agriculture is assisting farmers to prevent the spread of imported weeds (particularly striga) at farm level, facilitating a comprehensive campaign that incorporates all affected farms is recommended. Moreover, the Ministry of Agriculture could intensify the control measures on imported seed quality before farmers grow them (to minimize the risk of weed infestation). In a situation where there is great concern about farm labour supply, commercial farmers in Eritrea may attract more labour by offering them attractive wages and other benefits (e.g. accommodation).

The relatively high concern for changes in agricultural tax policy by poultry farmers in Zobas Maekel and Debub, the main poultry areas, implies the need for a clear and transparent agricultural tax system. Since sample poultry farmers perceived crop yield variability as a cause for poultry production variability and that changes in the availability of inputs is of another concern, the need to import animal feed may be a solution. Privatising the government-owned animal feed processing plant and encouraging competition could facilitate access of poultry and dairy farmers to feed at a reasonable price. Poultry farmers in Zobas Debub and Maekel need to be more cost conscious in order to compete with government-subsidized projects.

The result of factor analysis that sample dairy farmers in Zobas Debub and Gash-Barka perceived insecurity as a relatively important source of risk could imply the need for a favourable working environment for dairy farmers in these Zobas. In a situation where diversification is difficult due to relatively small farm sizes, dairy farmers in Zoba Maekel should utilize their land efficiently by introducing relatively capital-intensive milking systems and high yield cattle types. The need for a transparent agricultural tax system, particularly for farmers in Zobas Maekel and Debub, could minimize their concern regarding those changes.

Results also indicate the need for leveraged and inexperienced horticulture farmers to be more cost effective so as to compete with the highly subsidized government projects, and to fully use their land so that there will be no land available to be taken away by the state. Horticulture farmers have to be farsighted and device long-term strategies that aim at crop export rather than focusing on the domestic market. These farmers need to spray appropriate pesticides to reduce the impact of pests in causing yield variability. Institutional arrangements with food-processing plants, such as vertical cooperation, could assist horticulture farmers, for example, to add value to their products and alleviate seasonal price fluctuations.

The fact that crop farmers are entirely dependent on rainfall makes crop farming risky. Therefore, the government has to give priorities to constructing dams in the high potential arable areas of Zoba Gash-Barka, as other Zobas are better off in terms of rainfall distribution. Crop farmers need to take a certain level of risk in producing cash crops, such as sesame and lentils, which have a reliable market. The introduction of drip irrigation could be a solution to both crop yield

variability and changes in the labour force. The government also needs to create a stable, transparent policy environment in which farmers can prosper. Research conducted by the Ministry of Agriculture on the potential for developing crops (e.g. sorghum) with a high-yield potential and the ability to resist drought could solve a main problem for field crop farmers. Since capital-intensive technologies are relatively expensive for many commercial farmers in Eritrea, use of private machinery contractors may be feasible.

The mean ratings of managerial responses show that farmers, on average, considered the importance of increasing sources of information, choice of production system, keeping production records, diversification of farm enterprise and being a low cost producer as their main production responses. Use of marketing information and indirect selling were the main marketing responses practised by respondents. Keeping financial records and off-farm investments were rated highly as the most important financial responses to risk in agriculture.

It appears also that the first factor (primary sources of heterogeneity) in almost all factor analyses of managerial responses are linked with geographical location. The first factor for poultry farmers indicates that compared to farmers in Zoba Gash-Barka, farmers in Zobas Maekel and Debub are relatively more concerned about the importance of having back-up management, making timely use machinery and being a low cost producer, and relatively less concerned with the importance of increasing the labour force. The first factor for dairy farmers shows that sample dairy farmers in Zobas Debub and Gash-Barka, as compared to farmers in Zoba Maekel, are relatively more concerned with increasing the labour force, farm enterprise diversification and speculation, and are relatively less concerned with increasing use of capital items and having management back-up.

The first factor for horticulture farmers indicates that, compared to farmers in Zobas Maekel and Debub, farmers in Zoba Gash-Barka considered direct marketing, speculation and use of marketing information to be relatively important, and considered indirect selling as a relatively less important response to risk. The first factor for crop farmers shows that sample farmers in Zoba Gash-Barka considered decreasing farm size, off-farm investments and timely use of machinery as being relatively important management responses compared to crop farmers in the other Zobas.

Generally, farmers in Zobas Gash-Barka and Debub are relatively more likely to use strategies of employing more labour, direct marketing, diversification, speculation and off-farm investments than farmers in Zoba Maekel. Farmers in Zoba Maekel are relatively more likely to use back-up management, being a low cost producer and indirect marketing than farmers in other Zobas.

Results also indicate that farmers with relatively higher leverage tend to use relatively more of capital items, timely use of machinery and being a low cost producer. Farm size was found to be a significant variable to explain some factors. Farmers with relatively large farm sizes place relatively more emphasis on farm enterprise diversification and choice of production system than farmers with smaller farm sizes. Results also suggest that better educated and inexperienced dairy farmers tend to use managerial responses, such as insurance, keeping records and debt management to counter risk, and tend to be less involved in off-farm investments.

The analyses of managerial responses to risk show interesting dimensions to farmers' risk strategies. Interestingly, there is considerable commonality in all four factor analyses, causing risk strategies to be neatly divided into production, marketing, financial and record keeping strategies.

Production strategies:- Choice of production system was typically grouped with increased use of information (dairy and crop) and diversification (dairy, horticulture and crop). Although it is clear from the mean rating analysis that the three managerial tools- choice of production system, increased use of information and diversification- are amongst the most important production risk management strategies, factor analysis shows that they are, in fact, largely part of the same production risk management strategy. It is not unexpected that farmers who use farm enterprise diversification as a strategy to seek more information and to consider choice of production system as an additional risk management tool. The strategy of being a low cost producer varies between farm types, largely due to differences in the nature of production. On poultry and horticulture farms (both relatively capital intensive) the strategy of becoming a low cost producer is positively related to increased use of capital items, on poultry and dairy farms it is positively related to making use of machinery, and on crop farms being a low cost producer is more related to obtaining economies of size (and is, surprisingly, negatively related to timely use of machinery).

Marketing strategies:- Although a majority of farmers interviewed considered indirect selling to be a more important risk reducing marketing strategy than direct marketing to consumers (mean of 3.87 vs. 2.22), farmers from all types of farms vary considerably in the relative importance they attach to these strategies for reducing risk. The percent of heterogeneity accounted for in the data by these factors is 12.5% for poultry farmers, 12.9% for dairy farmers, 24.9% for horticulture farmers and 9.8% for crop farmers. Clearly, this strategy is one of the most important sources of variation in farmers' risk management strategies.

Financial strategies:- Off-farm investment was negatively related with debt management in the analysis of poultry and dairy farms but positively related in the analysis for horticulture farms. Crop farmers, however, engage in off-farm investment at the expense of reducing investment in farming (decrease farm size).

Record keeping:- All analyses elicited a factor that can be interpreted as record keeping. Whilst farmers vary in their opinions on the importance of record keeping as a risk management strategy, this is not a large source of variation in their risk management strategies: the elicited factors accounted for 9.6%, 5.7%, 9.3% and 5.7% for poultry, dairy, horticulture and crop farmers, respectively.

Some policy recommendations arising from the analysis of mean ratings of managerial responses to risk may assist the Ministry of Agriculture, through extension agents, veterinarians, and researchers to advise farmers on how to manage the main sources of risks they have identified by, for example, providing relevant extension services (information), appropriate training programmes (e.g. record-keeping and financial management), and constructing dams for irrigation. Private consultants, financiers and insurers could also play an essential role in providing relevant information and advice. The low level of education of most commercial farmers in Eritrea implies the need for further training in appropriate record-keeping systems since sample farmers considered keeping production, marketing and financial records as important managerial practices. Relaxing foreign exchange rate controls could help farmers better manage the risk that could emanate from changes in the Nakfa exchange rate.

Almost all commercial poultry farmers and the government-subsidized poultry project are currently producing layers. Therefore, the idea of including broilers (diversification) by the commercial poultry farmers could change the nature of local market competition between commercial farmers and the government-subsidized project. The government should focus on improving infrastructure, particularly in Zoba Gash-Barka, in order to reduce transaction costs for farmers. Private investors should be encouraged by the government (provision of business license and land) to invest in animal feed processing plants so as to reduce the risk arising from changes in the availability of feed. Commercial poultry farmers may need to be trained and consulted on how they can produce different breeds of chicken at a time. Commercial poultry farmers could also work for niche markets, such as restaurants, hospitals, factories and pastries to meet their requirements (some of the restaurants are currently importing chickens and eggs).

Improved infrastructure may help the establishment of milk processing plants in Zoba Gash-Barka, which could make commercial dairy farming in this Zoba more attractive. The fact that most dairy farmers in Zoba Maekel and Debub sell their milk to the milk processing plant to secure feed indicates that these farmers also have a relatively secure market. However, since the prices of animal feed, raw milk and the processed milk are relatively fixed and determined by the government-owned processing plant, dairy farmers need to be cost conscious to survive. This may imply the need for private animal feed suppliers, who work in a demand-driven market, so that farmers can decide where, and from whom to buy.

The comparative advantage of specialization versus diversification has to be considered by commercial horticulture farmers as an export-focused strategy that involves the production of specialized crops at both low cost and high quality could help them compete in international markets. Decreasing farm size, as a strategy, involves cost (unused land will be taken by the state). Therefore, horticulture farmers need to be aware of the importance of using their land fully. Banks could increase funding to farmers to promote use of their land, if this is a viable option for banks. Extension agents (Ministry of Agriculture) should inform farmers about the appropriate crop protection system (e.g. spraying) that fits their farm environment.

The critical problem of weed infestation in Zoba Gash-Barka needs a comprehensive strategy aimed at the complete eradication of striga as a matter of urgency. Individual efforts to control the weed have already failed since a weed-free farm can easily be infected by a neighbouring farm, which is infested. The construction of dams and use of drip irrigation technology in the high potential areas of Zoba Gash-Barka could help adopting farmers to reduce risk and produce more crops.

In the study of sources and use of information, sample commercial farmers highly rated sources of information for production decisions (3.98), followed by financial (3.90) and marketing (3.87) decisions. Excluding cost of time, sample commercial farmers spent, on average, an estimated NKF 1365 of which 41 percent was spent on consultants (particularly poultry and horticulture farmers). Overall, sample farmers highly rated the importance of additional information for farm production decisions (4.34) and farm finance (3.90).

Results of a discriminant analysis of information sources by enterprise show that sample poultry and dairy farmers depend largely on information provided by the government while horticulture and crop farmers (except for extension agents) rely mostly on their own sources of information or non-governmental sources.

The results of the study on use of information have some policy implications. The first is that since own farm records are the most important source of information for sample farmers, it is recommended that the Ministry of Agriculture and local government should provide additional and appropriate record-keeping training for farmers. Second, the result shows that government participation in providing information to commercial farmers in Zoba Gash-Barka is low. As this could be due to the poor road and communication infrastructure, improving the infrastructure in this Zoba may improve information flow.

Third, the fact that most information sources come from government implies the lower availability of private commercial information sources in Eritrea. Commercial information providers could play a role in supplementing government sources. This may provide farmers with access to more relevant information. Fourth, the low rating of university specialists as sources of information to

farmers may indicate that there are few research programmes being conducted at the university to equip farmers with appropriate information. More research by professionals and university specialists aimed at helping farmers to assess more and relevant information is, therefore, recommended. Lastly, the Ministry of Agriculture should periodically publish an agricultural magazine (so far no publications exist) in a way that farmers can understand the information provided.

As far as adoption of livestock insurance is concerned, the empirical results of logit analysis indicate that the demand for dairy livestock insurance in Eritrea is positively influenced by the level of formal education of a farmer. The greater the extent of the information about and awareness of the importance of insurance, the greater the probability of insurance purchase. Alternative risk management strategies, such as off-farm investments and farm diversification, were negatively related with the likelihood of livestock insurance participation. Years of farming experience and location of farms in Zoba Gash-Barka were also negatively related to the probability of livestock purchase.

In the livestock insurance study, the positive coefficients for formal education and information imply the need for policy makers and insurers to better educate farmers so that they can assess risk management tools and thereby increase farmers' participation in insurance. Since the low level of education of many farmers in the study area may have negatively influenced the decision to purchase livestock insurance, NICE should intensify its advertising efforts and inform farmers in all Zobas about their insurance products, taking into account the farmers' education level. Dairy farmers with alternative risk management strategies, such as off-farm investments and farm diversification, had a lower probability of participating in insurance implying the need to target dairy farmers with low off-farm income and those that are not diversified. NICE's plan to introduce horticulture insurance may encourage many diversified dairy farmers to adopt either dairy or horticulture insurance.

Although results suggest that young and inexperienced farmers have a greater probability of adopting insurance, it may not be economical for NICE to charge all farmers a fixed premium, as less risky farmers may be reluctant to pay the same premium rate as high risk farmers. Also, NICE may not insure high-risk farmers (young and inexperienced farmers living in high risk areas)

unless they can charge a higher premium. Skees (1999) reported that subsidized insurance programmes favour those with highest risk and those in the highest-risk region. Therefore, a variable premium, as in all private insurance schemes, is recommended. Despite NICE's claims that it offers subsidized premiums, some farmers might feel that the premium payments are still too high. Therefore, further lowering premiums could be a motive for many farmers to adopt insurance.

The relatively low numbers of dairy farmers (4.3 percent) who have adopted insurance for their livestock may cast doubts on the feasibility of livestock insurance. Moreover, adoption of insurance by commercial dairy farmers may always be low because it is a relatively low-risk enterprise that generates regular cash flows. Alternatively, NICE might contemplate poultry and horticulture insurance (crop insurance might have frequent systemic risk), since most poultry and horticulture farmers have less farming experience and are younger than dairy farmers. Since location of the farm is crucial in determining livestock insurance purchase, improving the poor infrastructure of Zoba Gash-Barka may increase farmers' adoption of livestock insurance. Moreover, if NICE's Zoba branches are authorized to provide full services at the Zoba level, the negative effect of location on farmers' decision to adopt livestock insurance could be minimized. Lastly, it is highly recommended that a thorough study be conducted and workshops be held that involve all stakeholders (farmers, Ministry of Agriculture staff, bankers, researchers, NICE) before additional insurance products are launched.

SUMMARY

Farmers operate in a risky environment due to some unforeseen changes in climatic conditions, input and output prices, technology, family relationships and government regulations and policies. As these changes affect decision making, farmers device certain risk management strategies to either control the risk or minimize the impact of risk.

Eritrea, situated in the northeast Africa, is bordered by Ethiopia, Sudan, the Red Sea and Djibouti. Administratively, it is divided into six provinces (Zobas). The population of Eritrea is estimated to be 4.3 million. Although agriculture is the mainstay of the country's economy by employing over 78% of the working population, it only contributes about 16% to the national Gross Domestic Product (GDP). Land belongs to the government and only the right to use it is granted to commercial farmers.

Data for this study were collected from three Zobas of Eritrea, namely Maekel, Debub and Gash-Barka, between November 2002 and February 2003. A sample of 186 commercial farmers, of whom 42 are from Zoba Maekel and 72 from each of the Zobas Debub and Gash-Barka, was interviewed. Of the sample, 40 are poultry farmers, 31 horticultural, 74 dairy and 41 crop farmers.

Individual ownership of the land accounts for over 74% of the sample farmers, followed by family ownership (22%), while the remaining 4% comprises association ownership. About 20% of sample farmers (mostly poultry farmers) were between 40 and 50 years of age and only 12% had more than 20 years of farming experience. About 60% of sample dairy producers and 36% of crop farmers had over 16 years of farming experience. About 58% of the respondents (mostly dairy and field crop farmers) had completed primary and junior school, 32% reached secondary school, and 8% completed either technical school or college. Only 1% and 2% of the respondents (poultry and horticulture farmers) were graduates with diplomas and first degrees, respectively.

About 75% of the sample farms had an annual gross income of less than 450 000 Nakfa, 21% between NKF451 000 and NKF750 000, and only 4% had a turnover of more than NKF751 000. Sample dairy farmers have the highest turnover, indicating relatively greater liquidity, whereas other farmers seem to have liquidity constraints. Thirty-eight percent of sample farmers, mainly

crop farmers, had no farm liabilities, and 43% of respondents had debt-asset ratios of less than 30% indicating that nearly half of the respondents are solvent. About 60% of the sample farmers engage in off-farm businesses.

Mean ratings and factor analysis of perceived risk sources and managerial responses to risk were performed to identify the main risk sources faced by Eritrean farmers and how they respond to risk. Results indicated that sources of risk, such as weather and climate change, change in the labour force, and diseases, pests and weeds, changes in the Nakfa exchange rate, government's demobilization and rehabilitation programmes and changes in agricultural tax policy had high mean ratings. Increasing sources of information was ranked overall as the most important production response followed by choice of production system, keeping production records, diversification of farm enterprise and being a low cost producer. Marketing responses, such as use of marketing information and indirect selling of products, were highly rated. Keeping financial records and off-farm investments were highly rated as financial management responses.

Factor analysis was used to analyse heterogeneity amongst farmers' perceptions of various risk sources and farmers' managerial responses to risk. Results indicate that programmes designed to assist farmers in Eritrea to manage production and price risks should vary between enterprises and between regions, and that farmers respond differently to different types of risk that is highly attributed to enterprise type.

Results show that commercial farmers' main sources of information vary according to farm type. Overall, sample farmers rated own farm records as an important source of information for production, marketing and financial decisions. While own farm records, own farm workers, local veterinarian, radio and television, and extension agents were the most important sources of information for production decisions, own farm records and salesmen were important sources of marketing information, and own farm records, lenders, and radio and television were important for financial decisions. While poultry and dairy farmers depend largely on information provided by the government, horticulture and crop farmers rely mostly on their own sources of information or non-governmental sources. On average, respondents spent NKF1365 per year on information.

A logit model was used to identify factors that affect livestock insurance adoption by commercial dairy farmers in Eritrea. The results of this analysis indicate that formal education of the farmer and the farmer's awareness of livestock insurance increase the probability of insurance adoption, whereas farming experience, poor location and use of alternative risk management strategies, such as off-farm investments and farm enterprise diversification, reduce the probability of livestock insurance adoption.

The policy implications of this study include that the government of Eritrea should create a more conducive environment for business, train farmers with appropriate record keeping skills, and improve road and communication infrastructure, promote commercial information providers, and periodically publish an agricultural magazine in a way that farmers can understand the information. The government should also disseminate information to clarify agricultural tax and land policies, and its demobilization and rehabilitation programmes. Relaxing foreign exchange rate controls may reduce price risks in agricultural input markets.

The need for a variable rather than fixed insurance premium, improving the know-how of farmers concerning risk assessment, and a need for a thorough study to be conducted on the demand for agricultural insurance in Eritrea are some of the policy implications of the results of the livestock insurance study.

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APPENDIX A

Farm Survey Questionnaire

**UNIVERSITY OF NATAL
SCHOOL OF AGRICULTURAL SCIENCES AND AGRIBUSINESS
DISCIPLINE OF AGRICULTURAL ECONOMICS**

FARMER QUESTIONNAIRE

TO BE COMPLETED BY THE RESEARCHER ON BEHALF OF THE
PRINCIPAL FARM DECISION-MAKER OF THE FARM BUSINESS.
THE INFORMATION WILL BE STRICTLY CONFIDENTIAL.

Code: _____

Part I - General Information about the Farm

1. Zoba/Zone: _____

2. Form of business organization

Individual ownership	_____
Family partnership	_____
Other partnership	_____
Corporation	_____
Company	_____
If Other (specify)	_____
_____	_____
_____	_____

3. Type of the farm

Crop	_____
Dairy	_____
Horticulture	_____
Poultry	_____

4. How many hectares does the farm business own? _____ ha

5. What are the main crops/fruits/vegetables that you grow?

6. What main rotation of crops do you generally follow

7. As a farmer, how do you define risk? _____

Part II – Information about Sources of Risk

8. How do you rate the following sources of risk in terms of their importance to your farm decision-making? Please circle the number representing the importance to you of each source.

Sources of Risk	Importance				
	Low				High
Availability of inputs	1	2	3	4	5
Change in labour force	1	2	3	4	5
Changes in agricultural tax policy	1	2	3	4	5
Change in the Nakfa exchange rate	1	2	3	4	5
Change in agricultural land policy	1	2	3	4	5
Change in availability of credit	1	2	3	4	5
Change in input cost	1	2	3	4	5
Change in capital cost	1	2	3	4	5
Changes in agricultural tax policy	1	2	3	4	5
Change in family relationship	1	2	3	4	5
Crop yield variability	1	2	3	4	5
Crop price variability	1	2	3	4	5
Disease, pests and weeds	1	2	3	4	5
Government's demobilization and rehabilitation programmes	1	2	3	4	5
Insecurity	1	2	3	4	5
Poultry price variability	1	2	3	4	5
Poultry production variability	1	2	3	4	5
Technological change	1	2	3	4	5
Weather and climate	1	2	3	4	5
Others	1	2	3	4	5
	1	2	3	4	5

Part III- Management Responses to Risk

9. How do you rate the following managerial responses to risk in terms of their importance to your farm decision-making? Please circle the number representing the importance to you of each.

A. Production Responses

Production Responses	Importance				
	Low				High
Increase source of information	1	2	3	4	5
Choice of production system	1	2	3	4	5
Keeping production records	1	2	3	4	5
Diversification of farm enterprise	1	2	3	4	5
Being low cost producer	1	2	3	4	5
Increase labour force	1	2	3	4	5
Increase use of capital items	1	2	3	4	5
Making timely use of machinery	1	2	3	4	5
Decreasing farm size	1	2	3	4	5
Having back-up management	1	2	3	4	5
Others	1	2	3	4	5
	1	2	3	4	5
	1	2	3	4	5

B. Marketing Responses

Marketing Responses	Importance				
	Low				High
Use of marketing information	1	2	3	4	5
Indirect selling	1	2	3	4	5
Keeping marketing records	1	2	3	4	5
Speculation	1	2	3	4	5
Direct marketing to consumer	1	2	3	4	5
Others	1	2	3	4	5
	1	2	3	4	5

C. Financial Responses

Financial Responses	Importance				
	Low				High
Keeping financial records	1	2	3	4	5
Off-farm investments	1	2	3	4	5
Debt management	1	2	3	4	5
Insurance	1	2	3	4	5
Others	1	2	3	4	5
	1	2	3	4	5

- D. Would you use more information on risk management if you had access? If so, please indicate the relative importance of more information on risk management in farm production, product marketing, and farm finance and in overall farm management.

Management Areas	Relative Importance of more Information on Risk Management				
	Low				High
Farm production	1	2	3	4	5
Product marketing	1	2	3	4	5
Farm finance	1	2	3	4	5
Overall farm management	1	2	3	4	5

- E. What additional information would you find useful for risk management in the following areas:

1. Production? _____

2. Marketing? _____

3. Finance? _____

Part IV – Information Use for Risk Management

10. Please circle the number representing the importance to you of each source of information.

Source of Information	Value for farm production decision					Value for farm marketing decision					Value for farm financial decision				
	Low		High			Low		High			Low		High		
Newspapers	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Radio and television	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Own farm records	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Extension agents	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
University specialists	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Salesmen	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Other farmers	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Own farm's workers	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Lenders (banks)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Consultants	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Local government	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Local veterinarian	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
NGO's	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Others (specify)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

11. Please Provide the annual out-of-pocket costs spent on finding, studying and consulting each sources of information.

Sources of Information	Annual Costs (NKF)
Newspapers	
Radio and television	
Own farm records	
Extension agents	
University specialists	
Salesmen	
Other farmers	
Own farm's workers	
Lenders (banks)	
Private consultants	
Local government	
Local veterinarian	
NGO's	
Others (specify)	

Part V – Livestock Insurance

12. Do you understand the importance of Livestock insurance? Yes ___ No ___
13. Do you need more information about Livestock insurance? Yes ___ No ___.
14. Have you purchased Livestock insurance? Yes _____ No _____.
15. Have you benefited from insurance so far? Yes ___ No _____.

Part VI – Socioeconomic Information

The information in this section, like in all the previous sections, is strictly confidential. It is important because your attitudes and responses to risk may be related to these characteristics.

- 16. Age _____
- 17. Education Level
 - Illiterate _____
 - Primary School _____
 - Junior School _____
 - Secondary School _____
 - Technical or Vocational School _____
 - Some College _____
 - 2-year Graduate _____
 - 4-year Graduate _____
- 18. Years of farming experience _____
- 19. Marital status _____
- 20. Number of dependents (spouse and children) _____
- 21. What is your typical farm turnover per year? ERN _____
- 22. What are the farm’s total liabilities? ERN _____
- 23. What is the approximate market value of the farm’s total assets?
ERN _____

Do you or your spouse have:

	Off-farm investments	Off-farm work
You	Yes/ No	Yes/ No
Spouse	Yes/ No	Yes/ No

APPENDIX B

Correlation Matrices for Risk Sources

Table B1: Correlation Matrix for Poultry Farms (RISK SOURCE)

Socioeconomic Factor	Factor					
	1	2	3	4	5	6
Farm size	0.330	0.063	0.339	0.310	0.143	0.085
Education	0.162	0.286	-0.182	-0.011	0.135	0.305
Experience	-0.107	0.175	0.026	-0.169	-0.212	0.381
Leverage	0.205	0.594	-0.131	0.044	0.495	0.062
Zoba	0.459	0.212	0.595	0.511	0.321	0.405

Table B2: Correlation Matrix for Dairy Farms (RISK SOURCE)

Socioeconomic Factor	Factor					
	1	2	3	4	5	6
Farm size	0.231	0.322	-0.484	0.002	0.439	0.126
Education	-0.040	-0.113	0.239	0.062	-0.064	0.058
Experience	0.108	0.240	0.165	0.009	0.140	0.046
Leverage	0.110	0.147	0.273	0.446	0.061	0.117
Zoba	0.426	0.336	0.222	0.372	0.377	0.305

Table B3: Correlation Matrix for Horticulture Farms (RISK SOURCE)

Socioeconomic Factor	Factor					
	1	2	3	4	5	6
Farm size	0.543	0.211	0.270	0.400	0.473	0.210
Education	0.226	0.193	0.062	0.165	0.097	0.067
Experience	0.063	-0.322	-0.076	0.167	0.192	0.125
Leverage	0.049	0.387	0.537	0.298	0.135	0.004
Zoba	0.632	0.300	0.505	0.363	0.337	0.361

Table B4: Correlation Matrix for Crop Farms (RISK SOURCE)

Socioeconomic Factor	Factor					
	1	2	3	4	5	6
Farm size	0.306	0.395	0.406	0.377	-0.187	0.306
Education	-0.331	0.143	0.022	-0.101	0.079	-0.331
Experience	0.114	-0.055	0.094	-0.064	-0.033	0.114
Leverage	0.248	0.182	-0.072	-0.214	-0.009	0.248
Zoba	0.603	0.320	0.528	0.479	0.301	0.603

APPENDIX C

Correlation Matrices for Managerial Responses

Table C1: Correlation Matrix for Poultry Farms (MANAGERIAL RESPONSE)

Socioeconomic Factor	Factor					
	1	2	3	4	5	6
Farm size	0.320	0.030	0.216	0.182	0.166	0.122
Education	0.251	0.077	-0.099	0.419	-0.105	0.117
Experience	-0.014	-0.016	-0.141	0.299	-0.017	-0.217
Leverage	0.285	-0.077	-0.248	0.258	-0.101	0.385
Zoba	0.568	0.399	0.375	0.507	0.315	0.293

Table C2: Correlation Matrix for Dairy Farms (MANAGERIAL RESPONSE)

Socioeconomic Factor	Factor					
	1	2	3	4	5	6
Farm size	0.396	0.230	-0.216	-0.182	0.166	0.122
Education	-0.251	0.477	0.099	0.219	0.105	0.325
Experience	-0.014	-0.216	0.141	-0.299	-0.017	0.217
Leverage	-0.285	-0.277	-0.048	0.008	0.401	0.285
Zoba	0.575	0.336	0.302	0.538	0.331	0.366

Table C3: Correlation Matrix for Horticulture Farms (MANAGERIAL RESPONSE)

Socioeconomic Factor	Factor						
	1	2	3	4	5	6	7
Farm size	0.375	0.210	0.248	0.008	0.330	0.323	0.256
Education	0.278	0.207	0.178	0.017	0.153	0.063	0.295
Experience	-0.179	0.220	0.044	0.054	0.136	0.287	-0.202
Leverage	0.213	0.445	0.138	0.356	0.067	0.153	0.144
Zoba	0.823	0.487	0.318	0.364	0.333	0.360	0.382

Table C4: Correlation Matrix for Crop Farms (MANAGERIAL RESPONSE)

Socioeconomic Factor	Factor					
	1	2	3	4	5	6
Farm size	0.322	0.241	0.362	0.291	0.290	0.217
Education	0.009	0.134	0.105	0.246	0.018	0.320
Experience	0.225	0.246	0.105	-0.086	-0.491	0.244
Leverage	0.158	0.040	0.247	0.256	0.286	0.126
Zoba	0.454	0.775	0.587	0.403	0.310	0.428

APPENDIX D

Tables of Factor Analysis Conducted for Risk Sources and Managerial Responses to Risk for the Pooled Data

Table D1: Rotated factor loadings of risk sources and factor scores for sample commercial farmers in three Zobas of Eritrea, 2002/03.

Factor		1	2	3	4	5	6
Eigenvalue		5.785	3.659	3.119	1.503	1.275	1.04
Percentage variance explained		26.3	16.6	14.2	6.8	5.8	4.7
Sources of risk	Communalities	Poultry gross income	Crop gross income	Livestock gross income	Credit access & technology	Cost	Natural
Poultry price variability	0.944	0.846					
Poultry production variability	0.919	0.833					
Change in labour force	0.759	-0.684					
Change in agricultural land policy	0.765	-0.677					
Insecurity	0.888	-0.670					
Availability of inputs	0.548	0.645					
Changes in agricultural tax policy	0.551	0.528					
Horticulture price variability	0.854		0.895				
Field crop price variability	0.830		0.886				
Horticulture yield variability	0.823		0.836				
Field crop yield variability	0.806		0.809				
Livestock yield variability	0.881			0.919			
Livestock yield price variability	0.827			0.861			
Technological change	0.606				0.729		
Change in availability of credit	0.717				0.684		
Change in capital cost	0.665				0.500	0.440	
Change in government support programmes	0.728				0.473		
Change in input cost	0.729					0.799	
Change in Nakfa exchange rate	0.647					0.754	
Change in family relationship	0.519						0.660
Disease, pests and weeds	0.750						0.623
Weather and climate	0.626						0.540
Zoba		Factor score					
Maekel		0.49	-0.57	0.21	0.15	0.56	0.01
Debab		0.19	-0.44	0.32	0.22	0.53	0.09
Gash-Barka		-0.29	0.42	-0.20	0.10	0.30	1.55
Enterprise							
Dairy		-0.10	-0.13	0.52	-0.26	-0.56	0.20
Crop		-0.28	0.33	-0.29	-0.31	-0.39	1.38
Horticulture		-0.41	1.01	-0.10	0.24	0.30	0.12
Poultry		1.13	-0.53	-0.35	0.06	0.55	0.02

Part of the variable's variance that is related to the common factors.

Table D2: Rotated factor loadings and factor scores of managerial responses to risk for sample commercial farmers in the three Zobas of Eritrea, 2002/03.

Factor		1	2	3	4	5	6
Eigenvalue		4.446	3.280	2.459	1.533	1.313	1.217
Percentage variance explained		23.4	17.3	13	8.1	7	6.4
Managerial response	Communalities	Information	Production	Records	Investment and Insurance	Marketing	Cost reduction
Increase source of information	.788	0.829					
Use of marketing information	.634	0.747					
Keeping marketing records	.671	0.739					
Increase use of capital items	.436	0.613					
Diversification of farm enterprise	.802		0.733				
Making timely use of machinery	.641		0.645				
Decreasing farm size	.794		0.645				
Choice of production system	.794		0.629				
Increase labour force	.722		0.602				
Speculation	.845		0.595				
Keeping financial records	.743			0.833			
Keeping production records	.708			0.817			
Having back-up management	.923			0.676			
Off-farm investment	.864				0.800		
Insurance	.887				-0.810		
Direct marketing to consumer	.839					0.890	
Indirect marketing	.823					-0.830	
Debt management	.662						0.774
Being low cost producer	.672						0.600
Zoba		Factor Score					
Maekel		0.306	-0.329	0.101	-0.040	-0.009	0.006
Debab		0.288	-0.163	0.171	-0.090	-0.004	0.172
Gash-Barka		-0.023	0.318	-0.182	0.159	0.020	0.023
Enterprise							
Dairy		0.083	-0.072	0.124	-0.021	-0.061	-0.054
Crop		-0.009	0.104	-0.436	0.560	-0.205	-0.065
Horticulture		0.164	0.658	0.118	0.261	0.267	0.054
Poultry		0.358	-0.421	0.124	0.007	-0.123	0.048

Part of the variable's variance that is related to the common factors

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