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Critical factors determining successful irrigation farming in Lesotho

By

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ABSTRACT

Critical factors determining successful irrigation farming in Lesotho

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Lesotho has ample water resources which could be used to improve the livelihoods of Basotho as a nation in many aspects. However, this seems not to be the case as Lesotho suffers from food in security particularly during severe droughts, to an extent of seeking support from international communities. Therefore the purpose of the study was to identify and investigate critical factors that determine successful irrigation farming in Lesotho in order to uplift the performance of irrigation and livelihoods of Basotho. A structural questionnaire was administered amongst 153 irrigation farmers and 31 extensionists randomly in the four southern districts of Lesotho, namely Maseru, Mafeteng, Mohale's Hoek and Quthing. The above mentioned districts were chosen because of the spacious agricultural land they have. Secondly most rivers with significant amount of water flow towards these areas.

Irrigation farmers showed that households are engaged in a wide range of livelihood activities, both on-farm and off-farm (e.g, taxi, business, etc). In addition, they obtain a substantial portion of the household income from the state through pensions and social grants. Agriculture is an important livelihood activity among irrigation plot holders in the four districts. Maize, potatoes, cabbage and beans are the most common crops grown by irrigation farmers in Lesotho. 34% of the farmers perceive climate as the most important factor determining what crops to plant, while 29% of the respondents consider potential markets as an important factor with decision making. Farmers use hoeing as the main method of controlling weeds and involve family members as their source of labour. 64% of farmers use rivers as their main source of water while the rest use dams and boreholes. Irrigation water is free of charge with exception of the fewer farmers located in the Maseru district where they irrigate from the Mohokahare and Phuthiatsana rivers. Most farmers perceive irrigation as an expensive activity especially those who are using diesel and electricity to pump water from the rivers and dams. Evidence suggests that very few farmers (5%) and extensionists (3%) have received any training in terms of irrigation farming and maintenance of irrigation systems, marketing opportunities and farm entrepreneurship

planning. Extension credibility is highly questionable as 70% of irrigation farmers do not regard extension as important for irrigation management decisions. Evidence further indicates that most farmers do not belong to any farmer groups/associations. 78% of extension workers indicate that the main problem hindering them from efficient extension delivery is the lack of infrastructure and facilities.

These results suggest the need for greater political and institutional input in irrigation farming and in particular to revisit institutional policy instruments and institution for extension, technical assistance, training and credit services that will facilitate performance of irrigation farming in Lesotho. Most importantly, farmers and extensionists should be adequately trained on the economic use of water and how to preserve it for sustainable irrigation development.

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DECLARATION

I declare that this dissertation, submitted for the degree of masters in Agricultural Extension at the University of Pretoria, is my own work and has not been previously submitted by me or anyone else for the degree at any other University. All the sources quoted have been acknowledged by references.

Signature _____

Dedication

To my dear parents, Mohapi Daniel and Masenna Alice Ntai.

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ACRONYMS AND ABBREVIATIONS

UNDP	United Nations Development Programme
GNP	Gross National Product
GDP	Gross Domestic Product
FAO	Food Agricultural Organisation
SIDA	Swedish International Development Authority
SWACAP	Soil Water Agro-forestry Conservation Programme
T&V	Training and Visit
GTZ	Gesellschafttir Technischa Zusammenarbeit
IFAD	International Food Agricultural Development
NGO	Non-Governmental Organisation
UEA	Unified Extension Approach
WB	World Bank
MOA	Ministry of Agriculture Lesotho
LEMA	Lesotho Enterprise in Mechanical Agriculture
GOL	Government of Lesotho
SRAEP	Senqu River Agricultural Extension Project
HVP	Hololo Valley Project

CHAPTER 1

INTRODUCTION

1. Introduction and background

Lesotho is a small land locked mountainous country completely surrounded by the Republic of South Africa. It has a total area of 30 350km^2, a north-south extent of about 230km and a maximum width of about 210km. Lesotho is the only country in the world that is entirely situated above 1000m in altitude (Bureau of Statistics, 1999-2000).

The cultivated land is largely confined to the lowlands and foothills on the western border and Senqu river valley in the south. Much of the rest of the land area is utilised for extensive livestock farming. Smallholder farmers whose farms are generally less than one hectare in size dominate the agricultural production (Bureau of Statistics, 1999-2000).

In 2002, the arable land was estimated at 334 000 hectares of which 330 000 hectares were cultivated while 4 000 hectares were under permanent crops. Maize is by far the most popular crop accounting for 60% of the crop area; sorghum varies between 10% and 20%, wheat approximately 10% and beans 6 % (Bureau of Statistics, 1999-2000). Out of the 330 000 hectares which were cultivated, only 12 500 were considered suitable for formal irrigation as determined by the FAO in 2007. Production yields have declined since independence as reflected in a dependence ratio of 32 in 1965 to 52 in 1990 (UNDP, 1994). Sechaba, (1994) estimated that if present trends in population growth and agricultural production continue, Lesotho would face soon difficulties of producing enough food to meet the demand.

In economic terms, Lesotho is one of the world‘s least developed countries. The Gross National Product (GNP) in 1997 was 4.747 million Maluti, which is equivalent to about 790 US$ per capita. In 1998 the Gross Domestic Product (GDP) had declined in real terms by 5.5% to US$ 747. The nominal GDP however has increased since 1997, reflecting a domestic inflation rate of about 9%. The average nominal income per person amounted to 3.133 Maluti (US$570) per annum which was slightly lower than the 1997 level (Central Bank of Lesotho Annual Report, 1999).

Water resources, surface and ground water, are abundant in Lesotho. The average rainfall is 760mm per annum, varying from 300mm per annum in the western lowlands to 1600mm per annum in the north eastern highlands. Surface water resources are estimated at 4.73km^3 per annum, which is far in excess of the country's requirement. Despite the availability of water; effective distribution of water is a major problem in Lesotho. Water is not always where it can readily be used. Due to the geographical situation, water is mostly abundant in the mountains where arable land is less available. In the lowland areas, water is often found in the valleys, but it is slightly below the level of arable lands, and therefore requiring to be pumped to the arable lands (United Nations Statistics, 2004).

Although Lesotho's main natural resource is water, drought occasionally affects agricultural production leading to significant declines in the contribution of the Gross Domestic Product and forcing the country to apply for assistance from the international community (FAO, 2007). According to a Government Report (2007), the possibility of increasing food production through area expansion is extremely limited which leaves only one option namely to intensify production from irrigation schemes.

In recent years many irrigation development projects were launched in Lesotho, most of them being funded by external donors. Public-supported irrigation development projects have been largely unsuccessful due to a top-down and supply-driven approach followed by the government, donors and with little consultation and participation by farmers (FAO, 2004).

1.2. History of extension in Lesotho

The Department of Agriculture in Lesotho was established in 1935 with three sectors of responsibility, namely: Veterinary Services, Crops and Co-operatives and Soil Conservation. The extension approach adopted was a general one with all messages communicated to farmers by agricultural demonstrators. In 1966 the Ministry of Agriculture was created with three departments (Livestock, Crops and Conservation) each having its own extension section (Government Report, 2007).

From 1966 onwards different extension approaches funded by different donors have been tried; different donors adopted different approaches such as the participatory approach funded by the Swedish International Development Authority (SIDA), the client demand approach funded by the Soil and Water Conservation and Agro-forestry Programme (SWACAP) and the Training and Visit approach (T&V) funded by Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) (Ministry of Agriculture, 1996).

1.2.1. Challenges of Extension

As frequently observed in other developed and developing countries, Agricultural Extension has played a remarkable role in developing the agricultural sector and the economy of Lesotho. However there were a lot of challenges, which had to be overcome. Some still exist today. For example politicians mostly decide what developmental projects should be initiated and extensionists are just instructed what to do. Most extension workers are appointed on the basis of their political affiliations and not on how competent they are in service delivery. Globalisation, market liberation, deterioration of natural resources and population growth all pose tremendous challenges for extension institutions to re-adjust their strategies and services. (IFAD, 2007). It is because of these challenges, that extension is taking different shapes so as to adapt to the changes and challenges of the day.

1.2.2. Efficiency of Extension

The efficiency of extension systems in sustainable agriculture and rural development for food security is a major concern of the FAO (2007). The FAO (2007) identified shortcomings with regard to extension systems, policies, strategies and approaches adopted for extension management, extension-research-education linkages and developing extension programmes and methodological tools tailored to farmers. It is important that agricultural extension prioritises, its interventions with farmers and selects efficient decision-support tools which will efficiently target the needs of farmers within specific environmental and socio-economic settings (Patanothai, 1997).

1.2.3. Funding of Extension

Worldwide, agricultural extension performs important roles to enhance agricultural productivity. However, during the 1990s economic structures and adjustment policies triggered governments to cut back extension support in many countries which consequently led to crises in public agricultural extension (Bebbington *et al.* 1993*).* Many local Non-Governmental Organisations (NGOs) have tried to fill the gap by implementing extension services through private grants. These created challenges for NGOs due to lack of resources, namely lack of specialised expertise and financial resource (Schuh *et al*. 1989).

1.3. Problem statement

The overview of the history of irrigation in Lesotho clearly illustrates the results of a donor driven approach, where participants were not considered during the designing and planning of the projects. The majority of projects collapsed after a while and new donors were sought to support the irrigation schemes.

Much time and national resources were spent on irrigation schemes, which failed to be sustainable and profitable to Basotho as a nation. All the irrigation schemes which have been developed in Lesotho were either funded by the government or by international donors. Some irrigation schemes are currently considered functional but are highly dependent on government subsidies and financial support. Poor performance of these irrigation schemes has led to low crop yields to such an extent that since 1987 irrigation farmers were unable to make profits on these schemes (Bureau of Statistics, 1994).

Inefficient extension support constitutes yet another problem in irrigation performance in Lesotho. According to FAO (2007), irrigation is a very expensive enterprise. It requires comprehensive preparations and understanding by all stakeholders. It is estimated that on average 12 000 US$/ha have been spent during the establishment of irrigation systems which comprises gravity fed and low pressure sprinkler systems, excluding main pipe lines from the water source to the edge of the field.

The Extension Division in the Department of Agriculture is responsible for mobilising farmers and communities to adopt new irrigation technologies. Various extension approaches have been

implemented since 1966. Presently, three extension approaches are generally used by the Agricultural Department in Lesotho namely, the Training and Visit Approach, Client-Demand Approach and the Participatory Extension Approach.

An evaluation process that was done by the districts agricultural officers' in 1995 revealed the performances of each approach. The outcome of this evaluation was incorporated in the new approach called Unified Extension Approach (UEA) (Ministry of Agriculture Cooperatives and Land Reclamation, 1996). It is not clear what this approach entails except to say it is a hybrid of training and visit, client-demand and the participatory extension approaches. Also the implementation of the UEA has not been explained in sufficient detail (since 1996). Several workshops have been offered to help extension officers with the implementation of the UEA (Extension Report, March, 2000). Antholt (1994) contends that a variety of extension approaches is required to meet the diverse needs of different groups and types of farmers.

1.4. Purpose of the study

The study will identify and analyse the critical factors that determine successful irrigation extension support to farmers in Lesotho. The study will also discuss the possible reasons which led into poor performance of the irrigation schemes in Lesotho.

1.4.1. Objectives of the study

a) To determine and analyse the current situation of irrigation schemes in Lesotho.
b) To determine possible reasons for poor performance of irrigation farmers in Lesotho.
c) To analyse the efficiency of extension support rendered to irrigation farmers in Lesotho.
d) To make recommendations regarding the improvement of irrigation development in Lesotho.

1.4.2. Hypotheses

Hypothesis 1: Poor extension support to irrigation farmers impacts negatively on irrigation development.

Hypothesis 2: Participation of farmers in the planning and implementation of irrigation development programmes is a pre-requisite for sustainable irrigation development.

CHAPTER 2

LITERATURE OVERVIEW

2.1. Overview of irrigation internationally

This chapter gives some insight into irrigation performance in a broad sense, internationally and further narrows the perspectives to the situation in Lesotho. The history of irrigation development and potential is dealt with in this chapter.

At first sight, it may appear to be unnecessary to define an activity which is well known and practised in a great many countries; however it is imperative to view how various people define irrigation. Stern (1979) defines irrigation as any process, other than natural precipitation, which supplies water to crops, orchard, grass or any other cultivated plants. Vaughn *et al.* (1980) defines irrigation generally as application of water to the soil for purposes of supplying the moisture essential for plant growth.

Irrigation has been practised in some parts of the world for several thousand years. For example rice has been grown under irrigation in India and the Far East for nearly 5000 years (Stern, 1979). History notes that irrigation was one of the first modifications of the natural environment undertaken by early man (Hoffman, Howell and Solomon 1992).

2.2. The importance of irrigation

Irrigated agriculture plays an important role in providing the general stability in the food production required to keep pace with the population growth in Sub-Sahara Africa. Since the world population has increased from 1.6 billion to more than 5 billion over the last 90 years, agriculture needs to produce more food for the growing population (Howell, 2001). Irrigation is a cornerstone in global food security. The relative high crop yields farmers could get with controllable water supply can play a vital role in feeding millions being added to the existing population (Peter and Gleik, 1993).

However, both irrigation development and food production have serious substantial limitations. This is because most skills that are required for the development of these sectors are imported

from developed countries and in most cases, are not compatible with the indigenous knowledge and the needs of the smallholder farmers in the Sub-Sahara Africa (Parr *et al.* 1990).

2.3. The importance of water in irrigation

Water plays a vital role for all living organisms and major ecosystems as well as for human health, food production and economic development. Access to clean water is an essential necessity for the well-being of all people. Water availability has been identified as an important environmental constraint on development and ultimately a limiting factor for population growth and food production (World Bank, 1992).

Water availability is closely related to human welfare, since it affects nutrition through food production and people's health through quantity and quality of drinking water. Falkenmark (1989) illustrates that a population usually experiences food security problems if there is not enough water locally available for food production.

Today nearly 40% of the world food supply is grown under irrigation (Desherbinin and Dompka 2005). In recent years, increasing emphasis has been placed on smallholder irrigation as a means of promoting socio economic development in less developed areas. In certain areas, production was increased, however this was due to centralised planning with insufficient participation of stakeholders. As a result, it was not sustainable (Thomas and Stilwell 1984).

2.4. Management of irrigation water

Van der Leeuw, (2000) and Mclntosh *et al.* (2000) asserted that the preconditions to the improvement of sustainable livelihoods are dynamic; the world is continuously experiencing social-ecological changes that can alter the capacity of the ecosystems to generate goods, including food and services on which society depends. Water being a key element in all ecosystems has to be cared for by users and governments (Daily, 1997).

Cai and Rosegrant (2003) indicates that agriculture consumes 72% of the world's fresh water and that the use of water for irrigation is not efficient in many countries. Kirda and Kanber,(1999) suggests that sustainable methods of drought mitigation and increasing of production need to be adopted.

Many important agricultural areas experience shortage of water because water is not used efficiently. In addition, residential and industrial demands for water are increasing, due to increase in urbanisation (Postel, 2001). However the new development of modern irrigation technology addresses the need for more efficient water use. New irrigation technology includes irrigation drip kits (Samakande and Manzunqu, 2004) and techniques of irrigation scheduling (Thomas *et al*. 2000).

Advocating for efficient irrigation water management gained momentum during the late 1960's and early 1970's. The emphasis in general was on irrigation scheduling at farm level but Wickham and Takase, (1976) as confirmed by Stevens (2006), illustrates that efficient bulk water distribution at system level is a prerequisite for efficient farm irrigation water management.

2.5. Challenges for irrigation

The main challenge facing water resource managers in coming years is to secure enough water for irrigation. This is especially so in countries where population growth is very high. In Sub-Sahara Africa water scarcity as well as very high levels of malnutrition often occur (Rockstrom, Barron and Fox 2003).

Perret, Farolfi and Hassan (2006) are of the opinion that although irrigation previously played a vital role in the food supply as well as world economics for almost a century, it faces a variety of challenges to-day namely: lack of irrigation efficiency, public demand for alternative water uses, lack of maintenance and often socio-economic inequalities. Peter and Gleick (1993) also indicate that there has been a tremendous slowdown of irrigation development brought about by lower commodity prices, comparatively high energy costs and unfavourable economic conditions.

Sustainable irrigation development has been much slower than expected during the last 20 years due to factors which include degradation of irrigated crop land, mismanagement of irrigation schemes, difficulties in maintaining and rehabilitation of schemes, and problems experienced upstream and downstream in the sharing of water resources (FAO, 2002).

2.5.1. The role of irrigation in food security

Although there has been a significant development in addressing malnutrition some developing countries are still undernourished and do not have enough food to eat (Flore, 2001). Irrigation schemes have a role to play in the reduction of poverty and food insecurity, (Samakande *and* Manzunqu, 2004). Poverty, food security and rural development are intertwined concepts which have caused concern globally and governments are trying their best to combat this problem. In recent years, large irrigation schemes seem to have been a failure in most African countries. Presently smallholder irrigation farmers who stay in the rural areas have been targeted. This is because they are the ones affected most severely by poverty and food insecurity (Chigerwe *et al*. 2004).

2.5.2. Water policy and water use charges

Continuous increases in water demand globally have triggered intense debate around the world. This has motivated the formulation of water policies and water pricing methods (approaches) for irrigation water. Water charges that recover costs of water supply are seen as an incentive for users to use water resources more efficiently and economically Backeberg *et al.* 1996; Stevens, 2005. It is believed that farmers will respond to the introduction of water charges by reducing their consumption (Ministry of Environment in Spain, 1998). However these assumptions have been disputed by various authors who have studied the impact of water charges on more efficient water use (Varela-Ortega *et al*. 1995).

2.6. History of irrigation in Lesotho

According to the Ministry of Agriculture (MOA, 2002) irrigated crop production in Lesotho has a long history. It started with small dams being constructed by the British Empire in 1964, before Lesotho become independent. Since then, irrigation enjoyed high priority in the Ministry of Agriculture. In 1965, a five year project funded by the British government established a core of irrigation research at Thaba-Phatsoa in the Leribe District and Tsakholo in Mafeteng District. In the Maseru district however, agricultural research concentrated mainly on fertiliser requirements, cropping patterns and cost of effectiveness of various irrigation systems. At Tsakholo station, the focus was on finding suitable irrigation methods for duplex soils that are common in Lesotho (MOA, 2002).

2.6.1. The first irrigation projects in Lesotho (1968)

According to the MOA (2002) the first irrigation scheme in Lesotho commenced at Thaba-Phatsoa in the Leribe district in 1962. However, due to problems experienced during the pre-independence period, the scheme had to be restarted in 1967/68. This included 8.2 hectares consolidated irrigation block with 11 stakeholders. During subsequent years, the scheme expanded and during the winter of 1971 about 60.1 hectares were irrigated. The project was managed by extension agents employed by the Ministry of Agriculture. Each farmer had to sign a contract with the Ministry of Agriculture to provide free labour irrespective of the size of the land under irrigation. The net profit was determined after harvesting the crops and was divided equally between the government and the farmers. The farmer's share of profits however, was divided on the basis of each farmer's original size of landholding. (MOA, 2002).

During the initial stages of irrigation development, crops such as maize, wheat, peas, beans and potatoes were commonly grown. Later during the summer of the 1969/70, twelve hectares of *Eragrostis teff* was also produced alternating with experimental cropping of Lucerne, cabbage, carrots and rice. By 1974, seventy-five smallholders were growing maize, beans, wheat and peas on 65 hectares of irrigated land (MOA, 2002).

2.6.2. Leshoele Irrigation Scheme (1968)

Thaba-Phatsoa Irrigation Scheme was generally considered successful and gave rise to the development of other irrigation schemes like Leshoele in 1968. However, production returns (yield) from Leshoale was very low. One of the major constraints was that farm machinery was mainly provided by the Lesotho Enterprise the Mechanical Agriculture (LEMA) and broken machinery had to be taken to South Africa for repair. Another constraint was the general poor management and the unwillingness of farmers to provide labour which led farm operations frequently being carried out late or not at all. The general low morale on the scheme probably rooted in social issues, for instance, the uneven distribution of profits which penalised small holders (MOA, 2002).

In 1974, the rules and regulations of participation on irrigation schemes were revised to ensure that provision of labour was proportional to the size of landholding. This new arrangement

however proved to be unacceptable to traditional chiefs and larger landholders who had benefited from the previous system.

2.6.3. Taiwanese and Chinese governments interventions (1978-1990)

In 1975/76 the governments of Lesotho and Britain failed to provide sufficient funds for production and this exacerbated the debts of farmers. British financial assistance to Thaba-Phatsoa ended in 1977. In the late 1970s, the Taiwanese Government took over the project management from the governments of Lesotho and Britain. The emphasis of the government of Taiwan was on the production of high value crops, which required changes in the methods of irrigation by using small pumps. In 1983, when the Taiwanese Government intervention came to an end, nine families (households) were involved in the production of cabbage under irrigation covering 2.4 hectares. In 1984, the officials from the Republic of China took over and managed the project. They followed the same approach as the Taiwanese. This intervention ended in 1990. In 1991, with the assistance of the Ministry of Agriculture and the extension support, the project was allocated to business people who had organised themselves (MOA, 2002).

2.6.4. Assessment of the efficiency of irrigation on irrigation schemes in Lesotho (early 1970 s)

During the early 1970s, the efficiency of various forms of irrigation were assessed on the irrigation schemes of Thaba-Phatsoa, Tsakholo, Maseru Experimental farm and others. In 1972, Binnie and Partners were commissioned by the United Nations Development Programme (UNDP) and the World Bank to produce a strategic plan for water resource development in Lesotho. As part of this plan, prospects for irrigated agriculture and the possible pattern of irrigation development in Lesotho were identified (MOA, 2002).

The study identified 12 488 portions of land comprising of 5 787 hectares of class 1 land, 4 428 hectares of class 2 land and 2 273 hectares of class 3 land as technically feasible for irrigation. The study recommended commercial management of this irrigation land in consolidated units of 4 00 hectares or more (MOA, 2002).

2.6.5. Senqu River Agricultural Extension Project (SRAEP) (1972)

Simultaneously the government of Lesotho (GOL) came to an agreement with (UNDP) to establish a large scale irrigation scheme on land previously described as suitable for overhead sprinkler irrigation. The Senqu River Agricultural Extension Project (SRAEP) was funded by UNDP and implemented by the Food and Agriculture Organisation (FAO). It began to function in 1972 and covered Quthing and Mohale'shoek districts respectively. The objectives of this project were to demonstrate economic irrigation methods for fodder production.

The project provided credit to farmers for the purchase of seasonal inputs, irrigation equipment and tractor units and for the training of staff. The project also served farmers by identifying market opportunities. The requirement of the MOA was that the project should be administered using consolidated irrigation blocks to demonstrate possible advantages with the use of this method. Six dry land and two irrigated blocks were established which formed the core areas for demonstrations. The farmers formed an association to improve communication amongst themselves and the project officials (MOA, 2002).

From the onset of the project, tremendous delays in the signing of project documents were experienced. Many of the technical personnel were not in place and the original planning of the project did not include the intervention of sociologists and economists. This led to confusion and disappointment amongst the participants. Severe financial problems were experienced with the project which prompted the Government of Lesotho to request a mid-term review. This led to the creation of positions on the project for rural sociologists and farm economists (MOA, 2002).

2.6.6. Hololo Valley Project and Bauer irrigation Schemes (1978-1985)

During April 1978, the Hololo Valley Project (HVP) commenced under the Irish Government Foundation. A total of seventeen irrigation schemes were included in this project that was developed over a period of ten years. Twelve of these irrigation schemes were run by individual smallholders while five were communal schemes. The twelve irrigation schemes managed by individual farmers with assistance from HVP became successful. The HVP provided technical support and loans for irrigation equipment. This project proved that small-scale irrigation

schemes managed by farmers can do well, provided the necessary, technical and financial supports were offered (MOA, 2002).

During 1985, Bauer Irrigation Schemes were established by the Ministry of Agriculture. This irrigation scheme entailed large-scale area-based irrigation at eleven sites in the lowlands, totalling 2 519 hectares. This irrigation project differed from the other schemes in that it was financed by means of a loan which was designated in Austrian schilling. The Bauer irrigation projects included Ha Nyenye, Hlotse. Tsikoane and Peka in Leribe District, Masianokeng in Maseru District, Ha Thoahlane and Litsoeneng in Mafeteng District, Ha Khitsane and Maphutseng in Mohale'shoek District, and Seaka and Tele in Quthing District. Selected farmers from these districts did not participate in the development and planning of the project and therefore many problems were encountered at the implementation stage (MOA, 2002).

2.7. Irrigation potential in Lesotho

The long term irrigation potential of Lesotho has been estimated at 12 500 hectares during 1996, with the possibility to extend it with 2 520 hectares. (FAO, 2007) The potential extension of the irrigation area per district is presented in the Table 2.1.

Table 2.1 Potential extension of irrigation areas in selected lowlands districts in Lesotho

	Potential extension of irrigation area (ha)
Hololo	30
Hlotse	500
Phuthiatsana	950
Mpetsana	40
Makhaleng	1 000
Total	**2 520**

Source (FAO, 2007).

Other estimates of the potential irrigation extension of Lesotho were considered in terms of the available water resources. According to these estimates, a minimum of 3 500 hectares and up to

7 000 hectares could be brought under irrigation if the Senqu River potential is fully exploited. (FAO, 2007).

2.8. Policies and legislation to promote water use and rights in Lesotho

The Water Act of 1978 is a framework for utilising and managing water resource in Lesotho. It states that all water found naturally in the country belongs to the Basotho nation. It however forces anybody who needs to use water for reasons other than for primary purposes to apply for a permit to the Department of Water Affairs (Government of Lesotho, 1978). The primary water use includes irrigation of less than a quarter of a hectare, rural domestic water use and watering of not more than 30 head of cattle (Government of Lesotho, 1978). According to the Lesotho government report (1997) the national irrigation policy of the government is currently in disarray as the government and its donors recognise that previous policies have failed. The report further indicates that there is no comprehensive alternative developed to date.

The poverty reduction strategy and action plan is a document that underlines the commitment and strategies of the Lesotho Government to reduce poverty and the challenges relating to it. Its overall goal is to reduce poverty by more than 50% by 2015 and ultimately eradicate it by 2022 (Government of Lesotho, 2005). Water is seen as the first priority under the poverty reduction strategy and action plan. Hereby the poor are empowered to generate income through the promotion of irrigation in the rural areas (Government of Lesotho, 2005).

2.9. Land tenure system in Lesotho

Currently the distribution and use of land in Lesotho are arranged by principal chiefs. Few people own and manage their land. Land has traditionally been regarded as a common resource regulated by the chiefs and local communities. Chiefs are responsible for the allocation of land to households. The rangelands are grazed communally, using rotational grazing. However the system faces a number of challenges as indicated by UNDP (1993). The challenges are as follows:

- Since most individuals do not own land, there is almost no interest in husbandry.
- Land cannot be used as collateral in taking loans for other businesses.

- Although 50% of the households are headed by women, they are not allowed to own land or inherit land.
- There is no transparency in the current system. For example, if land is lying fallow for two years, under the customary law, the chief has a right to take that land. However, this power has been abused by chiefs who used the legitimate resting of land as justification for reallocating it to others.

2.10. Extension Approaches commonly used for persuasion of farmers

Agricultural extension is concerned with the diffusion and adoption of new technologies and practices. Diffusion and adoption of technologies differ from innovation to innovation. Some innovations take a short time to be adopted while others may not be adopted at all (Rogers, 1972). Extensionists use different approaches of persuasion depending on the nature of innovation and farmers perception.

2.10.1. Participatory Approaches

Farmers have often been ignored in the development of innovations that can change and improve production in their farming systems. Participatory approaches however consider farmers to be the main stakeholders in research and they become fully engaged in the generation and dissemination of knowledge (Braun, Thiele and Fernadez, 2000).

An intrinsic characteristic of farmers is that they are innovative to sustain, expand and improve their production systems. Agricultural innovation is a product of social negotiation among stakeholders. The spreading of this innovation is only possible through effective social organisation and communication at community level (Hagman *et al*. 1999; Padre, Sudarshana and Tripp, 2003). Two participatory extension approaches implemented in Lesotho are the Farmers Participatory Research and the Participatory Action Research.

2.10.1.1. Farmers Participatory Research

Farmers Participatory Research (FPR) has been proposed as an approach to develop appropriate agricultural systems that are indisputably acceptable to the farmers while simultaneously contributing to the improvement and maintenance of Agricultural Sustainability and Environmental Quality (Fujisaka NRC, (1989). Cox (1996) and Rhodes (1997) developed so-

called the Farmer Back to Farmer model which was a forerunner of the participatory approach. This model begins and ends with the farmer, and involves four activities namely; *farmer-scientist diagnosis, interdisciplinary team research, on-farm testing and adaptation and farmer-evaluation adaptations*. Farmers are therefore accepted (engaged) as expert members of the interdisciplinary team and are integrally engaged in the problem identification, definition and solution aspects of the approach (Dick, 2002).

2.10.1.2. Participatory Action Research

Participatory Action Research is another recognised form of experimental research. It focuses on the effects of the direct actions of practice within a participatory community with the goal of improving the performance quality of the community or an area of concern (Dick, 2002). Action research involves utilising a systematic cyclical method of planning, taking action, observing, evaluating and critical reflecting prior to planning the next cycle (Quilley *et al.* 2000). It is a collaborative method to test new ideas and implement action for change and involves direct participation in a dynamic research process (Dick, 2002).

At its core, action research is a way to increase understanding of how change in one's action or practice can mutually benefit a community or practitioner (Mcniff, 2002). The enhanced involvement of farmers, farmer organisations, and farmer's advocates of innovation development planning, management and monitoring, evaluation has contributed to a more demand-driven agriculture research and extension agenda of public and private service delivery (Gladwin, Peterson and Mwale, 2002).

2.10.2. Training and Visit approach to Agricultural Extension

The Training and Visit system is an extension management system that was developed for the World Bank (WB) by Benor and James (1977). It was aimed at upgrading the technical content of field extension staff. Proven agricultural practices from international and national research centres were prepared and recommended for practice. They were passed down to the extension organisation's hierarchy from subject matter specialist to agricultural extensionists. These packages are then passed to the village extension workers who disseminate the information to the farmers (Benor and Harrison, 1977).

Irrespective of one's view of the Training and Visit approach, extension has enhanced its image in developing countries. One of the remarkable achievements of the T&V approach which has not be quantified is that, it has established the importance of Agricultural Extension and the need to manage it effectively (Benett,1999).

The International Fund Agriculture Development (IFAD) (1997) as cited by Mokone, (2005), was introduced into Lesotho in 1990's under the World Bank's Basic Agricultural Support Programme. It was to be integrated into normal government extension functions in the lowland districts of Lesotho. The motive behind the introduction of this programme was to upgrade technical content of field extension activities, while allowing agents activities to be more predictable and thus more accessible to farmers. The idea was to increase the effectiveness of agricultural extension services through comprehensively structured training delivery and administrative systems (IFAD, 1997).

2.10.3. Top-down and centralised approach

The Top-down or Blueprint approach corresponds to the conventional way of developing a programme. In this model, research stations generate technologies which are then transferred to extension services through subject matter specialists. Extensionists at districts level plan and develop the programmes and define specific objectives and messages to be disseminated. At the village level, extension workers implement the activities according to fixed work schedules, under close supervision and leadership. Farmers' involvement is generally not a priority (Dusseldorp and Zijderveld, 1991).

The Top-down approach has been criticised for various reasons, the most important being uniformity, that is not taking into account the socio-cultural environment, the particular circumstances in which project implementation occurs, and the characteristics of the different clientele groups. Consequently the dissemination of a given technology package takes place without an adequate understanding of the farming systems and diversity of farmers' problems, potentials, rationales and strategies (Portela, 1990). This method featured quite often during the early development of irrigation schemes where farmers would be informed that their fields had been identified for irrigation development in the early1960's and 1970's (MOA, 2002).

2.10.4. Client demand approach

According to Scarborough *et al (*1997) the Client Demand approach is a relatively recent label for a notion that has been debated since individuals began to write about extension as an academic discipline and an education practice. It captures the idea that the information, advice and other services offered by extension professionals should be tailored to the expressed demands of the clients or recipients of the service and not just according to their needs as identified by various stakeholders.

According to Mokone and Steyn, (2005) the Client Demand approach was implemented in Lesotho in 1986 under the programme of Soil and Water Conservation and Agro-Forestry (SWACAP). This method was practised in the northern districts of Lesotho namely Botha-Bothe, Berea, Leribe and Maseru. It was designed and implemented within the existing Ministry of Agriculture (MOA) structures and programmes. However this programme focused on working with groups and village chiefs, Villages Development Councils (VDC) and community leaders and refrained from working with individual farmers (IFAD, 1997).

According to the literature, one can conclude that irrigation will continue to be more instrumental in addressing poverty in most countries although there are still challenges to be addressed such as economic and other issues. It would appear that most irrigation projects in Lesotho have been imposed on people, hence the limited success.

CHAPTER 3

METHODOLOGY

3.1. Sources of information

Information used to complete this study was acquired from both secondary and primary sources. Secondary sources included published and unpublished sources, periodicals, dissertations and theses reports from research institutions, conference papers, textbooks, journals, articles, the internet and library reference services. Primary data was gathered by means of formal survey questionnaires. The respondents included farmers on irrigation schemes, extensionists, and some irrigation engineers who are working with extensionists for the Department of Horticulture, Forestry and Land Reclamation.

3.2. Choice of study area

In an effort to be representative of the major irrigation schemes in Lesotho, four study areas were chosen. These four study areas are situated in the three major catchments of Lesotho namely, the Senqu, Makhaleng and Mohokare catchments. The four study areas are Mafeteng, Quthing, Mohale's Hoek and Maseru districts. Three of the named districts are located on the southern part of Lesotho and are characterised by duplex soils and semi-arid conditions. Without irrigation, crop farming in these areas is highly impossible, although most of the arable land is situated in these areas.

The four research areas were selected because they represent the major cropping areas and show the highest agricultural potential due to the relative abundance of arable land (situated in the lowlands) (Agricultural Census, 1996). However, there are a number of challenges to be dealt with in these districts. Lack of capital, poor market outlets, inefficient extension services and poor soils as reflected on the findings of this research are among the important challenges needing attention.

3.3. Design and formulation of the questionnaire

Two questionnaires were designed to collect information from the farmers and extensionists respectively. The questionnaire developed for collecting data from the farmers consisted of two parts. The first focused on the gathering of demographic information while the second part focused on competences, attitudes, cropping systems, cultivation practices, crop and irrigation management and the economic status of the farmers in relation to agricultural production and irrigation. The questionnaire was tested in Maseru with farmers and no amendments were necessary. The same format and procedure was followed with the designing and testing of the questionnaire for extension workers. The respondents were interviewed using structured open-ended and closed questions.

3.4. Sampling procedures

The target populations were the irrigation farmers and their extension workers from the four study areas. The population was divided into four strata based on the four districts. From each stratum a range of 36 to 38 farmers were randomly identified and interviewed, regardless of the type of irrigation found in their area. This lead to the total number of 153 farmers which was slightly less than the original plan as 170 farmers were targeted. Six to seven (6 to 7) extensionists were interviewed in each district making a total of 31 which was also slightly less than the original plan as 50 extensionists were targeted. The independent samples from which information was obtained were later combined to identify common problems and differences in the four study areas. The reason for selecting this sampling technique was that more precise data is easily obtained without deep expenses.

3.5. Data Collection

Data collection commenced in November 2008 and ended in March 2009. No enumerators were used. The Ministry of Agriculture (Lesotho) organised transport for data collection in the named four districts. Some extensionists were provided by the Ministry to work as guides to the irrigation areas in the districts.

3.6. Data analysis

The questionnaires were coded for computer analysis and the Department of Statistics of the University of Pretoria took the lead in the analysis of the data. The Statistical Analysis System was used to analyse the data. The dominant analysis of data was descriptive.

CHAPTER 4

DESCRIPTION OF THE STUDY AREAS

4.1. Introduction

The Kingdom of Lesotho is situated at the highest part of the Drakensberg escapement. Lesotho is divided into four ecological regions based on elevation and Agro-climatology, namely the Lowlands, Senqu River valley, the foothills and the mountains. The climate in Lesotho is generally temperate. The highland areas experience severe winters with ground frost occurring approximately 200 days per annum.

Lesotho has ten local districts which are grouped as the southern and the northern districts. There is a great variability of climate, soils and vegetation found between the southern and northern districts. (Lesotho Agricultural Report, 1996). The four southern districts identified for the study are Maseru, Mafeteng, Mohale'shoek and Quthing.

4.2. Common challenges

Soil degradation, poor grazing systems and food shortages count among the greatest challenges facing these districts. The southern districts occupy the biggest portion of both the arable and rangeland farming but crop production and animal husbandry are at risk in these districts due to severe soil erosions and poor grazing systems (Lesotho Agricultural Report, 1996).

4.3. Maseru district

Maseru is one of the ten districts of Lesotho. It is surrounded by the districts of Berea, Thaba-Tseka, Mohale'shoek and Mafeteng. Maseru is divided into three agro ecological zones namely the lowlands, Foothills and the Mountains. It has an elevation ranging from 1200 to 1800 metres in the Lowlands, 1800 to 2300 metres in the Foothills and 2 300 to 3 000 metres in the Mountains. It has five peaks namely Qeme (2 027 m), Thaba-Telle (2 533 m), Thabana-li-'mele (2 660 m), Machache (2 886),Thaba-Putsoa (3 096 m) and two well-known passes called Blue Mountain and Bushmen's passes (Ministry of Agriculture Cooperatives and Land Reclamation March 2002).

The total geographical area for the District is 427 900 hectares. Before the creation and development of the Thaba-Tseka district, the Maseru District was the largest in the country accounting for 20.4% of the total area. The district now accounts for only 14.1% of the total area. Approximately 41% (17 5439 hectares) of this is the Mountains, 31% (13 2649 hectares the Foothills and 28% (119 812 hectares) the Lowlands.

4.3.1. Population

The total population of the Maseru district during the 1996 census was 39 3154 residents. 52% of this population represented females. Approximately 9% of this population resided in the Mountains, 19% (75 567) in the Foothills and 72% (28 3847) in the Lowlands. The average population density for the District as a whole is 92 people per square kilometre. Of the total population, 86% are fulltime permanent residents while 14% are classified as absent. The annual growth rate of the Maseru District is 2.1% (Bureau of Statistics 1996).

Table 4.1 Population distribution

Age range in years	0-9	10-19	20-29	30-39	40-49	50-59	60-69	>70
% of population	25%	25%	18%	13%	9%	5%	3%	2%

Source: Bureau of Statistics (1996)

Maseru city has 13 7837 residents (7% of the national population) and is the largest urban centre in Lesotho. The rural population of Maseru district is reported as 215 500. The rural population represents 54.8 % of the total population of the Maseru district as represented in Table 4.2 in (1996).

Table 4.2 Summary of population data for the Maseru district

Population for Maseru district				
	Population	Lowlands	Foothills	Mountains
Urban	178814	166 447	12 367	-
Rural	214340	117 400	63 200	33 740
Total	**393 154**	**283 847**	**75 567**	**33 740**

Source: Bureau of Statistics 1996

The total number of households in the Maseru district is quoted as 83 961 of which 63 691 (76%) are found in the Lowlands, 13 831 (16%) in the Foothills and 6 439 (8%) in the Mountains. The average household size is 5 with households tending to be slightly larger in the foothills and the mountains. 31% of these households are female headed. Out of the 52 858 rural households, 47 000 (89%) are engaged in agriculture while 5 858 (11%) are engaged in non-agricultural activities. For the 47 000 households engaged in agriculture in Maseru district 58% are found in the Lowlands, (27%) in the Foothills and (15%) in the Mountains (Agricultural Census, 1999/2000).

4.3.2. Climate

Maseru district is hot in summer with mean maximum temperatures ranging between 22 and 31degrees Celsius. The hottest areas are in the Lowlands while the Foothills and the Mountains are considerably cooler. Winter temperature ranges between cold in the Lowlands to very cold in the Foothills and Mountains. The mean minimum temperature ranges from zero to six degrees Celsius. The hottest temperatures occur during November, December and January. During the winter months frosts are common as indicated in Table 4.3.The daily mean hours sunshine throughout the year fluctuates from a minimum of 6.6 to a maximum of 10.3 hours per day.

Table 4.3 Monthly mean maximum and minimum temperatures

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Maximum Temperatures												
1995	29.8	31.1	25.5	22.8	18.8	16.8	16.5	20.4	25.4	24.6	25.3	24.4
1996	27.9	25.8	25.3	21.5	18.7	17.4	13.7	17.0	22.7	24.8	23.3	27.5
Average	28.8	28.4	25.4	22.1	18.7	17.1	15.1	18.7	24.0	24.7	24.3	25.9
Mean Minimum Temperatures												
1995	15.8	15.5	11.0	7.8	1.6	0.1	0.6	3.1	6.9	8.0	10.9	-
1996	15.9	14.8	12.1	8.3	6.1	0.5	0.1	1.8	6.5	10.9	11.4	13.8
Average	15.8	15.1	11.5	8.0	3.8	0.3	0.3.	2.4	6.7	9.4	11.1	13.8

Source: Meteorology Lesotho, (1995-96)

Rainfall in the Maseru district is moderate with a minimum of 500mm per annum in the Lowlands and maximum of 1000 mm in the Mountains. The Foothills receive between 800 and 1000 mm except the areas between Machache peak and Blue Mountain pass where the annual rainfall is above 1000 mm. The rainy season starts in September and extends until March. The distribution of rainfall is uniform throughout the district. During the winter months the foothills and Mountains commonly experience snowfalls. Most of the rainfall happens in the summer months with the least rainfall falling in July.

4.3.3. Land distribution in the Maseru district

Approximately 4% (17 116 hectares) of the Maseru district is classified as good arable land although mixed farming can be practised on close to 25% of the area (106 975). Most of the arable land is found in the Lowlands with only pockets of arable land found in the Foothills and the Mountains.

4.3.3.1. Soil classifications/nomenclature

The Maseru district has seven main soil associations based on geographical considerations.

The Lowlands

- Sephula-Maseru-Berea (gullied land)
- Berea-Matela-Ntsi
- Leribe-Berea-Sephula
- Khabos-Bela-Berea

The Foothills

- Ralebese-Matsaba-Machache

The Mountains

- Matsana-Fusi-Popa
- Popa-Rock Land (Basalt)-Matsana.

In general, the soils are grayish brown/dark brown to black loam, moderately acidic pH (5.3 to 6.0) in the Lowlands and moderately alkaline (6.0 to 8.2) in the foothills and mountains (Agricultural census Lesotho, 1999/2000).

The following land distribution occurs in the Maseru district :

Table 4.4 Land use

Total area	427 900 ha	100%
Good arable land	17 116 ha	04%
Mixed farming	106 975 ha	25%

4.3.4. Agriculture

The major crops produced in the Maseru district vary and include maize, sorghum, beans, wheat, peas and vegetables. Maize is the staple food for the Basotho and is the most popular crop during the summer. Winter crops include wheat, barley, peas, oats and winter vegetables. Livestock farming is considered to be important in this district especially towards the mountainous regions (Agricultural Census Lesotho 1999/2000).

4.3.5. Irrigation potential

According to the Department of Water Affairs (1978) there are four main rivers which pass through this district and these are the main sources of water for domestic use and irrigation. These are the Mohokare, the Makhaleng, the Maletsunyane and the Phuthiatsana Rivers. The river water supply is supplemented by boreholes and dams around the district. However rivers remain the most important sources of water in this district. All these rivers flow from the mountainous catchments situated in the northern districts of the country towards the southern part.

4.3.5.1. Monthly flows in Million Cubic metres of Mohokare and Phuthiatsana, (2005-2006)

A. **River: Mohokare (Caledon**).

Location: Ha Mohloka-qala.

Station Number: CG39.

Coordinates: Latitude:27^{o} 20’00’’; Longitude: 29^{o}00’00’’

Table 4.5 Mohokare flow

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	**Total**
2005	34.9	23.9	30.2	264.1	467.2	137	69.2	219	12.7	13	65	15.7	**1352**
2006	21.6	240.4	121.4	37.8	10.57	4.02	3.7	1.74	14	1.6	-	-	**457**
Aver	28.3	132.1	75.8	150.9	239	70.4	36.5	110	13.4	7.3	65	15.7	**945**

Source: Water Affairs and Rights, (2006)

The Mohokare River is the lawful/ official boarder-line between Lesotho and Republic of South Africa. According to Table 4.4 the Mohokare River has good flows from November up to May. During this time farmers have ample water for irrigation.

B. River: Phuthiatsana

Location: Masianokeng

Station Number 40 :

Coordinates: Latitude: 28^{o}21’00’’; Longitude: 30^{o}00’00

Phuthiatsana River is situated South of Maseru town, a few kilometres from the city centre, estimated to be less than 10 kilometres away. Irrigation is mostly done from this river because it is closer to town where there are market opportunities.

Table 4.6 Phuthiatsana flow

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
2005	2.91	3.92	2.57	7.62	19.43	24.90	21.34	18.32	9.93	6.58	22.24	10.23
2006	6.75	26.86	14.13	6.45	5.25	3.58	4.19	3.53	3.79	3.31	2.89	-
Aver	9.66	30.78	16.70	14.07	24.68	28.48	25.15	21.85	13.72	9.89	25.13	10.23

Source: Water Affairs and Rights (2006).

According to the Water Resource Act of 1978, the Department of Water Affairs Maseru has power to allocate water permits to applicants who want to use water in large quantities either for personal use or for the benefit of the community. This is due to the fact that some people may use a lot of water for their own benefit while the entire community is suffering; therefore control of water rights is appropriate. The Department also tests the quality of water before allocation for domestic or irrigation use is permitted.

4.3.6. Number of irrigation schemes in the Maseru district

It is being said that a number of irrigation schemes and irrigation plots for individuals have not been registered with the Department of Water Affairs and Rights for the control of water use. According to the Department of Agriculture in Maseru (2005/2006) only five irrigation schemes have been developed under low cost gravity fed irrigation system namely: Masianokeng, St Michael, Likotsi, Semphetenyane, and Qeme.

Table 4.7 Irrigation schemes according to the Ministry of Agriculture

PLACE	TYPE	SOURCE OF WATER	USER	AREA (ha)
Makhoati	Bucket system	Dam	Individual	1.40
Mahlabatheng	Bucket system	Ground water	Individual	2.00
Sofonia	Bucket system	Dam		10.36
Masianokeng	Sprinkler Irrigation	Phuthiatsana River	Community	1.00
St. Michael	Sprinkler Irrigation	-	Individual	1.20
Likotsi	Sprinkler Irrigation	-		2.00
Semphetenyane	Sprinkler Irrigation	Phuthiatsana River	Individual	2.00
Qeme	Sprinkler Irrigation			1.20
Tonki	Bucket	Spring	Individual	2.00
Mosalla	Sprinkler irrigation	Phuthiatsana River	Individual	2.00
TOTAL				**25.16**

(Sources: FAO 2002)

4.4. Mafeteng district

Mafeteng has a relatively mild climate, compared to the other districts in Lesotho. On average there are 180 days of summer with mean daily temperatures exceeding 14 degrees Celsius. The average number of frost days is 127 in the Lowlands and 271days in the Highlands. Late frosts during September or early frosts during March and April can cause crop damage particularly in the higher areas. The occurrence of hail impacts negatively on crop production and fruit trees (Agricultural Policy and Capacity Building Project, 2001).

Table 4.8 Risk periods for farming from adverse weather conditions in the Mafeteng district

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Drought												
Frost												
Snow												
Hail												

Source: Meteorology Lesotho (1995-96)

4.4.1. Topography of the land

The district is predominantly situated in the Lowlands (82%), with 15% of the area in the Foothills and 3% in the Mountains. Altitude varies from 1 300 to 2 900 metres above sea level. Soils of the Lowland areas are primarily Alfisols, consisting of duplex or clay pan soils, derived from the decay of the sedimentary rocks.

Water logging is a common problem in the district as water is unable to penetrate compacted layers of the duplex soils. However the soils in the Foothills are more generally fertile. Soil erosion is a major problem in the Mafeteng district. Gullies are more visible signs of excessive erosion. Sheet erosion is the dominant form of erosion in this district. According to the 1999/2000 Agricultural Census, some 46% of arable land in the Mafeteng suffers from severe erosion.

4.4.2. Land use

Table 4.8 gives an indication of the types and quality of land available in the district. Mafeteng has the greatest amount of arable land in the country but the quality of the land is generally poor only 33% being suitable for semi-intensive crop production.

Table 4.9 Land use

Agriculture potential		**Area in hectares**	**Area as % of total**
Suitable for cultivation	Semi-intensive	68 700	32.90
Suitable for cultivation	Extensive	54 800	26.20
Suitable for grazing	Small stock	800	0.38
Suitable for grazing	Large stock	19 900	9.50
Suitable for graze & agric	-	24 900	11.90
Unsuitable for agric	-	39 900	19.10
Total	-	**209 000**	**100.00**

Source: Physical Planning Department (1997)

4.4.3. Sources of water

The Mafeteng district lies within the catchment areas of the Mohokare and Makhaleng Rivers. Communities rely on the collection of surface water and water from the natural springs. Increasingly these sources are becoming over utilised and many boreholes have been sunk, mainly in the Lowlands. Mafeteng has some 22% of the total number of boreholes in Lesotho. The average yield of the boreholes is about 41%. There are very few farmers employing irrigation on a large scale. However there is a potential for intensive use of water for irrigation. (Water Affairs and Rights, 2006).

Table 4.10 Irrigation schemes (Mafeteng)

PLACE	TYPE	SOURCE OF WATER	USER	AREA
Ribaneng	Sprinkler	Makhaleng River	Community	13.00
Sekameng	Sprinkler Irrigation	Caledon River	Individual	10.00
Makhaleng	Sprinkler Irrigation	Caledon River	Individual	3.60
Motsekuoa	Sprinkler Irrigation	Tsoaing River	Individual	4.00
Thabana-Morena	Sprinkler Irrigation	River	Individual	1.40
Thabana-Morena	Sprinkler Irrigation	River	Individual	1.20
Makoabating	Sprinkler Irrigation	-	Community	0.90
Malumeng	Sprinkler Irrigation		Individual	1.20
Sekoati	Sprinkler Irrigation	Duma Dam	Individual	8.00
Tsakholo	Furrow Irrigation		Individual	1.20
Phechela	Gravity fed hoses	Dam	Individual	2.40
Wepener Road	Sprinkler Irrigation	Duma Dam	Individual	2.00
Ramangatana	Sprinkler Irrigation	-	Individual	1.00
Heremoni	Sprinkler Irrigation	Dam	Individual	3.00
Ha-Oni	Sprinkler irrigation	Dam	Project	1.50
Hospital Area	Furrow Irrigation	Raleting dam	Individual	0.84
Total				**55.24**

Source: FAO (2002)

4.5. Mohale'shoek district

This district is situated to the south of the Maseru and the Mafeteng districts. The first known inhabitants of the district were San Bushmen. During the 17th to 19th centuries, the Bahalanga (a clan of the Basotho) moved from the Pitseng area and established a base at Thabana-Morena, just north of the present Mohale'shoek town. The most famous chief at that time was Moorosi, born in 1795, at Lifateng in Makhaleng. At this time Mohale'shoek was called Kubake (Mohale'shoek District Economic Strategic, 2002/2007).

The early history of the district was marked by conflict between different groups fighting for land and domination of the territory, including Sotho speaking clans, the Ndebele, the Xhosa, the San Bushman, the Boers and the British. Some marked events during the 20th century include:

- A major drought in 1933 (marked by red dust storms and plagues of locusts).
- In 1949/51 (with red snow, livestock died and some people starved to death) also in 1968, 1994 and 1997.
- In 1940-48 there was a severe outbreak of small pox causing many people to die.
- Some developments started in 1970 during which some roads were constructed. Contours banks were also started at the same time to control soil erosion. Agricultural extension started during the 1960's (Mohale'shoek District Economic Strategic 2002/2007).

4.5.1. Climate

Drought, frost, snow and hail constitute major risks for agriculture in the Mohale'shoek district. Mohale'shoek is known to experience severe droughts. Rainfall occurs during summer time but is extremely variable in quantity and time. District rainfall totals for the period 1995 to 1998 varied between 426mm in 1995 and 853mm in 1998. The Lowlands are significantly drier than the highlands. Although the Foothills and the Mountains receive higher rainfall, dry land cropping is difficult in these areas (Agricultural Census Mohale'shoek, 1995/97).

Table 4.11 Rainfall of Mohale'shoek district 1995-97

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995	60	25	104	50	45	13	13	15	43	48	48	98
1996	104	25	53	48	45	11	0	5	10	30	48	270
1997	200	150	155	60	48	47	30	0	35	54	125	130
Average	**121**	**66.6**	**104**	**52.6**	**46**	**23.6**	**14.3**	**6.6**	**29.3**	**44**	**73.3**	**166**

Source: Meteorology Lesotho (1995-96)

Table 4.12 Risk periods for farming due to adverse weather conditions in Mohale's Hoek

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lowlands												
Drought												
Frost												
Hail												
Wind												
Foothills												
Drought												
Frost												
Snow												
Wind												
Mountains												
Drought												
Frost												
Snow												
Wind												

Source: Meteorology Lesotho (1995-96)

4.5.2. Land use

As it is the case in other districts, this district is classified into Lowlands, Foothills, Senqu River valley and Mountains.

Table 4.13 Land use in Mohale's Hoek district

	Lowlands	Foothills	Mountains	Senqu Valley	**Total**
Area (ha)	81 768	99 544	135 096	39 107	355 515
% Of total area	23	28	38	11	**100**

Source: Physical Planning Department (1997)

Although Mohale's Hoek is often seen as a Lowland district, only 23% of the area is officially classified as Lowlands. According to the Physical Planning Department (1997), only 21% of the land is suitable for crop production. The department further indicates that the area of land available for crop production has dropped from 637 164km^2 to 511 662km^2 in 1986 and 1996 due to gulley erosion and residential occupation.

Table: 4.14 Arable land in Mohale's Hoek district

	Arable	Grazing	Other	Total
Area (ha)	76 429	248 615	30 471	355 515
% of total area	21	70	9	**100**

Source: Physical Planning Department (1997)

4.5.3. Water Sources

Several major river systems are found in this district. The Senqu River forms the southern border against the Quthing district. The Ketane, Maletsunyane, Senqunyane and Qabane rivers are the major tributaries of Senqu. Mohale's Hoek is one of the districts in Lesotho with the highest water resources. This area has the potential for more intensive use of water for irrigation (Water Affairs and Rights, 2005/2006).

Table 4.15 Irrigation schemes in Mohale's Hoek

PLACE	TYPE	SOURCE OF WATER	USER	AREA
Ha khets'ane	Sprinkler Irrigation	River	Individual	2.85
Ketane	Sprinkler Irrigation	-	-	3.00
Maqhena	Sprinkler Irrigation	River	Individual	1.00
Thaba-Ts'oeu	Sprinkler Irrigation	Dam	Individual	4.80
Mekaling	Sprinkler Irrigation	Dam	Individual	0.84
Maphutseng	Sprinkler Irrigation	Maphutseng River	Individual	3.00
Ha mahlele	Sprinkler Irrigation	-	Individual	4.00
Makhaleng	Sprinkler Irrigation	Makhaleng River	Individual	3.00
Ha T'sepo	Sprinkler Irrigation	Dam	Individual	10.00
Qalakhaleng	Sprinkler Irrigation	Potsane River	Individual	6.00
TOTAL				**38.49**

Source: FAO (2002)

4.6. Quthing district

The Quthing district is situated in the far south of Lesotho and lies in the Mountains and Senqu river valley agro-ecological zones (FAO, 2005/06). San Bushmen were the first known inhabitants of the Quthing district before being assimilated into the Basotho nation. As in Mohale's Hoek, the early history of this district was marked by conflict among different groups fighting for land and domination of the territories. During these wars, there was a gradual move into the mountain areas, following Basotho custom, where new chiefs established their new territories.

Unlike other districts, Quthing has a diverse cultural history. Alongside the Basotho clan there are large number of Baphuthi and Xhosa people who still maintain their own cultures, values and beliefs and their own languages. (Ministry of Agriculture, Cooperatives and Land Reclamation, 2007).

Other remarkable events of the area include the following:

- 1933: Major drought that resulted in the death of many cattle in this district.
- 1942: A plague of locusts which heavily fed on the crops causing hunger for many households.
- 1970: Village government introduced by colonial government.
- 1980: Great drought and skin disease outbreaks.
- 1987: Many animals died due to heavy snowfall during September.
- Late 1990s: Major outbreaks of stock theft especially between Quthing and the Eastern Cape.

Quthing District has an area of about 182 000 hectares, with a population estimated at 90 000 people of which 90% are rural based. Crop land in Quthing is limited and rain-fed crop production of the traditional food grains like maize, sorghum and wheat. (IFAD Operations in Lesotho, 2007).

4.6.1. Climate

Drought, frost, hail and snow pose major risks for agriculture in the Quthing district. Strong winds have also become major problem. Quthing is one of the relatively drier districts in Lesotho. Rainfall occurs mainly during the summer months but is extremely variable in quantity and timing. Annual rainfall usually ranges between 600 to 800mm per annum (Agricultural Census, 1996).

The Mountain areas receive a high rainfall but have shorter growing seasons due to prolonged winters. Dry land crop failures due to drought conditions are common. Frost and snow are particular hazards in the district, especially in the mountain areas. Major snowfalls and storms were recorded in 1950 and 1987, which led to the death of many animals (Meteorology, 1996).

Table 4.16 Risk periods for farming from weather conditions in Quthing district

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SE	OCT	NOV	DEC
SENQU VALLEY												
Drought												
Frost												
Hail												
MOUNTAINS												
Drought												
Frost												
Snow												
Hail												

Source: Meteorology Lesotho (1995-96)

4.6.2. Topography of the land

The district is predominantly mountainous. Some flatter land is found along the Senqu River Valley and its main tributaries are the Mjanyane, Qomoqomong, Sebapala, Quthing and Qhali

rivers. 56% of the district falls in the mountain agro-ecological zones and 44% in the Senqu Valley.

Table 4. 17 Different agro-ecological zones and Population density of Quthing (1996)

	Mountains	**Senqu river Valley**	**Total**
Area (ha)	161 522	129 218	290 740
% of total area	56%	44%	100%
Number of house holds	7 258	15 802	23 060
% of total households	31%	69%	100%
Density (households/ha)	22	8	30

Source: Physical Planning Department (1997)

4.6.3. Land use

According to land use planning studies, only 11% of the land in this district is suitable for crop production.

Table 4.18 Land use in the Quthing district

	Arable	**Grazing**	**Other**	**Total**
Area	32 127	23 7786	23 764	293 677
% of total area	11%	81%	8%	100%

Source: Physical Planning Department (1997)

4.6.4. Sources of irrigation water in the district

The Quthing district lies within the catchment area of the Senqu river which forms the northern boundary of Lesotho with the Republic of South Africa. The Quthing, Sebapala, Qomoqomong, Qhali and Tele rivers are major tributaries of the Senqu River. There are many other smaller streams, which tend to dry up during winter months. Some areas of wetlands are found on the highland plateaux. An important dam and prominent wetlands (Letseng-la-Letsie) are found in the Mphaki area. While the rivers form major features of the landscape, they are generally not used productively, either for domestic use or for irrigation (IFAD Operations in Lesotho, 2007).

Table 4.19 Irrigation schemes in the area (Quthing)

PLACE	TYPE	SOURCE OF WATER	USER	AREA(ha)
Seaka	Sprinkler	Senqu River.	Individual	18.00
Basieng	Sprinkler Irrigation	Dam	Individual	45.00
Qomo- Qomong	Sprinkler Irrigation	River	Individual	15.50
Tele Bridge	Sprinkler Irrigation	Tele River	Individual	4.00
Villa Maria	Sprinkler Irrigation	Stream	R.C.C Mission	4.00
Sheep stud	Sprinkler Irrigation	River	Community.	3.50
TOTAL				**90.00**

Source: FAO (2002)

CHAPTER 5

PERSONAL PROFILE OF IRRIGATION FARMERS

5.1. Introduction

This chapter renders insight into some important personal profiles of irrigation farmers in the four study areas. It also reflects the distribution of land use and major farming systems and styles identified in the areas and levels of education attained by respondents. These factors may have a strong influence on the general performance of irrigation farming in Lesotho. Wilson (1997) indicated that age, education and the length of residency are important factors for explaining participation and performances of farmers. Damianos *and* Giannakopous (2002) suggest that agricultural education and training of farmers can influence farmer's performance.

5.2. Gender composition of the respondents

Gender is an aspect considered most important for in agricultural development initiatives. According to the World Bank (2001) report, land in developing countries is normally allocated to men either through inheritance or traditional kingship laws leaving women marginalised.

Table 5.1 Frequency distribution of the respondents according to gender per district (N=153)

DISTRICTS	Male		Female		Total	
	n	%	n	%	n	%
MASERU	33	89.19	4	10.81	37	24.19
MAFETENG	26	70.27	11	29.73	37	24.18
MOHALE 'S HOEK	25	62.50	15	37.50	40	26.15
QUTHING	31	79.49	8	20.57	39	25.49
TOTAL	**115**	**75.16**	**38**	**24.84**	**153**	**100.00**

According to the findings in Table 5.1, the majority of irrigation farmers (75%) in this study are men. The distribution of this percentage is such that the majority of male farmers are located in

Maseru (89.19%) and Quthing (79.49%) districts respectively. This is presumable so because of the customary law of Lesotho, which stipulates males as the ones to be allocated land.

5.3. Educational qualification

Education is a factor that is believed to influence individuals in the decision making processes. It is believed that those who have acquired a good educational background, mostly make better informed decisions. Ramji, Neupane and Shaha, (2002) and Tassew, (2004) indicated that farmers who have attained higher levels of educational are more likely to adopt new technologies or practices. Sidibe (2005) indicates that young members of any society have a greater chance of absorbing and applying new knowledge.

The education system in Lesotho comprises of a certificate for primary school, which is awarded after studying for 1 to 7 years. A junior secondary certificate is awarded after schooling for 8 to 10 years. After 11 to 12 years a (C.O.S.C) Cambridge Overseas School certificate (High School) is awarded which is equivalent to the South African Grade 12.

Table 5.2 Frequency distribution of educational qualification of respondents according to various age categories (N=143)

AGE CATEGORIES IN YEARS										
EDUCATIONAL LEVELS	**< 40**		**40-49**		**50-59**		**60<**		**TOTAL**	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)	(n)	(%)
PRIMARY	0	0	10	28.57	19	54.29	6	17.14	35	24.48
SECONDARY	5	10.42	12	25.00	22	45.83	9	18.75	48	33.57
HIGH SCHOOL	7	4.9	18	12.6	9	6.29	2	1.4	36	25.17
TERTIARY	10	6.99	9	6.29	3	2.1	2	1.4	24	16.78
TOTAL	**22**	**15.38**	**49**	**34.3**	**53**	**37.06**	**19**	**13.26**	**143**	**100.00**

Table 5.2 illustrates that a relative high percentage (77%) of farmers younger than 40 years attained High School and tertiary education, while a steep decline in levels of education was found with farmers older than 40 years. This may emanate from the fact that in Lesotho agriculture is perceived as a career for less intelligent people and therefore a high level of education is not required (Qhobela, 2005). Although livelihood status like qualifications are

associated with higher household income, skills through training transferred from one generation to another play a vital role in the development of farmers. Farmers with relatively high education levels in general understand the agriculture marketing environment and challenges better than farmers with relative low level of education (Stevens, 2006).

5.4. Household composition

Size and household composition may directly influence the performance of irrigation farming through the availability of labour for agricultural activities. Big families may generally be associated with large number of potential labour which naturally impacts on the quality of irrigation management (Stevens, 2006). Table 5.3 illustrates that the size of the households ranges between 1 to 11 members with an average size of approximately six members per household.

Table 5.3 Household size and composition (N=146)

Label	N	Mean	Std Dev	Minimum	Maximum
Size of the household	146	5.8972	2.129366	1	11
Number of adults	151	3.4172	1.613929	1	8
Number of children	152	2.42105	1.388345	0	6

In general the household composition illustrates a healthy balance between adults and children. Households with fewer adults and relative more children are more vulnerable to shocks (Mettrick, 1997).

5.5. Sources of household income

The household income source is an important factor which influences production decisions taken by a household (Abera, 2003). A lower household income lowers the ability of the household to influence the biophysical condition in which they have to farm as they can afford less external inputs for their production system (Dixon, Gulliver and Gibbin, 2001). 58% of the households indicate that farming is their main source of income, while 8% are categorised as wage earners where salaries for formal employment are received. Informal business or self-employment (20%) through the running of taxi businesses or local shops is also a very important source of household income.

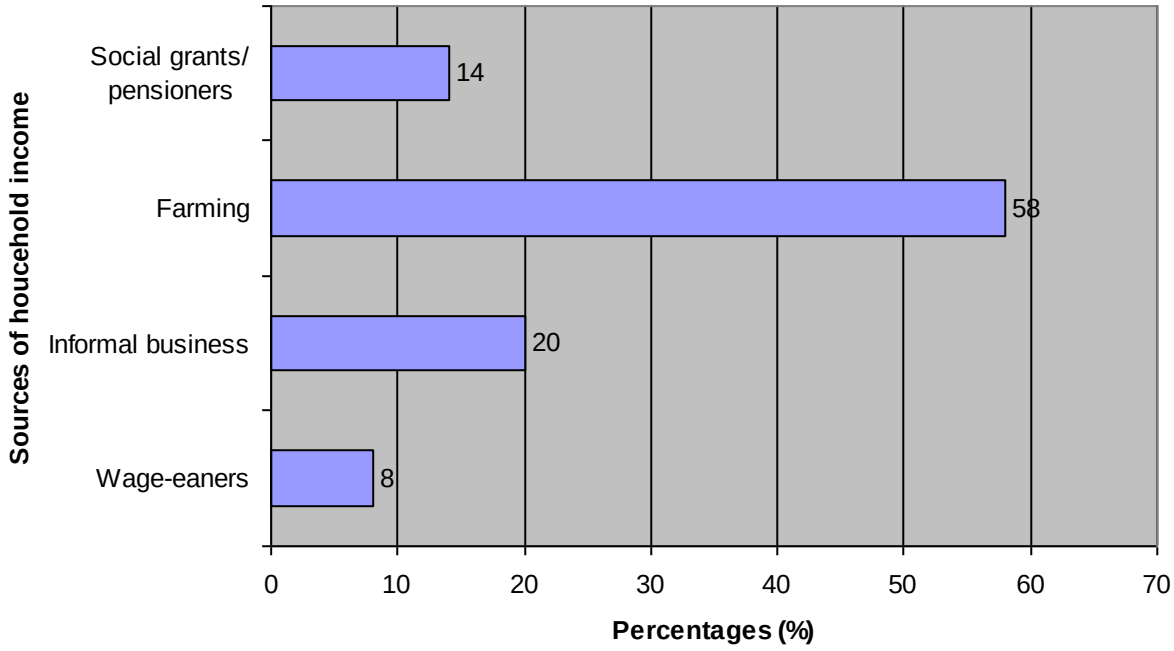

Figure 5.1 Distribution of sources of household income (N=153)

The proportional contribution made by farming to the household income is quiet significant. 46% of the farmers generate income in the category of 41 to 60 percent from farming while 30% of the respondents indicate that farming income proportionally contributes more than 60% of the household income (Table 5.4).

Table 5.4 Proportional contribution derived from farming to household income (N=128)

Proportional income from farming percentages (%)	Frequency	(%)
<40	31	24
41-60	58	46
>60	39	30
Total	**128**	**100**

5.6. Fulltime or part time farming

Farmers were asked to indicate whether they farm on fulltime or part time bases. 71% of respondents indicated that they are fulltime farmers and of those 86% were farming on relative

big farms (15 ha<). The rest were part time farmers who are either employed in government or who own informal businesses (taxi or shop owners). Fulltime farmers are in general involved in one of the following livelihood outcomes namely: improved food security or producing enough agricultural produce to sell. Part time farmers on the other hand are earning off-farm income.

Table 5. 5 Frequency distribution of full time and part time farmers (N=152)

	Farm size (ha)							
Respondents	**<10**		**10-15**		**15<**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Fulltime farmers	88	70.27	8	61.50	12	86	108	71
Part time farmers	37	29.73	5	38.46	2	14	44	29
Total	**125**	**100.00**	**13**	**100.00**	**14**	**100**	**152**	**100**
Frequency missing = 1								

(df=2, χ^2 =2, p=0.001)

5.7. Labour force

Stevens (2006) is of the opinion that irrigation farming often requires very skilful, well trained labour. Therefore labour is perceived as a crucial factor which influences progress in irrigation development and the adoption of new irrigation technologies. 56% of irrigation farmers in Lesotho use family labour, which usually relates to the objective and scale of farming.

Table 5.6 Frequency distribution of farm labour (N=151)

Type of labour	**Frequency**	**Percentage**
Family labour	84	55.63
Hired labour	49	32.45
Both	18	11.92
TOTAL	**151**	**100.00**

5.8. Size of the farm

The size of the farm can significantly influence the potential income of the farm and the performance of irrigation farming. Bigger farms are usually more profit oriented than small sized farms, and farmers are usually in better positions to invest on more sophisticated agricultural technologies.

Table 5.7 Frequency distribution of the sizes of farms across the districts (N=126)

DISTRICTS	<10ha		10-15ha		15ha<		Total	
	n	%	n	%	n	%	n	%
MASERU	24	70.59	3	8.8	7	20.59	34	26.98
MAFETENG	36	100.00	0	0.00	0	0.00	36	28.57
MOHALE'S HOEK	16	80.00	3	15.00	1	5.00	20	15.88
QUTHING	36	100.00	0	0.00	0	0.00	36	28.57
TOTAL	**112**	**88.89**	**6**	**4.76**	**8**	**6.35**	**126**	**100.00**
Frequency missing = 27								

The majority of farms (89%) are less than 10ha in extent with the highest occurrence of farms larger than 15ha occurring in Maseru. A possible reason for this may be that the Maseru district is more developed in comparison to the other three districts which consequently offer more opportunities for farmers. The majority of farmers in the Maseru district rent land. Generally farmers are not secured in terms of the leasing period as some landowners breach contracts before the expiring dates. This type of ownership inevitably impacts negatively on long term investment optionally required by irrigation farmers.

5.9. Farming styles

Van der Leeuw (2000) indicates that farming style is an integrating concept that portrays a particular way of practising agriculture. He indicates that farming styles are a composition of complex but integrated set of notions, norms, knowledge and experience held by a particular group of farmers in a specific location.

Various reasons were provided for farming, which include farmers that produce mainly for food security (34%) and those that produce mainly for profit (28%). It is well established in the literature that successfully farming is the most important way in which poverty could be eradicated. Provision of food for people is considered the basic element for the development of the entire world (FOA 2002).

Table 5.8 Frequency distribution of reasons for farming (N=142).

Reasons for farming	Frequency(n)	Percentages (%)
Profit making	40	28.16
Food production	48	33.80
Both	54	38.04
TOTAL	**142**	**100.00**

Table 5.9 Livelihood systems for irrigation farmers (N=153)

		Profit making		Food production		Both		Total	
		n	%	n	%	n	%	n	%
Age	<40	15	10.56	19	13.38	9	6.3	43	30.28
	40-49	6	4.2	22	15.49	12	8.5	40	28.17
	50-59	10	6.5	7	4.9	20	14.1	37	26.06
	>60	9	6.3	0	0	13	9.2	22	15.49
	TOTALS	**40**	**28.20**	**48**	**33.70**	**54**	**38.1**	**142**	**100.00**
Size	<10	17	13.49	29	23	28	22.22	112	88.88
	10-15	4	3.2	0	0	0	0	6	4.76
	>15	3	2.3	0	0	1	0.79	8	6.36
	TOTAL	**24**	**18.99**	**29**	**23**	**29**	**23.01**	**126**	**100**
Sources of income	Farming	26	16.99	36	23.53	28	18	90	58
	Government	1	0.65	7	4.58	5	3.27	13	8
	Social grants/pensioners	3	3.96	5	5.27	8	5.58	15	14
	Informal business	6	2.61	20	13.07	10	6.53	32	20
	TOTAL	**36**	**22.21**	**68**	**44.45**	**49**	**35.3**	**153**	**100**

Table 5.9 illustrates that farmers involved in farming for profit also tend to farm on bigger farms (>10 ha) and rate farming as their most important source of household income (72%). Also farmers younger than 40 years of age tend to farm for profit. Farmers who farm for food production and food security reasons are farming on relatively smaller farms (<10 ha) and 47% of them earn their household income from employment (wage-earners), social grants and pension or informal business (owning taxis and/ or shops). For these farmers, the income sourced from

the engagement in off-farm activities is very important. Dixon *et al* (2001) is of the opinion that, apart from farming options, off-farm income is a major contributor of household income of poor farmers.

5.9.1 Livestock farming

Livestock farming plays an important role in Lesotho, mostly in the Mountain areas where livestock is kept as a major source of animal draught power. It is also appreciated as a potential source for cash income. Farmers sometimes irrigate fodder crops to be used for supplementary feeding of their livestock.

Table 5.10 Frequency distribution of irrigation farmers keeping livestock (N=152).

DISTRICTS	Keep livestock		No livestock			Total
	n	%	n	%	n	%
MASERU	28	75.68	9	24.32	37	24.34
MAFETENG	29	78.39	8	21.62	37	24.34
MOHALE'S HOEK	34	87.18	5	12.82	39	25.66
QUTHING	24	61.54	15	38.46	39	25.66
TOTAL	**115**	**75.66**	**37**	**24.34**	**152**	**100.00**

Table 5.9 illustrates that 76% of the irrigation farmers also keep livestock. Two areas namely Mohale's Hoek and Mafeteng districts showed relatively higher livestock practices, probably due to the suitability of these area for stock farming (because of topography).

5.9.2 Perceived satisfaction with land size and form of ownership

Land ownership poses many problems in irrigation farming as farmers cannot incur long term capital investment due to temporary rental agreements or the lack of full ownership of land. Although the question of ownership was not included during the preparations and piloting of the questionnaire, it became evitable during data collection that many farmers particularly in the Maseru district were not satisfied with the current rental agreements because of the informal contracts that usually exist between relevant parties. This factor was identified as a significant stumbling block in potential irrigation development in the area.

5.9.3. Distances travelled between residence and the farm

Distance between the farm and dwellings (homes) may impact on the performance of the irrigation farming in general. It impacts on the management capabilities of the farmer. Table 5.11 indicates the perceived opinions of the respondents regarding this aspect of their farming situation.

Table 5.11 Satisfaction of farmers regarding the distances travelled between the farm and the residence (N=153)

DISTRICTS	Dissatisfied		Fair		Satisfied		Total	
	n	%	n	%	n	%	n	%
MASERU	17	45.95	10	27.03	10	27.02	37	24.18
MAFETENG	7	18.92	6	16.22	24	64.87	37	24.18
MOHALE'S HOEK	20	50.00	2	5.00	18	45.00	40	26.15
QUTHING	1	2.56	9	23.08	29	74.36	39	25.49
TOTAL	**45**	**29.41**	**27**	**17.65**	**81**	**52.94**	**153**	**100.00**

The majority of irrigation farmers (53%) are satisfied with the distances between their residences and their farms. Farmers from Mohale's Hoek (50%) and Maseru (46%) indicated their dissatisfaction with the current situation due to mainly poor access roads and the topography of the terrain.

Although farming is done on a small scale, it is generally identified as the major source of household income, however, findings point towards the need for revision of a number of presently existing practices such as the land tenure system of the country which does not cater for both men and women equally in the distribution and ownership of land.

CHAPTER 6

CROP PRODUCTION SYSTEMS

6.1. Introduction

Crop production is a laborious activity, which requires thorough planning before implementation. Pereira (1982) asserts that several steps should be considered when doing a comprehensive production farm plan. Availability of the necessary farming equipment for proper soil preparations, cultivar selection, agro-climatic potential of the region and market surveys all form the base of the plan. He further indicates that each cultivar responds in its own way to climate, and success of a given crop in a region depends on finding the appropriate variety to fit the local environment.

Chapter 6 gives an insight of how irrigation farmers in Lesotho approach their crop planning session. It further elaborates on the financial support and satisfactions of farmers concerning such supports.

6.2. Crops grown in the area

The selection of the correct crop type in irrigation farming is not the only factor to consider but also water productivity. According to Lieu *et al.* (1998) water productivity in crop production systems is the relationship between the water used and the crop produced. Economically less water must be used to produce higher yields. Pereira (1982) illustrates that high water productivity could usually be achieved where high value crops are selected.

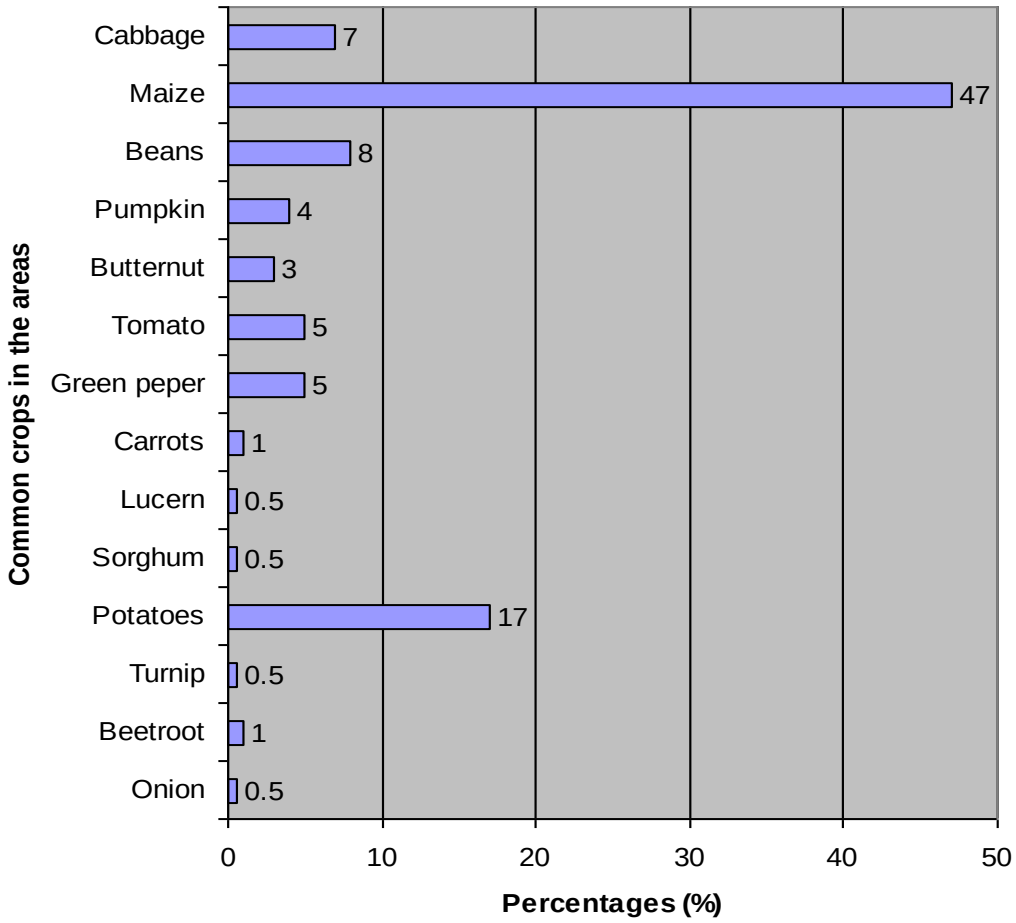

Figure 6.1. Common crops grown in the area

Figure 6.1 illustrates a wide range of crops that are grown by irrigation farmers in Lesotho. The most common crops include maize (47%) and potatoes (17%). Maize is regarded a staple food in Lesotho hence it is not surprising that it is planted by the majority of irrigation farmers. Potatoes on the other hand are cash crops which are highly marketable. The rest of the crops are mainly grown for household consumption and for feeding of livestock.

6.3. Factors affecting the selection of crop type

Crop management entails various activities that should be practised on the farm in order to enhance better performance of crops. Amongst the management factors selected for a more productive farming system are the use of improved (suitable) crop rotations, appropriate sowing dates and effective weed, disease and pest control (Pala and Studer,1999). Lacewell *et al.* (1978)

illustrate that irrigation alone cannot improve productivity but that there are also other factors which dictate what crop could be grown and also the profitability of such crops e.g. soil type and climate.

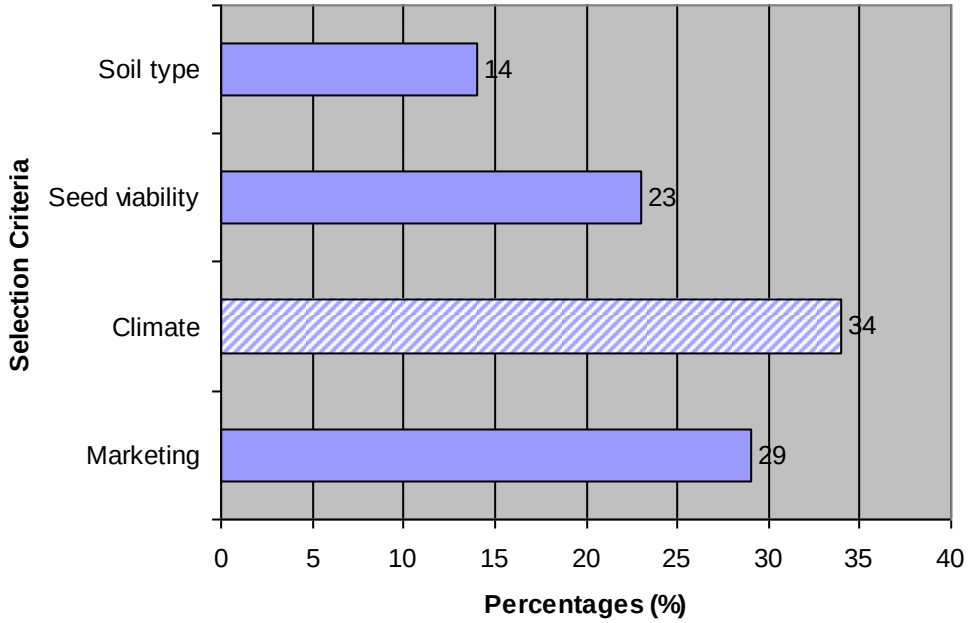

Figure 6.2. Criteria used by respondents for selecting a crop (N=153)

Figure 6.2 indicates that 34% of farmers consider climate as the most important factor determining the selection of crops to be grown. This confirms the findings of Pereira (1982) that climate is the most determinant of what should be grown in any region. Secondly 29% of the respondents indicated that appropriate markets are very important in the selection of appropriate crops. The selection of appropriate soil type for crop production is perceived important by only 14% of the respondents. This corresponds with the results in Table 6.3 where 95% of the farmers do not conduct soil analysis before planting crops.

6.3.1. Use of recommended varieties

According to Khush, (1999), the major factors contributing to the success of the Green Revolution were the introduction of the high semi-varieties and a combination of both proper irrigation and fertiliser application management. In this study investigations were conducted to detect to what extent farmers use recommended varieties.

Table 6.1 The use of recommended varieties (N= 150)

DISTRICTS	YES		NO		Total	
	n	%	n	%	n	%
MASERU	31	83.78	6	16.22	37	24.67
MAFETENG	13	37.14	22	62.86	35	23.33
MOHALE'SHOEK	18	45.00	22	55.00	40	26.67
QUTHING	32	84.21	6	15.79	38	25.33
TOTAL	**94**	**62.67**	**56**	**37.33**	**150**	**100.00**
Frequency missing = 3						

Table 6.3 indicates that 63% of farmers used recommended varieties but they indicated that, it is not through the influence of the extensionists that they used these varieties. Interesting is that the biggest influence regarding this aspect is derived from white farmer friends in the Republic of South Africa who normally help farmers in Lesotho with the selection of good varieties.

6.3.2 Perceived constraints that prevent the use of recommended varieties

Rogers (1972) asserts that diffusion is not a simple process. It takes time for technology to be diffused and be adopted by farmers. Düvel (1999) indicates that adoption resistance is mostly caused by lack of assurance that recommended innovations will succeed when put into practice. Quality information can certainly reduce uncertainty, duration of time until adoption and the perceived risk of making wrong decisions (Fischer, Arnold and Gibbs1996). Respondents indicated that the main reasons for not using recommended varieties are in order of priority satisfaction with the current traditional varieties used (48%), the fact that recommended variety seeds are usually more expensive (32%) and thirdly the general lack of technical knowledge about the advantages of using recommended varieties (20%) (Figure 6.3).

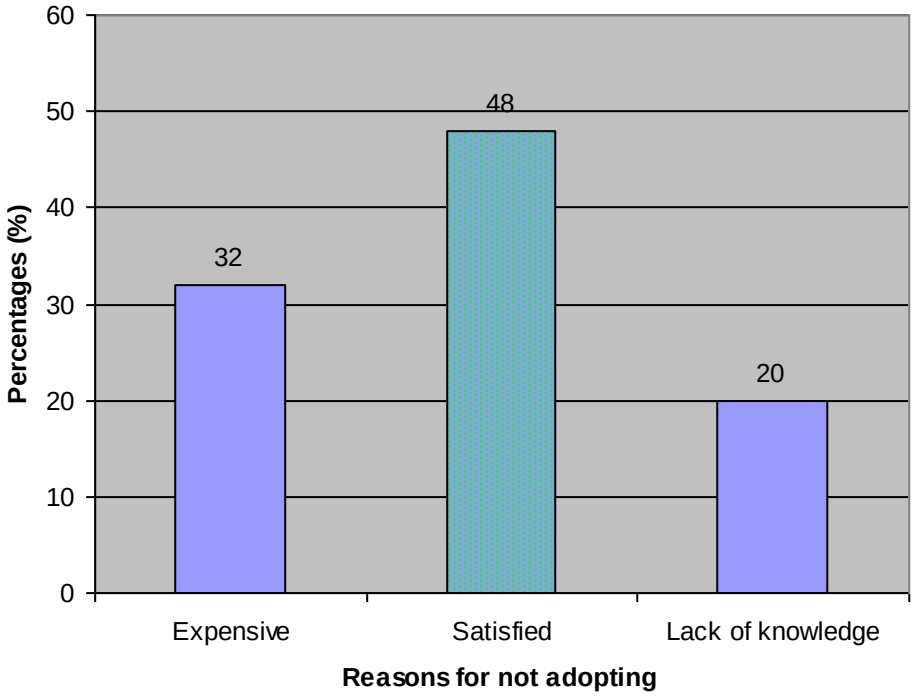

Figure 6.3 Reasons for not adopting recommended varieties (N=56)

6.3.3. Perceptions regarding the advantages of recommended varieties

On the question of how recommended varieties perform in comparison to the traditional varieties, 53% of farmers believe that recommended and traditional varieties perform equally well (Table 6.2). Only 37% of farmers perceived that recommended varieties were performing much better than traditional ones. It is well established in the literature that many trials are conducted at research stations and not on the farms with the farmers. Therefore the research knowledge is localised and not always appropriate for farmers (Farrinton and Martin, 1988). The same reason could be raised for the perception of farmers, since recommended varieties are only tested on Maseru research station. It appears that recommendations are often made based on the performance of the specific varieties tested exclusively in this research station.

Table 6.2 Rating of recommended varieties (N=139)

DISTRICTS	Worse than traditional		Same as traditional		Better than traditional		Total	
	n	%	n	%	n	%	n	%
MASERU	4	11.76	5	14.71	25	73.53	34	24.46
MAFETENG	4	12.12	20	60.61	9	27.27	33	23.74
MOHALE'SHOEK	5	13.16	23	60.53	10	26.32	38	27.34
QUTHING	2	5.90	25	73.53	7	20.59	34	24.46
TOTAL	**15**	**10.79**	**73**	**52.52**	**51**	**36.69**	**139**	**100.00**
Frequency missing = 14								

6.4. Soil preparation and fertilisation practices

Ali, *et al.* (2007) is of the opinion that soil analysis forms a basic principle of irrigation. He further indicates that different types of soils perform differently under different irrigation methods. He argues that properly conducted soil analysis to detect the mineral content of the soils, soil pH and other fundamental components of the soil is a prerequisite for successful irrigation. According to Odeh *et al. (*1998*)*, sustained irrigation with the use of poor quality water is commonly practised in many countries which affect the productivity of the soil in general.

6.4.1. Soil analysis

Table 6.3 indicates that 95% of farmers do not conduct any soil analysis prior to planting. Only a few farmers (15%) located in Maseru conduct some soil analysis. A possible reason for this may be the fact that the only national research station is situated in Maseru district where soil analysis can be done for farmers.

Table 6.3 The use of soil analysis for crop production purposes (N=149)

DISTRICTS	Conducting soil analysis		Not conducting soil analysis		Total	
	n	%	n	%	n	%
MASERU	5	14.71	29	85.29	34	22.82
MAFETENG	1	2.70	36	97.30	37	24.84
MOHALE'SHOEK	1	2.56	38	97.44	39	26.17
QUTHING	0	0.00	39	100.00	39	26.17
TOTAL	**7**	**4.7**	**142**	**95.3**	**149**	**100.00**

6.4.2. Fertilizers management on the farm

Extensive research has been conducted in fertilizer management on the farm, and most researchers indicate that both irrigation management and fertilizer management are pre-requisites for improving crop productivity (Martinez *et al*. 2002).

6.4.3. Types of fertilizer used

The type and method of fertiliser application may have a direct influence on irrigation performance on the farm. Some nutrients such as nitrogen are easily leached if excessive amounts of irrigation water is applied, thus affecting crop productivity. Lieu *et al.* (1998) indicate that the maximum crop yield and the highest water productivity could only be achieved under optimum fertiliser management. They further assert that inappropriate fertiliser applications can lead to immense crop losses.

Table 6.4 The distribution of fertilisers use on the farm (N=152)

DISTRICTS	Organic fertiliser		Inorganic fertiliser		Both		Total	
	n	%	n	%	n	%	n	%
MASERU	11	29.73	9	24.32	17	45.95	37	24.34
MAFETENG	27	75.00	1	2.78	8	22.22	36	23.68
MOHALE'S HOEK	22	55.00	5	12.5	13	32.50	40	26.32
QUTHING	26	66.67	7	17.95	6	15.38	39	25.66
TOTAL	**86**	**56.58**	**22**	**14.47**	**44**	**28.95**	**152**	**100.00**
Frequency missing = 1								

Results illustrated in Table 6.4 show that the majority of irrigation farmers (57%) in Lesotho use organic fertilisers rather than chemical fertilisers. This may be attributed to the fact that the majority of farmers as illustrated in Table 5.2 (Chapter 5) enjoy lower levels of education within the age category40< years. Fewer farmers who have attained better education may be exposed to the use of new technology while the majority may still be trapped in traditional practices. Results in Chapter 5 Table 5.9, also illustrates that 75% of irrigation farmers in Lesotho keep livestock. It is therefore more affordable to use organic fertilisers due to their freely availability.

6.4.3.1. Criteria used for selection of fertilizer

Respondents were asked to identify the main criteria that they take into consideration with the selection of specific fertilisers for crop production. 32% of the respondents are of the opinion that they use organic fertilisers to improve the soil structure. Important criteria like easiness of application (29%), affordability (13%) and composition (19%) are taken into consideration with the selection of specific type of fertiliser.

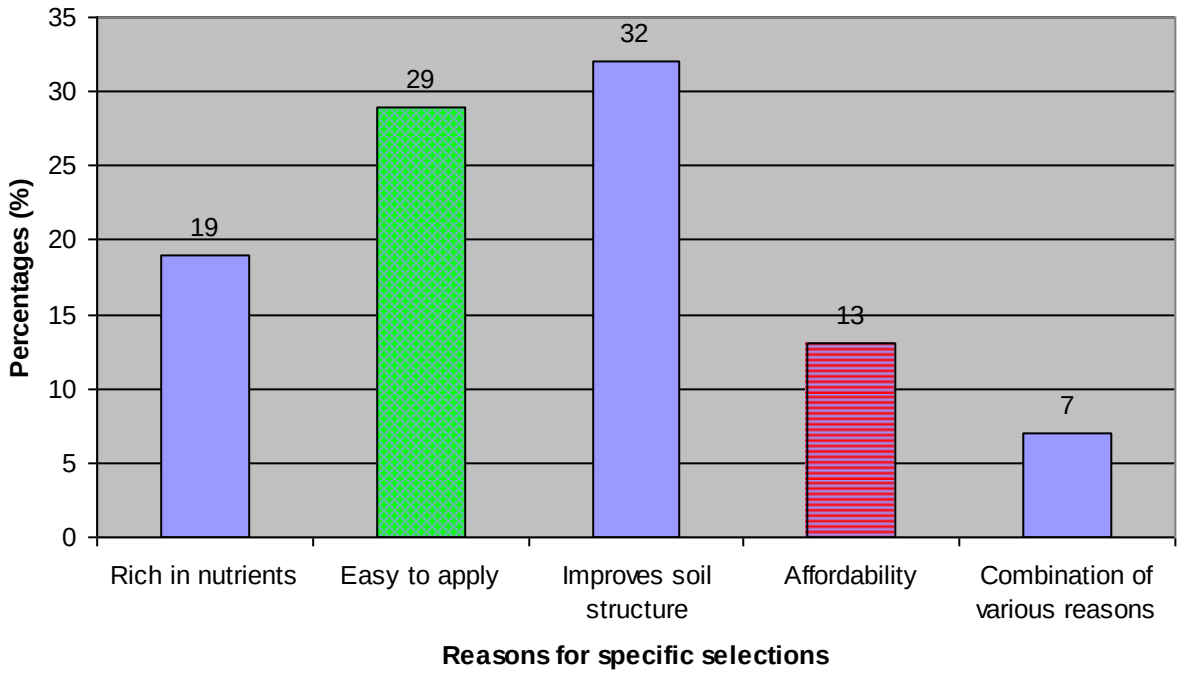

Figure 6.4. Distribution of possible reasons for selecting types of fertilisers (N=153)

6.4.3.2. Management of fertilizers

According to the results presented in Table 6.5, 45% of farmers believe that they are doing well in terms of fertiliser management on their farms and are therefore satisfied with their fertilising practices.

Table 6.5 Satisfaction of farmers with regard to fertiliser management (N=152)

DISTRICTS	Very dissatisfied		Dissatisfied		Moderate		Satisfied		Very satisfied		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
MASERU	1	2.70	0	0.00	15	40.54	0	0.00	21	56.76	37	24.30
MAFETENG	11	30.56	3	8.33	15	41.67	2	5.56	5	13.89	36	23.70
MOHALE'S HOEK	13	32.50	0	0.00	20	50.00	0	0.00	7	17.50	40	26.30
QUTHING	0	0.00	0	0.00	6	15.38	7	17.95	26	66.67	39	25.70
TOTAL	**25**	**16.45**	**3**	**2.00**	**56**	**36.82**	**9**	**5.92**	**59**	**38.81**	**152**	**100.00**
Frequency missing = 1												

Only 18% of respondents indicated their dissatisfaction with fertiliser practices, which corresponds with the findings of Düvel (1970) that there is a tendency that farmers often overrate their performances due to the lack of necessary knowledge**.**

6.5. AVAILABILITY OF FARMING EQUIPMENT

Table. 6.6 illustrates that a relatively high percentage (57%) of irrigation farmers in Lesotho own farming equipment such as tractors for the cultivation of land whereas 14% are engaged in hiring contractors. Oxen are the main source of traction in Lesotho and 29% of the respondents use animal traction for sowing, harvesting, processing and transportation. Panin and Ellis, (1992) assert that draft animal power is potentially an appropriate technology for emerging farmers. They further indicate that animals like cattle, donkeys and horses could be used for almost all operations on the farm.

Table 6.6 Distribution of methods used to cultivate land (N=152)

DISTRICTS	Availability of equipment used to cultivate the land							
	Owning tractor		Hire a tractor		Animal traction		Total	
	n	%	n	%	n	%	n	%
MASERU	11	29.73	9	24.32	17	45.95	37	24.34
MAFETENG	27	75.00	1	2.8	8	22.22	36	23.68
MOHALE'S HOEK	22	55.00	5	12.5	13	32.50	40	26.32
QUTHING	26	66.00	7	17.95	6	15.38	39	25.66
TOTAL	**86**	**56.58**	**22**	**14.47**	**44**	**28.95**	**152**	**100.00**

6.6. Diseases and weed management

According to Adigun, Lagote and Karikari (1991), weeding of irrigation land is an important factor that determines crop production. It is pointless to engage in an expensive exercise like irrigation if weeding is not taken seriously by farmers. They further indicated that inappropriate weeding management can lead to heavy losses in crop production.

6.6.1. Methods of weeding

The majority of irrigation farmers in Lesotho (87%) use hoeing as the main method of controlling weeds, while only 10% of farmers apply chemical control. A possible reason for this distribution may be that farming in Lesotho is done mostly on a small scale as illustrated in Chapter 5 and that household members can engage themselves in weed control exercises. The use of chemical weed control is generally perceived as expensive.

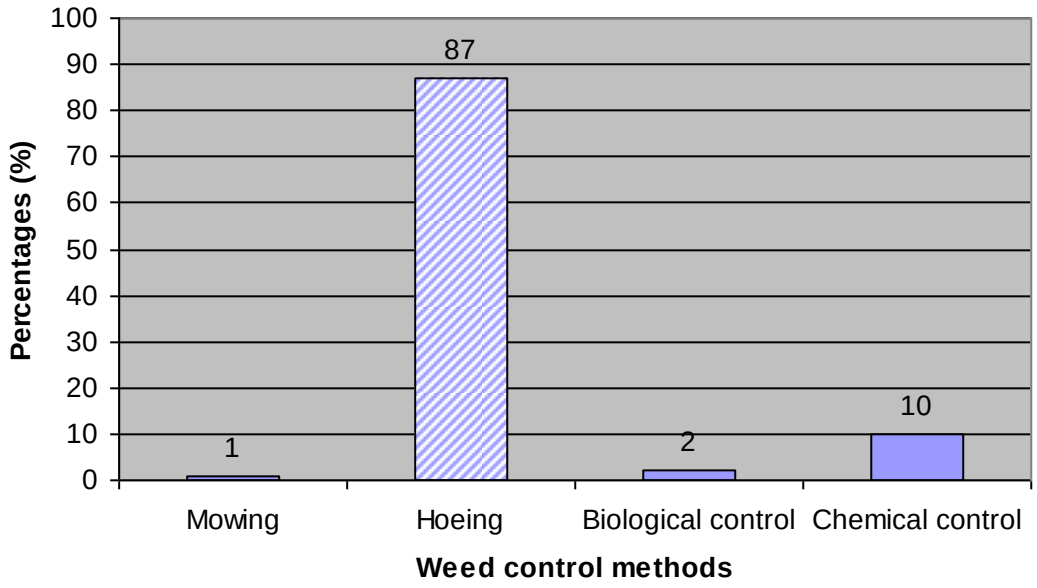

Figure 6.5 Distribution of weeding methods in Lesotho (N=153)

6.6.2. Diseases and pests

Diseases and pests may occur at different stages during the plant lifecycle. This may affect crop production and influence the performance of irrigation activities. Duniway (1983) indicates that epidemics of root and crown rot caused by phytophthora fungal species are largely determined

by climate, soil conditions, rainfall and soil moisture status. Table 6.7 illustrates that 54% of farmers experience pest and disease problems after planting their summer crops. The assumption is that, this is the time when temperatures start to increase and become conducive for diseases and pests to become activate. The same scenario was identified with winter crops where 51% of farmers experienced problems after planting. Farmers mainly experience disease and pest problems after planting.

Table 6.7 Distribution of diseases and pests during summer and winter seasons (N=153)

Summer Production Season						
DISTRICTS	**Pre-planting**		**Post-planting**		**TOTAL**	
	n	**%**	**n**	**%**	**n**	**%**
MASERU	11	29.73	26	70.27	37	24.18
MAFETENG	18	48.65	19	51.35	37	24.18
MOHALE'S HOEK	19	47.50	21	52.50	40	26.15
QUTHING	22	56.41	17	43.58	39	25.49
TOTAL	**70**	**45.75**	**83**	**54.25**	**153**	**100.00**
Winter Production Season						
	Pre-planting		**Post-planting**		**TOTAL**	
	n	**%**	**n**	**%**	**n**	**%**
MASERU	13	36.11	23	63.89	36	23.68
MAFETENG	18	48.65	19	51.35	37	24.34
MOHALE'S HOEK	18	45.00	22	55.00	40	26.32
QUTHING	26	66.67	13	33.33	39	25.66
TOTAL	**75**	**49.34**	**77**	**50.66**	**152**	**100.00**
Frequency Missing = 1						

6.7. IRRIGATION WATER MANAGEMENT

This section renders insight into irrigation methods applied in various areas and indicates how irrigation management is being carried out on farms. Investigations on sources of water and how water is being distributed from the sources to the fields forms part of this discussion.

6.7.1. Water source for irrigation

The source of irrigation water is important in determining the irrigation method to be selected. This has to happen before farmers can engage in irrigation activities. The study revealed that 65% of farmers use rivers as their water sources for irrigation. Most of these farmers are based in the Maseru and Quthing districts respectively. The dams used do not have specific names except for the Duma dam in the Mafeteng district. Common rivers that cut across these districts are the Mohokare, Phuthiatsana, Senqu and Makhaleng rivers. Being a mountainous country, Lesotho has big valleys which retain and a lot of water.

Table 6.8 Sources of irrigation water (N=153)

DISTRICTS	DAMS		RIVERS		BORE HOLE		Total	
	n	%	n	%	n	%	n	%
MASERU	3	2	30	20	0	0.00	33	22
MAFETENG	17	11	21	14	0	0.00	38	25
MOHALE'S HOEK	28	18	20	13	0	0.00	48	31
QUTHING	6	4	28	18	0	0.00	34	22
TOTAL	**54**	**35**	**99**	**65**	**0**	**0.00**	**153**	**100**

Table 6.9 Sources of irrigation water and the adoption of irrigation methods (N=146)

Water source	Sprinkler		Furrow		Total	
	n	%	n	%	n	%
Dams	18	50	18	50	36	24
River	67	80.7	16	19.28	27	19
Both	13	48.2	14	51.85	83	57
Total	**98**	**67**	**48**	**33**	**146**	**100**

(df= 2, χ^2 =16, p= 0.0003)

The decision to adopt a particular technology is influenced by a number of factors which are categorised as socio-economic background, institutional factors, agro-ecological zones and the characteristics of attributes of the technology (Karami and Rezai-moghaddam, 2002). The study revealed that there is a significant relation between the source of water and the adoption of irrigation method (df= 2, χ^2 =16, p= 0.0003). 81% of the farmers who use rivers as the main source of water adopt sprinkler irrigation method.

6.7.2. Water allocation and charging

The World Meteorology Organisation (2007) asserts that water is a scarce resource which needs to be used with care, to ensure sustainable development for all users. Water is not only used for irrigation purposes since there are other industries in Lesotho such as mining which cannot run in the absence of water. This requires proper allocation of water to all users.

According to a UN Report (1980) the fundamental role of water allocation and pricing is to distribute this limited resource equitably to all consumers which should in return influence the efficiency of water use and fair distribution among users. Frank (2010) illustrates that in order to promote efficient use of irrigation water, it is imperative that irrigators pay water levies based on their actual water consumption and not on their water allocation. In Lesotho irrigation farmers do not receive an allocation of water to irrigate except a few farmers located in Maseru and Mohale'shoek. 99 % of farmers pump water freely from rivers for irrigation purposes. It is therefore evident from these results that farmers do not pay water charges in Lesotho.

Table 6.10 Distribution of units of water allocated to the farmers (N=144)

DISTRICTS	Water allocated		Not allocated		Total	
	n	%	n	%	n	%
MASERU	1	2.90	34	97.14	35	24.31
MAFETENG	0	0.00	36	100.00	36	25.00
MOHALE'S HOEK	1	2.63	37	97.37	38	26.39
QUTHING	0	0.00	35	100.00	35	24.31
TOTAL	**2**	**1.39**	**142**	**98.61**	**144**	**100.00**
Frequency Missing = 9						

6.7.3. Source used for conveyance of irrigation water to irrigation fields

Table 6.11 illustrates that 54% of farmers use diesel engines to pump water from the rivers to their fields while 40% of farmers use gravitational methods. A minority of respondents use electricity as power source due to the limited availability of electricity in the rural areas.

Table 6.11 Source used for conveyance of irrigation water from the sources to the irrigation field (N=153)

DISTRICTS	Energy source							
	GRAVITY		WATER PUMPS/DIESEL		ELECTRICITY		Total	
	n	%	n	%	n	%	n	%
MASERU	4	2.61	25	16.00	10	6.54	39	25
MAFETENG	11	7.19	26	17.00	1	0.65	38	25
MOHALE'S HOEK	31	20.00	8	5.23	0	0.00	39	26
QUTHING	16	11.00	20	13.00	0	0.00	36	24
TOTAL	**62**	**40.52**	**79**	**51.63**	**11**	**7.85**	**153**	**100**

6.7.4. Irrigation methods

Irrigation technology has the potential to dramatically improve water use efficiency in crop production. However, due to increased complexity and variation in irrigation technologies available farmers face the challenge of having to make rational decision when selecting new irrigation methods. Diversity of social, economic and natural factors influence the adoption of irrigation technologies making such decisions difficult (Karami and Rezai-Moghaddam, 2002).

Irrigation farmers in Lesotho make use of either sprinkler, drip, furrow or flood irrigation. 64% of farmers prefer sprinkler irrigtion compared to other irrgation methods. This method is very common in Maseru and Quthing. 31% of the farmers, mostly from Mohale'shoek and Mafeteng use furrow irrigation. Other irrigation methods include the use of perforated hose pipes and basin irrigation.

Table 6.12 Distribution of irigation methods in specified areas (N=153)

DISTRICT	Sprinkler		Drip		Furrow		Flood		Others		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
MASERU	32	20.9	0	0.00	5	3.27	0	0.00	0	0.00	37	25
MAFETENG	15	9.80	0	0.00	22	14.40	0	0.00	0	0.00	37	24
MOHALE'S HOEK	12	7.84	0	0.00	21	13.70	1	0.65	5	3.30	39	25
QUTHING	39	25.50	1	0.70	0	0.00	0	0.00	0	0.00	40	26
TOTAL	**98**	**64.4**	**1**	**0.70**	**48**	**31.00**	**1**	**0.65**	**5**	**3.25**	**153**	**100**

6.7.4.1. Criteria for selection of irrigation methods

Each irrigation method has its own set of characteristics that need to be taken into account with the selection of specific irrigation type such as costs, ease of irrigation, water distribution and irrigation efficiency. Furthermore, factors such as soil type, size of farm and topography of the land also influence the selection of irrigation methods. (Karami and Rezai-Moghaddam, 2002). Caviglia and Kahn (2001) indicate that adoption of a given technology is a function of individual's socio-economic situation, institutional factors, agro-ecological zones and the characteristics of the technology.

Table 6.13 indicates that 51% of the farmers selected a specific irrigation method based on the time they could save with a specific irrigation system. 41% of the respondents indicated that the cost of the specific irrigation method is important in the selection of irrigation method.

Table 6.13 Distribution for criteria used in selecting irrigation methods (N=153)

DISTRICTS	It saves time		Cheap		Not labour intensive		Easy to manage		Common in the area		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
MASERU	20	13.07	16	10.46	0	0.65	2	1.31	6	3.54	44	29
MAFETENG	22	14.38	12	7.80	0	0.00	0	0.00	0	0.00	34	22
MOHALE'S HOEK	11	7.19	30	19.61	3	1.96	0	0.65	0	0.00	44	29
QUTHING	25	16.34	4	2.61	0	0.00	2	1.31	0	0.00	31	20
TOTAL	**78**	**51**	**62**	**41**	**3**	**2**	**4**	**3**	**6**	**3**	**153**	**100**

Table 6.14 illustrates that there is a significant relationship between farm sizes and the irrigation technology adopted (df=1, $\chi 2 = 6$, p=0.01). All the large scale irrigation farmers prefer to use sprinkler irrigation method, while farms smaller than 10 hacters mainly use furrow irrigation.

Table 6.14 Farm size and adoption of irrigation technology (N=124)

	Sprinkler		Furrow		Total	
Farm size	n	%	n	%	n	%
<10	75	68.18	35	31.82	110	89
≥10	14	100.00	0	0.00	14	11
TOTAL	**89**	**72**	**35**	**28**	**124**	**100**

(df=1, $\chi^2 = 6$, p=0.01)

6.7.4.2. Perceived satisfaction with the method selected

75% of the farmers are satisfied with their choices of the specific irrigation method they selected for their farms. A possible reason for this is that farmers in Lesotho have limited exposure to information on different irrigation methods and are therefore inclined to be satisfied with what they have.

Table 6.15 Perceived satisfaction of farmers on selected irrigation methods (N=153)

Levels of satisfaction	Frequency	Percentage (%)
Satisfied	115	75
Dissatisfied	38	25
TOTAL	**153**	**100**

6.7.4.3. Irrigation scheduling practices

Pereira (1982) is of the opinion that irrigation management as a planned activity is done on a number of factors which sometimes dictate the frequency of irrigation and the volume of water applied. He advocates that growing season and critical stages of crop development form the basis for irrigation management planning and scheduling. Stevens (2006) notes that irrigation scheduling is accepted as the process to decide when to irrigate crops and how much water to apply. He further states that irrigation scheduling plays an important role in the general improvement of water efficiency on the farm.

Table 6.16 illustrates that roughly 40% of farmers prefer to irrigate once every fortnight or twice a week 40% during the summer production season. During the winter production season farmers prefer to irrigate once every fortnight (53%). These differences in irrigation scheduling practices by farmers should be taken into consideration when planning irrigation management.

Table 6.16 Irrigation scheduling practices (N=152)

Summer										
DISTRICTS	**Once a week**		**Twice a week**		**Once every fortnight**		**Others**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
MASERU	3	8.3	24	66.67	2	5.57	7	19.44	36	23.68
MAFETENG	1	2.70	15	40.54	20	54.05	1	2.70	37	24.34
MOHALE'S HOEK	3	7.50	16	40.00	11	27.50	10	25.00	40	26.32
QUTHING	0	0	7	17.95	30	76.92	2	5.13	39	25.66
TOTAL	**7**	**4.61**	**62**	**40.79**	**63**	**41.45**	**20**	**13.16**	**152**	**100.00**
Winter										
DISTRICTS	**Once a week**		**Twice a week**		**Once every fortnight**		**Others**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
MASERU	23	65.71	5	14.29	4	11.43	3	8.57	35	23.81
MAFETENG	1	2.86	8	22.86	25	71.43	1	2.86	35	23.81
MOHALE'S HOEK	7	17.95	9	23.08	18	14.15	5	12.82	39	26.53
QUTHING	0	0	5	13.16	31	81.58	2	5.26	38	25.85
TOTAL	**31**	**21.09**	**27**	**18.37**	**78**	**53.06**	**11**	**7.48**	**147**	**100.00**

6.7.4.4. Cost of irrigation

The general perception of farmers regarding the cost of irrigation indicated that 60% of the respondents perceived irrigation as expensive. Farmers that perceive irrigation as relatively cheap use gravity to convey water from the source to the irrigation fields as illustrated in Table 6.17.

Table 6.17 Distribution of how expensive irrigation is from farmers point of view (N=153)

DISTRICTS	**Very cheap**		**Cheap**		**Moderate**		**Expensive**		**Very expensive**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	%
MASERU	0	0	5	13.89	2	5.56	5	13.89	24	66.67	36	23.86
MAFETENG	1	2.70	9	24.32	6	16.22	11	29.73	10	27.03	37	24.49
MOHALE'S HOEK	6	15.38	12	30.77	10	25.64	4	10.26	7	17.95	39	25.83
QUTHING	4	10.26	6	15.38	0	0.00	19	48.72	10	25.64	39	25.82
TOTAL	**11**	**7.28**	**32**	**21.19**	**18**	**11.9**	**39**	**25.83**	**51**	**33.77**	**151**	**100.00**

6.7.4.5. Maintenance of irrigation systems

The installation of an irrigation facility is an expensive exercise (FAO, 2007) and therefore such a facility must be well maintained. Respondents were asked to indicate who is responsible for the maintenance of their irrigation systems. 92% of farmers maintain their irrigation facilities on their own, while 0.68% use their associations and the rest rely on government for assistance.

Table 6.18 Distribution of responsibilities for maintenance of the systems (N=147)

DISTRICTS	Farmers		Farmers Association		Government		Total	
	n	%	n	%	n	%	n	%
MASERU	23	67.65	0	0.00	11	32.35	34	23.13
MAFETENG	35	100.00	0	0.00	0	0.00	35	23.81
MOHALE'S HOEK	38	97.44	1	2.56	0	0.00	39	26.53
QUTHING	39	100.00	0	0.00	0	0.00	39	26.53
TOTAL	**135**	**91.80**	**1**	**0.70**	**11**	**7.50**	**147**	**100.00**

6.7.4.6. Training in irrigation management

Harris (1983) noted that training for both farmers and extensionists is crucial for the purposes of improving the performance of individual extension workers and irrigation farmers. Respondents were asked whether they had ever attended any training course in irrigation management. 95% of the respondents indicated not to have attended any training courses.

Table 6.19 Distribution of training attended for irrigation management (N=141)

Responses	Frequency (n)	Percentages (%)
Attended training course	7	5
Not attended training course	134	95
TOTAL	**141**	**100**

6.8. MARKETING POTENTIAL OF CROPS

Clover (1983) is of the opinion that marketing is the most important component of irrigation farming. Without adequate knowledge of what the market requires, efficient crop production is not possible.

6.8.1. Target customers

52% of farmers produce primarily for local markets while only a small percentage (15%) produce for supermarkets. This finding illustrates the huge challenge facing extensionists and others to help farmers to identify alternative marketing opportunities.

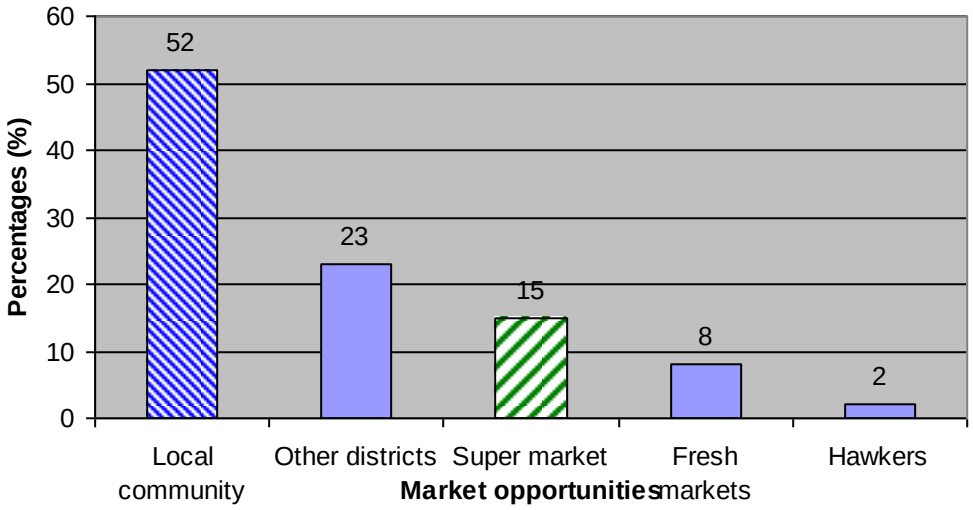

Figure 6.6 Distribution of marketing opportunities (N=153)

6.8.2. Perceived marketing opportunities

78% of farmers indicated reliable marketing opportunities is a challenge that influences viable farming practices in their respective areas. Quthing and Mohale'shoek districts are less populated and less developed resulting in more limited marketing opportunities when compared with other districts. In an informal discussion with these farmers they indicated that open trading between Lesotho and the Republic of South Africa influences their market niches since they compete with very advanced commercial farmers. Potential trading stores set very high quality standards which very few farmers in Lesotho can meet.

Table 6.20 Perceived existence of reliable marketing opportunities (N=87)

DISTRICTS	Reliable marketing opportunities		Non reliable marketing opportunities		Total	
	n	%	n	%	n	%
MASERU	9	39.13	14	60.87	23	26.44
MAFETENG	7	36.84	12	63.16	19	21.84
MOHALE'S HOEK	2	28.57	5	71.43	7	8.05
QUTHING	1	2.63	37	97.36	38	43.67
TOTAL	**19**	**21.84**	**68**	**78.16**	**87**	**100.00**

6.8.3. Contracts in marketing

Clover (1983) points out that contracts in marketing are seen as a basic solution of solving marketing problems for farmers. Contracts between firms and farmers' helps to clarify precisely what should be produced and for whom, and at what price. Contractual arrangements are usually more attractive to farmers seeking additional sources of capital to expand their businesses and those who wish to share part of the risk with the buyer (Hill and Ingersent, 1982). Hill and Ingersent (1982) further illustrate that contracts, either formal or informal, have become attractive because of benefits such as access to marketing and support system services. Goldsmith (1985) also indicates that farmers get access to new technologies and inputs through contractual agreements, which otherwise may be outside their reach. Results in Table 6.21 illustrate that 95% of farmers do not form any contracts with supply stores.

Table 6.21 Marketing contracts with supply stores (N=145)

DISTRICTS	Having contracts		No contracts		Total	
	N	%	n	%	n	%
MASERU	6	18.75	26	81.25	32	22.07
MAFETENG	0	0.00	37	100.00	37	25.52
MOHALE'S HOEK	1	2.70	36	97.30	37	25.52
QUTHING	0	0.00	39	100.00	39	26.90
TOTAL	**7**	**4.83**	**138**	**95.17**	**145**	**100.00**

6.8.4. Marketing information

57% of farmers indicated that they mainly get marketing information from fellow farmers, while 28 % of the farmers get marketing information from extensionists (Figure 6.7).

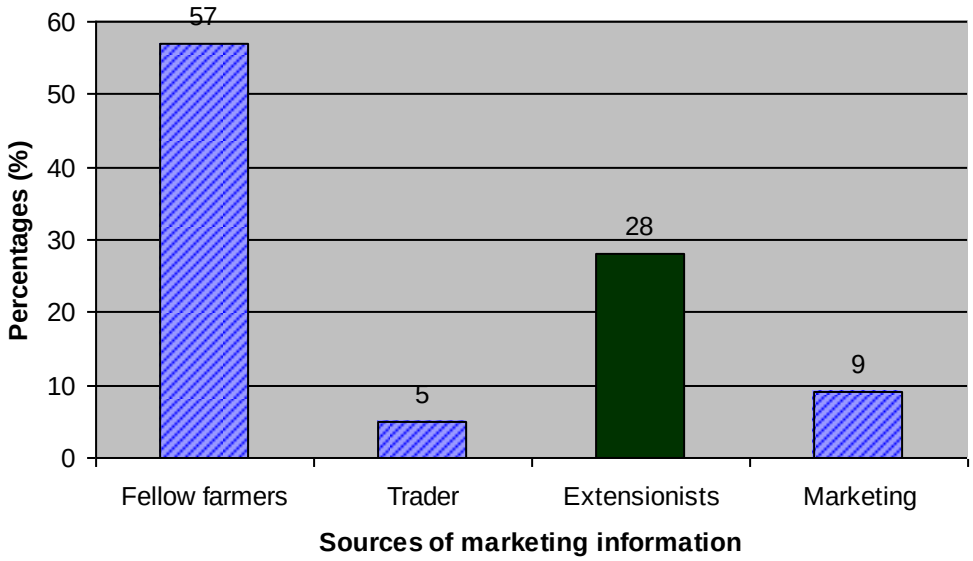

Figure 6.7. Distribution of market information source (N=153)

6.9. FINANCIAL SUPPORT

Ford (1987) argue that for irrigation farmers to perform effectively they need support from governments, non-governmental organisations and financial institutions.

6.9.1. Financial support to irrigation farmers

91% of the farmers indicated that they do not receive any financial support, while the rest mainly from Mohale's Hoek (20.51%) and Maseru (11.76%), receive financial support in the form of donations from the Roman Catholic Church.

Table 6.22 Financial support to irrigation farmers (N=147)

DISTRICTS	Receive financial support		Do not receive financial support		Total	
	n	%	n	%	n	%
MASERU	4	11.76	30	88.24	34	23
MAFETENG	0	0.00	36	100.00	36	24
MOHALE'S HOEK	8	20.51	31	79.49	39	27
QUTHING	1	2.63	37	97.37	38	26
TOTAL	**13**	**8.84**	**134**	**91.16**	**147**	**100**

6.9.2. Perceived satisfaction of farmers with regard to financial support

Farmers were asked to indicate their degree of satisfaction concerning available financial support. Since very few farmers receive financial support, 98% of the farmers were not satisfied with the current financial support provided.

Table 6.23 Perceived satisfaction with financial support (N=126)

DISTRICTS	Satisfied		Not satisfied		Total	
	n	%	n	%	n	%
MASERU	3	9.68	28	90.32	31	24.60
MAFETENG	0	0.00	32	100.00	32	25.40
MOHALE'S HOEK	0	0.00	27	100.00	27	21.40
QUTHING	0	0.00	36	100.00	36	28.60
TOTAL	**3**	**2.38**	**123**	**97.62**	**126**	**100.00**

Both high value and low value crops are being planted by irrigation farmers in Lesotho. However, since climatic and ecological conditions make it impossible to grow a wide variety of high value and low value crops, detailed studies have to be done to identify appropriate locations where particular crop varieties can or cannot do well.

CHAPTER 7

FARMERS INFORMATION AND KNOWLEDGE SUPPORT SYSTEM

7.1. Farmers' perceived role of extension workers

This chapter provides an insight into how farmers perceive the support they receive from extensionists on a number of practical aspects of irrigation farming. Membership of farmers to farmers associations or groups and contact with irrigation extensionists is also examined in this chapter.

Extension credibility plays a vital role in the adoption or rejection of new technologies on the farm as extensionists are considered to be information and knowledge providers. Ehrlich *et al.* (1999) define knowledge as accurate information that has been organised and evaluated by the human mind to shape actions, beliefs, attitudes and institutions or mental states.

In farming, information and knowledge are more important for capital intensive farming systems due to increasing economic pressure (Van Asseldonk *et al.* 1999). Useful scientific information could improve decision-making by expanding alternatives, clarifying choices and enabling decision makers to achieve desired outcomes (Ehrlich *et al.* 1999).

7.2. Perceived importance of extension support by irrigation farmers with regard to crop selection

43% of farmers do not consider extension support as an important factor with regard to the crop selection (Table 7.1). These results correspond with the findings in Chapter 6 that farmers in Lesotho often get advice from commercial farmers in the Republic of South Africa. This becomes more evident in Mafeteng (73.53%), and Mohale'shoek (64.42%) respectively. Extension is considered to be very important in Quthing district, where 92% of the farmers perceive extension support as very important in their decision-making.

Table 7.1 Perceived importance of extension support in crop selection (N=145)

DISTRICTS	Not important		Fairly important		Very important		Total	
	n	%	n	%	n	%	n	%
MASERU	10	29.41	13	38.24	11	32.35	34	23.45
MAFETENG	25	73.53	7	20.57	2	5.90	34	23.45
MOHALE'S HOEK	26	64.42	10	26.32	2	5.26	38	26.20
QUTHING	2	5.13	1	2.56	36	92.31	39	26.90
TOTAL	**63**	**43.45**	**31**	**21.38**	**51**	**35.17**	**145**	**100.00**

7.2.1. Perceived satisfaction of farmers with extension support on fertilizer management

Table 7.2 illustrates that 35% of farmers are dissatisfied with extension support in regard to fertiliser management. Clearly there are huge discrepancies between the various districts. In Mohale'shoek for instance, 60% of respondents are not satisfied while 92% of respondents in Quthing districts are satisfied with the service delivered by extensionists. Credibility of extensionists appears to be limited to personalities.

Table 7.2 Perceived satisfaction of farmers with regard to extension support on fertiliser application on the farms (N=153)

DISTRICTS	Dissatisfied		Moderate		Satisfied		Total	
	n	%	n	%	n	%	n	%
MASERU	14	37.87	19	51.35	4	10.81	37	24
MAFETENG	14	37.87	17	45.95	6	59.46	37	24
MOHALE'S HOEK	24	60.00	14	35.00	2	5.00	40	26
QUTHING	2	5.12	1	2.56	36	92.35	39	25
TOTAL	**54**	**35.29**	**51**	**33.34**	**48**	**31.37**	**153**	**100**

7.2.2. Perceived satisfaction of farmers with regard to extension support for irrigation management

69.7% of farmers are dissatisfied with the support they receive from extensionists with regard to irrigation management.The highest perceived disatisfaction of farmers with regard to irrigation management was perceived in Mohale'shoek (100%) and Maseru 91%. Only Quthing farmers were satisfied with their extension support.

Table 7.3 Perceived levels of satisfactions of farmers with regard to extension support on irrigation management (N=149)

DISTRICTS	Very dissatisfied		Moderate		Very satisfied		Total	
	n	%	n	%	n	%	n	%
MASERU	32	91	1	2.86	2	5.71	35	23.49
MAFETENG	30	83	0	0.00	6	16.67	36	24.17
MOHALE'S HOEK	39	100	0	0.00	0	0.00	39	26.17
QUTHING	3	8	0	0.00	36	92.31	39	26.17
TOTAL	**104**	**69.8**	**1**	**0.67**	**44**	**29.53**	**149**	**100.00**

7.2.3. Knowledge support for irrigation management on the farm

On the question of, who farmers consult when they take irrigation management decisions, results show that 53% of farmers acquire irrigation information from fellow farmers, while 34% of farmers get support from the private companies where they buy irrigation equipment. Only 2% of farmers indicated that they getting support from extensionists**.** Similar results were presented by Williams and Düvel , (2005) who found most farmers felt free to acquire information from fellow farmers.

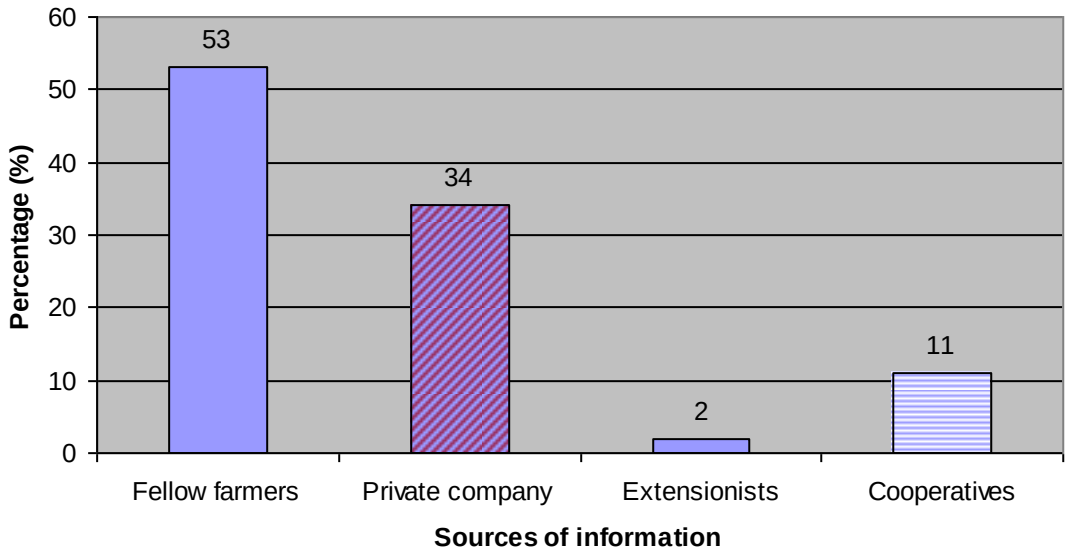

Figure 7.1. Frequency distribution of information sources used for irrigation management

7.2.4. Farmers group and associations

Farmer groups are one of the most appropriate ways in which farmers learn and distribute new information concerning innovations. Black (2000) indicates that group activities are usually seen as belonging to the suite of participatory extension methodologies that feature prominently in the extension literature. When people are given the opportunity to participate in an activity, they usually take ownership for it as (Kelley 1995). According to Colliver (2001), farmer groups play an important role to produce faster evolution of sustainable farming systems by facilitating a better flow of ideas and information amongst farmers. Stevens (2006) notes that farmer groups have proven to be an effective way of sharing information and knowledge between farmers. 93% of the farmers indicated that they unfortunately do not belong to any farmers associations or groups (Table 7.4).

Table. 7.4 Frequency distribution of farmers belonging to farmers association (N=134)

DISTRICTS	Member of a farmer group		Not a member of a farmer group		Total	
	n	%	n	%	n	%
MASERU	4	13.79	25	86.20	29	21.64
MAFETENG	0	0.00	33	100.00	33	24.63
MOHALE'S HOEK	5	15.15	28	84.85	33	24.63
QUTHING	1	2.56	38	97.44	39	29.10
TOTAL	**10**	**7.46**	**124**	**92.54**	**134**	**100.00**

On the question of how knowledgeable extensionists are with regard to guiding farmers to form farmer groups, 86% indicated that extensionists have never encouraged them to form any farmer groups and therefore respondents perceive their knowledge in this regard as inadequate.

Table 7.5 Perceived knowledge of extension officer in forming farmer groups (N=142)

DISTRICTS	Poor		Moderate		Good		Total	
	n	%	n	%	n	%	n	%
MASERU	19	63.33	8	26.67	3	10.00	30	**21.13**
MAFETENG	36	100	0	0	0	0	36	**25.35**
MOHALE'S HOEK	33	86.84	2	5.26	3	7.89	38	**26.76**
QUTHING	34	89.47	3	7.89	1	2.63	38	**26.76**
TOTAL	**122**	**85.92**	**13**	**9.15**	**7**	**4.93**	**142**	**100.00**

7.2.5. Contact with extension

Table 7.6 illustrates that 89.7% of farmers indicated that they meet once a year with extensionists. They indicated that extension officers meet them during the preparations of national agricultural shows which are held once a year. Regular contact between extension and farmers is required for effective technology transfer and agricultural development. Thus findings should raise huge concerns amongst extension managers and their staff.

Table 7.6 Frequency distribution of contact between farmers and extension staff (N=146)

DISTRICTS	Once a fortnight		Once a month		Twice a month		Once a year		On ad hoc		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
MASERU	3	8.33	1	2.77	3	8.33	26	72.22	3	8.33	36	25
MAFETENG	0	0	0	0	0	0	34	97.14	1	2.85	35	24
MOHALE'S HOEK	0	0	0	0	1	2.70	36	97.29	0	0	37	25
QUTHING	2	5.26	0	0	1	2.63	35	92.10	0	0	38	26
TOTAL	**5**	**3.44**	**1**	**0.68**	**5**	**3.44**	**131**	**89.7**	**4**	**2.74**	**146**	**100**

7.2.6. Perceived problems with extension delivery

From the farmers point of view, there are many problems surrounding extension services. In particular extensionists themselves have a very negative attitude towards irrigation farming. Farmers identify a lot of incompetence from extension officers regarding technical support in irrigation farming.

60% of farmers complained that most extensionists are not able to help them with technical aspects such as measuring of the fields and minor irrigation advice on irrigation equipment. They indicated that extensionists lack basic irrigation management knowledge and are appointed mainly because of political influence from the top management in the Ministry of Agriculture. 30% of the respondents indicate that irrigation engineers do not assist them with irrigation planning and design. Farmers complained that there are very poor linkages between extension, research and the farmers (22%) and as such, coordination is very poor.

Table 7.7 Perceived shortcomings of extension delivery as viewed by farmers (N=153)

Problems of extensionists viewed by farmers	Percentages of responses
Incompetence (technical knowledge)	60.00
No irrigation engineers	30.00
Poor linkages between research and extension	22.00
Office orientated/lack of practical experience	18.00
Poor training institutions (colleges)	6.00
No evaluation of work	5.00
No follow-up from superior	2.00
Negative attitude towards irrigation	2.00

Findings in this chapter send alarming warnings to the Department of Agriculture and policy makers concerning extension, as most farmers do not regard extension as their fundamental guide to successful irrigation farming. The credibility and competence of extensionists is highly questionable in many aspects of farming operations.

CHAPTER 8

PERCEIVED EXTENSION DELIVERY TO IRRIGATION FARMERS

This chapter render some insight into ways in which irrigation extensionists perceive their service with regard to the irrigation performance in their respective areas. Personal profiles and challenges affecting extensionists are reflected in this chapter.

FAO (2008) asserts that extension has played a central role in the development of the agricultural sector since the beginning of the Green Revolution. The FAO (2008) further points out that top-down extension approaches were the main drivers during this time. Swanson (1997) however indicates that extension has undergone tremendous changes since then. These changes are due to factors such as the growth of the commercial farm sector, trade liberalization and new approaches to technology transfer. Present extension approaches include techniques where extension is being decentralised to the farmers. The emphasis is on bottom-up approaches where farmers are seen as the most important stakeholders (Swanson 1997).

8.1. Profile of extension workers

This section provides a brief description of the profile of extensionists like their levels of education, age and experiences in irrigation farming across the four study areas**.**

8.1.1. Locality

A total of 31 extensionists were identified, who are responsible for serving farmers in irrigation farming. 31% percent of the extensionists were located in Mafeteng and 28% in Mohale's Hoek.

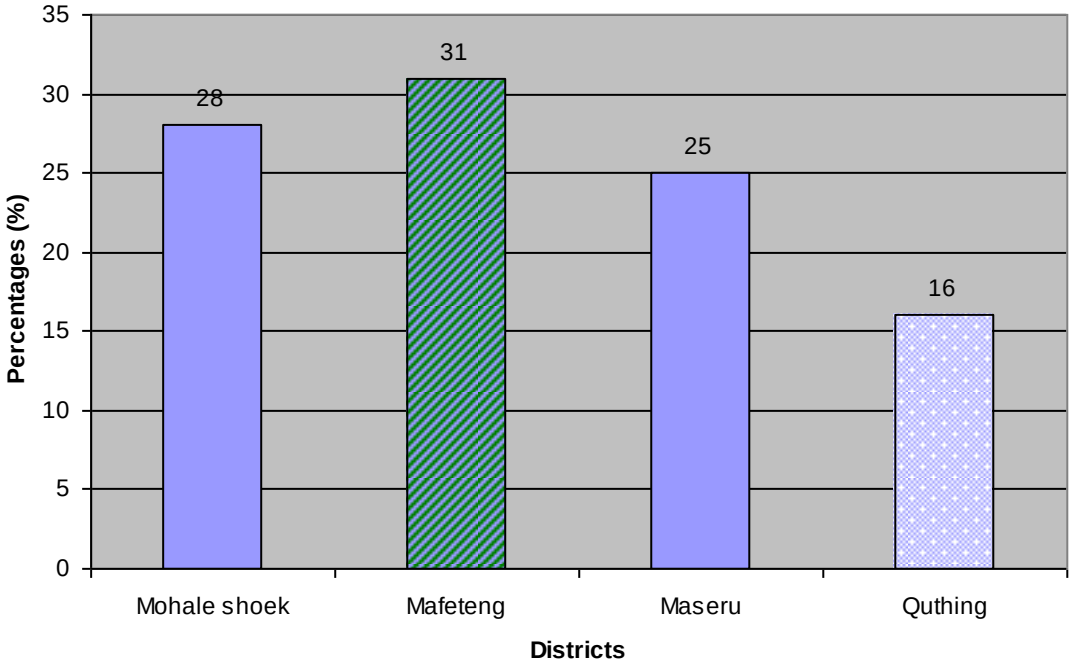

Figure 8.1 Frequency distribution of extensionists in the four study areas (N=31)

8.1.2. Gender distribution of extensionists

According to Mehta and Srinivasan *(*2001) gender reflects a set of behaviour norms ascribed to men and women in a given social group or system. Gender thus reflects attitudes and beliefs that a particular cultural group considers appropriate for males or females.

77% of the irrigation extensionists are males. This is probably because of the situation explained by Mehta and Srinivasan (2001) that women have been sanctioned for a long time in most African countries in matters relating to agriculture.

8.1.3. Education

Agricultural extension services require qualified extensionists who are competent in both the disciplines of agriculture and extension (Stevens and Van Heerden, 2007). Table 8.1 illustrates that 48% of extension workers have attained a diploma qualification while 35% respondents attained a degree qualification and 16% certificates in agricultural science. It is important to indicate that in an informal discussion with some extension workers, misgivings were observed

among extension workers depending on where extension staff received tertiary training. Some extensionists perceive their fellow extension workers as of a lower grade because of the universities and/ or colleges from which they acquired their training. This causes frustrations and conflicts between colleagues.

Table. 8.1 Distribution of gender and highest qualifications obtained by extension staff (N=31)

Gender distribution	**Frequency**	**Percentages**
Male	24	77.42
Female	7	22.58
TOTAL	**31**	**100.00**
Qualification distribution of extensionists		
Qualifications	**Frequency**	**Percentage**
Std 7	0	0.00
Std 7- 8	0	0.00
Form C	0	0.00
Form E	0	0.00
Certificate in agriculture	5	16.13
Diploma in agriculture	15	48.39
Degree	11	35.37
TOTAL	**31**	**100**

8.1.4. Age

Table 8.2 illustrates that 69% of the extension workers are younger than 41 years which implies that they can be sent for further training. They have approximately 25 years of service remaining before they qualify for retirement.

Table 8.2 Distribution of age amongst extensionists (N=26)

Age categories	**Frequency**	**Percentages**
20-30	5	19
31-40	13	50
41-50	5	19
51-60	3	12
Total	**26**	**100**

8.1.5. Working experience

Experience plays a very important role in the performance of individuals in extension activities. Figure 8.2 illustrates that 31% of the extension workers have less than five years of experience in agricultural extension. These extensionists rely on mentoring from their more senior colleagues and often lack appropriate experience to serve farmers efficiently.

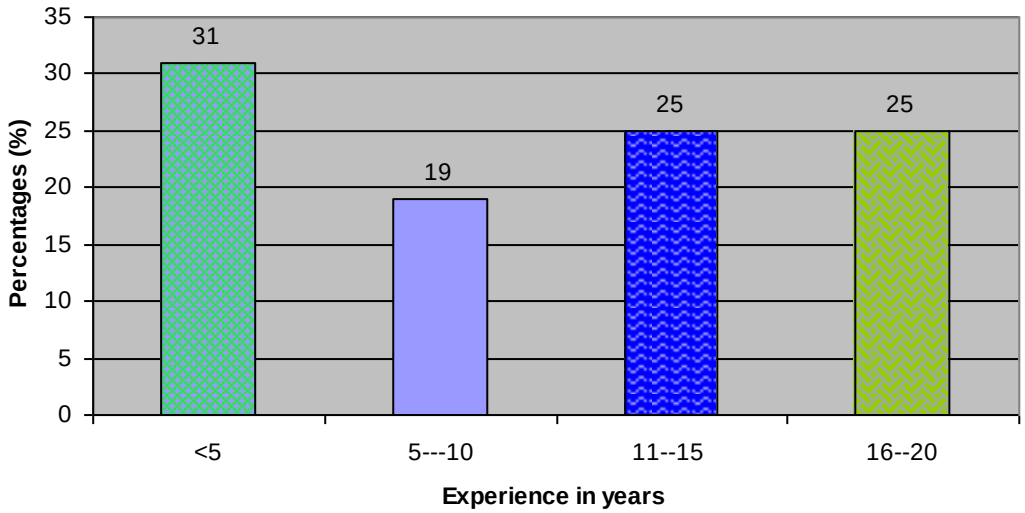

Figure 8.2 Levels of experiences of extensionists (N=31)

8.1.6. Field of specialization

Figure 8.3 illustrates that only 6% of extension workers were trained as agricultural extensionists, while the rest were trained in specific subject matters with little or no introduction to agricultural extension. Figure 8.3 also indicates that 16% of respondents were trained in engineering. It is also important to note that these engineers were trained as civil engineers and not specifically as irrigation engineers. 16% of the extensionists received training in crop production. Important is the fact that 41% of the respondents received general agricultural training which does not automatically qualify them as irrigation extensionists (without specialised in-service training).

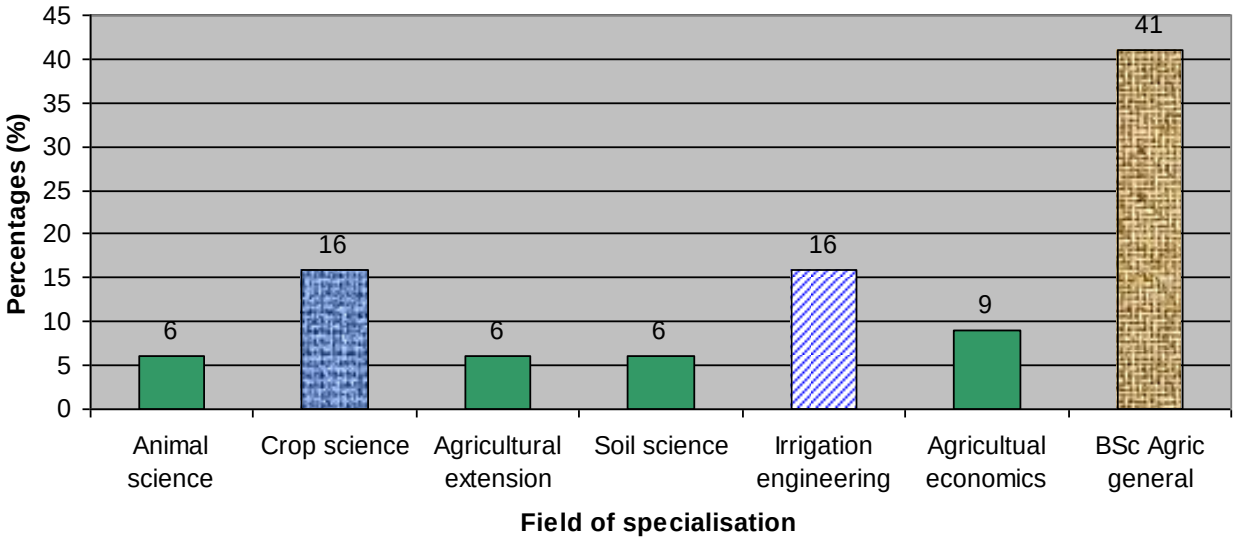

Figure 8.3 Frequency distribution of areas of specialisation (N=31)

8.1.7. Extension methods and approaches used in development

On the question of what extension methods are commonly used in Lesotho, all respondents avoided to answer the question. This could indicate that either the extensionists did not understand the question or they did not have the necessary knowledge to identify specific extension approaches and methods they follow.

8.1.8. Constraints in delivering extension services

For effective extension, extensionists need to be provided with the necessary support in terms of transport, teaching-aids and other essential equipment. 81% of extension workers indicated that the main problem hindering them from providing efficient extension service delivery is lack of facilities. They indicated that vehicles allocated for them to perform field work are sometimes taken from them and used for other official purposes, such as transportation of directors to attend to family matters. The second shortfall identified is the lack of appropriate in-service training (45%). The results correspond with the findings of Mokone and Steyn (2005) that 55% of extension workers in Lesotho are not offered any in-service training. 32% of the extensionists

complained about poor salaries. It is important for extension managers (line and senior) to take note of these constraints, since they in general give rise to poorly motivated extension staff.

Table 8.3 Perceived constraints that hinder extension performance in irrigation farming (N=31)

Constraints		Frequency	Percent of people
1	Poor transport	25	80.60
5	Lack of in-service training	14	45.16
2	Poor salaries	10	32.25
3	Poor communication channels	8	25.80
4	Incompetent staff members	6	19.35
6	Too many farmers to be served	4	12.90
7	Lack of computers and free internet	2	6.45

8.1.9. Monitoring and evaluation of extension impact

Respondents were asked whether they evaluated and monitored their progress in extension. 68% indicated that they never monitored and evaluated the impact of their extension work, while the rest indicated some form of monitoring and evaluation. Results are as observed probably because of the possibility that monitoring and evaluation are not used positively in the working places. Terblanche (2004) indicates that some people use monitoring and evaluation as a means of firing staff if they fail to achieve the set objectives of the organisations. For this reason, this practise is seen as a threat to many people in the field.

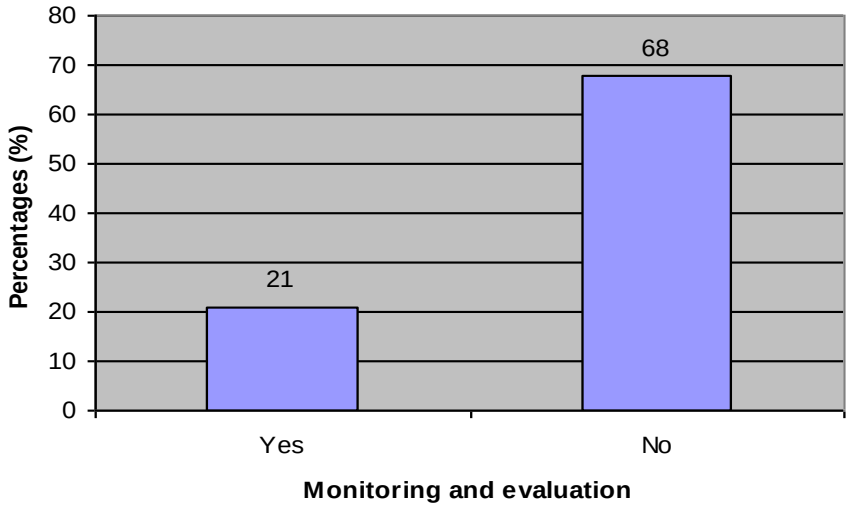

Figure 8.4 Frequency distribution of monitoring and evaluation of extension impact by extensionists (N=31)

8.1.10. Training in irrigation management

97% of irrigation extension workers did not attend any in-service training in irrigation management. The findings supports the findings in Figure 8.3 where respondents were found to have acquired training in different aspects of agriculture but none of them acquired training as specific irrigation engineers or specific irrigation extensionists. The possible reason for this may be attributed to lack of knowledge by management. Extension directors may not be aware of the importance of training even in the form of short or refresher courses in enhancing extensionists' technical competences and developing of irrigation farming in Lesotho.

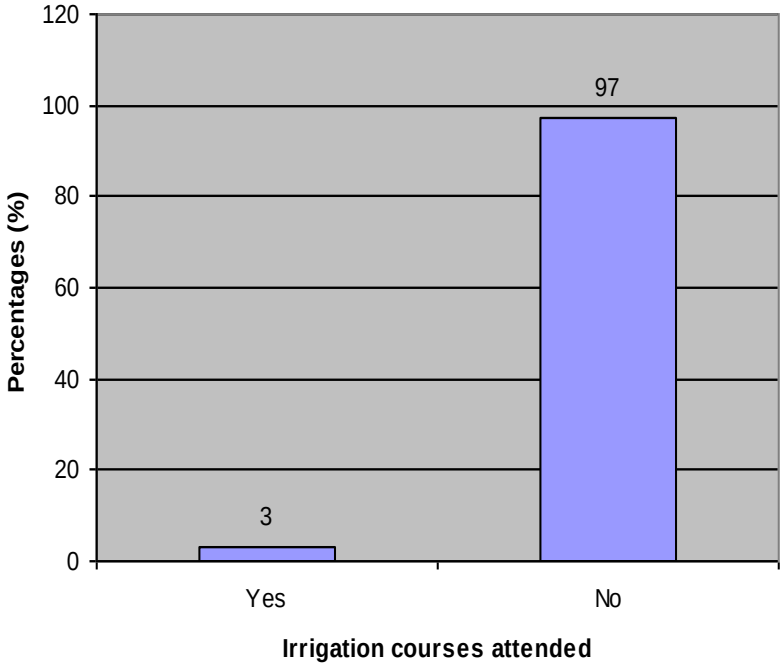

Figure 8.5 Frequency distribution of extensionists attending irrigation training (N=31)

8.1.11. Perceived technical knowledge level

Technical knowledge is essential for an extensionist to gain the necessary credibility amongst his or her farmers. This section reveals the perceived technical knowledge level of irrigation extensionists in Lesotho according to their own assessment.

8.1.11.1. Perceived satisfaction with fertiliser management and support

73% of extension workers rated themselves as being good in advising farmers on fertiliser management. Interesting is the fact that in Chapter 7 (Table 7.2), only farmers from Quthing district indicated that they were satisfied with the services of extensionists with regard to fertiliser management while the rest of the farmers were not satisfied with the knowledge that the extensionists displayed.

Table 8. 4 Perceived satisfaction of extensionists regarding fertiliser management support (N=30)

DISTRICTS	Poor		Fair		Good		Total	
	n	%	n	%	n	%	n	%
MASERU	0	0	2	6.67	6	20	8	26.67
MAFETENG	1	3.33	1	3.33	7	23	9	30.00
MOHALE'S HOEK	2	6.70	1	3.33	6	20	9	30.00
QUTHING	0	0	1	3.33	3	20	4	13.33
TOTAL	**3**	**10.00**	**5**	**16.7**	**22**	**73.3**	**30**	**100.00**

8.1.11.2. Perceived satisfaction with crop management support

Results in Table 8.5 indicate that 71% of extension workers rate themselves as good with advice on aspects such as crop selection, crop production and management.

Table 8.5 Perceived satisfaction of extensionists regarding crop management support (N=31)

DISTRICTS	Poor		Good		Total	
	n	%	n	%	n	%
MASERU	0	0.0	8	26.00	8	25.81
MAFETENG	1	3.2	9	29.00	10	32.26
MOHALE'S HOEK	5	16.2	4	13.00	9	29.03
QUTHING	3	9.7	1	3.23	4	12.90
TOTAL	**9**	**29**	**22**	**71**	**31**	**100.00**

8.1.11.3. Perceived satisfaction with weed management support

Table 8.6 illustrates that 81% of irrigation extension workers rate themselves as being good in weed control management.

Table 8.6 Perceived satisfaction of extensionists regarding weed management support (N=31)

DISTRICTS	Poor		Good		Total	
	n	%	n	%	n	%
MASERU	1	3.20	7	23	8	25.81
MAFETENG	0	0.00	10	32.25	10	32.26
MOHALE'S HOEK	3	9.68	6	19	9	29.03
QUTHING	2	6.45	2	6.45	4	12.90
TOTAL	**6**	**19.36**	**25**	**80.64**	**31**	**100.00**

8.1.11.4. Perceived satisfaction with agro-climate support

77% of extension workers rated themselves as not adequately trained in climatology and therefore incapable to assist farmers in their decision-making for effective irrigation management. A possible reason for this may be that agro-climate is not being appropriately addressed in the training curricula offered to agricultural students. Table 8.6

Table 8.7 Perceived satisfaction of extensionists regarding interpreting agro-climate data (N=31)

DISTRICTS	Poor		Good		Total	
	n	%	n	%	n	%
MASERU	6	19.35	2	6.46	8	25.80
MAFETENG	8	26	2	6.46	10	32.30
MOHALE'S HOEK	8	26	1	3.23	9	29.00
QUTHING	2	6.45	2	6.45	4	12.90
TOTAL	**24**	**77.4**	**7**	**22.6**	**31**	**100.00**

8.1.11.5. Perceived satisfaction with irrigation management support

The majority of extensionists (81%) are of the opinion that they are not competent due to training inadequacies in irrigation management.

Table 8.8 Perceived satisfaction of extensionists regarding competency in irrigation management (N=31)

DISTRICTS	Poor		Fair		Good		Total	
	n	%	n	%	n	%	n	%
MASERU	6	19.35	1	3.23	1	3.20	8	26
MAFETENG	8	26.00	0	0.00	2	6.43	10	32
MOHALE'S HOEK	8	26.00	1	3.23	0	0.00	9	29
QUTHING	3	9.68	1	3.23	0	0.00	4	13
TOTAL	**25**	**80.6**	**3**	**9.7**	**3**	**9.73**	**31**	**100**

8.1.12. Perceived irrigation efficiency in the area

On the question of how irrigation extensionists perceive the irrigation performance and efficiency of farmers in their respective locations, 52% of the respondents are of the opinion that irrigation is performing poorly in their areas. Only 3% of the respondents are of the opinion that irrigation is performing well and that they therefore satisfied with the general irrigation performance.

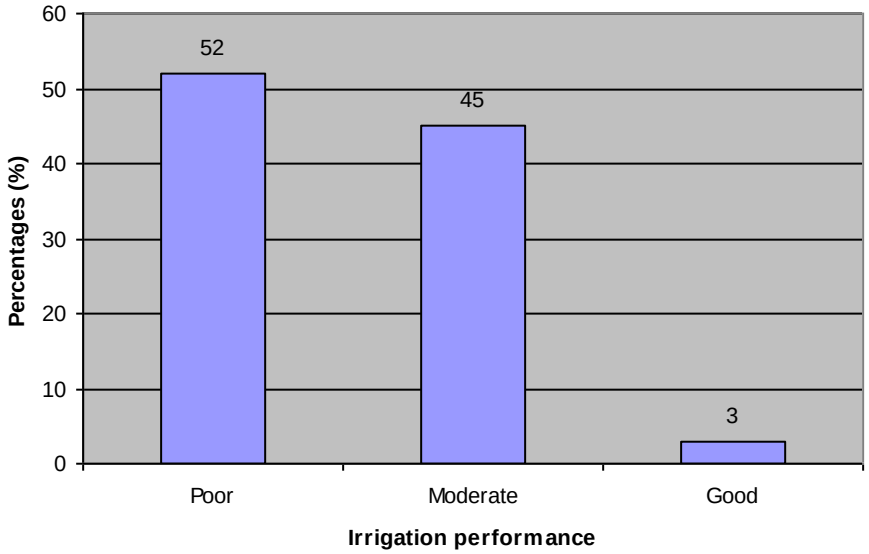

Figure 8.6 Rating of irrigation performance of farmers according to extensionists (N=31)

8.2. Major problems of farmers as viewed as by irrigation extensionists

Extensionists were asked to identify the main constraints that farmers experience in irrigation farming. 50% of the extensionists perceive poor financial support to farmers as a major constraint for the development of irrigation. The extensionists further indicated that many farmers depend on donations which imply that farmers establish irrigation projects only when donations are available.

The land tenure system applied in Lesotho is another stumbling block for sustainable irrigation performance. 28% of the extensionists indicate that farms are being rented and preventing farmers from investing fully on irrigation facilities.

Table 8.9 Constraints perceived to hinder irrigation performance

Main problems	Frequency(n)	Percentage (%)
Poor financial support	16	50.00
Land tenure system is still a problem	9	28.13
Poor training	5	15.63
No irrigation engineers	5	15.63
Low levels of education	5	15.63
Soil samples are done only in Maseru	3	9.38
Poor extension support	2	6.25
Poor planning	1	3.13
Not planting suitable crops	1	3.13

8.3. Climatic factors affecting irrigation performance

Extensionists (39%) in general were of the opinion that harsh winters and heavy storms are the main climatic factors that influence irrigation crop production. The majority of extensionists use radio Lesotho's weather forecasts as their main source of information, which they apply in their planning for farmers. Similar results were documented by Williams and Düvel, (2005). Only 34% of the respondents make use of information generated at the Lesotho weather forecast station.

Table 8.10 Perceived climatic factors affecting irrigation performance and sources of climatic information (N=18)

Climatic conditions		Frequency	Percent
1	Harsh winters	6	33.33
2	Heavy storms	7	38.89
3	Drought	4	22.22
4	Heavy rain that cause water logging	1	5.56
TOTAL		**18**	**100**
Sources of information for predicting weather forecast			
Source of climatic information		**Frequency**	**Percent of people**
1	Radio Lesotho	19	59.38
2	Weather forecast station	11	34.38
3	Historical	1	3.13
4	Internet climate updates	1	3.13
TOTAL		32	100.00

8.4. Perceived areas for improvement in irrigation development

75% of the extensionists were of the opinion that effective training for both extensionists and farmers can change the irrigation performance in Lesotho. 63% of the respondents indicate that if farmers are supported financially, sustainable irrigation development could be enhanced.

Table 8.11 Frequency distribution of points to consider in order to improve irrigation in Lesotho.

Areas of improvement	Frequency (n)	Percentage of people (%)
Effective training	24	75.00
Improve on the financial support	20	62.50
Employ more qualified staff	10	31.25
Deploy relevant technology	5	15.63
Evaluate extensionists/engineers often	4	12.50
Promotion of team work	4	12.50
Improve irrigation policy	2	6.25
Improve on marketing channels	2	6.25
Construction of more dams	1	3.13

The goals of agricultural extension include among others transfer of information from the global knowledge base and local research institutes to the farmers, enabling them to clarify their own goals. It also includes educating them on how to make better decisions and stimulating desirable agricultural development. However, for this to become a reality, all resources should be in place for extensionists to perform their duties.

CHAPTER 9

9. CONCLUSIONS AND RECOMMENDATIONS

9.1. INTRODUCTION

The purpose of the study was to determine the current irrigation situation in Lesotho and identify and analyse the factors that determine successful irrigation farming. The hypotheses set for the study were that poor extension support to irrigation farmers' impacts negatively on irrigation development and that participation in the planning and implementation of irrigation development programmes is a pre-requisite for sustainable irrigation development.

9.2. LIVELIHOOD SYSTEMS FOR SMALLHOLDER IRRIGATION IN LESOTHO

The majority (75%) of irrigation farmers are men with primary education. Irrigation farmers showed that households are engaged in a wide range of livelihood activities, both on-farm and off-farm (taxi, business, etc). In addition, they obtained a substantial portion of their household income from the state through pensions and social grants. Agriculture is an important livelihood activity among irrigation plot holders of the four irrigation schemes under review. 58% of the households indicated farming as the main income source. For part time farming households, the productive use of an irrigation plot is a supplementary or complementary livelihood activity.

Some farmers indicate that they use farming to survive, and they had deliberately selected an agrarian livelihood. These farmers are also more market-oriented and indicate that more than 60% of their household income is derived from farming. Almost invariably the market-oriented farmers are also interested in expanding their operations but the prevailing circumstances such as the land tenure system in Lesotho, are not conducive for this to happen. Some of these farmers therefore rent land from fellow irrigation plot holders, but experience problems due to poor contractual agreements and the general honouring of agreements.

From the study it is evident that diversity is also an important feature of the farming systems that were identified. 76% of the respondents indicated that they are practising a mixed farming

system with livestock as a main enterprise apart from irrigation. Three distinctive farming styles were identified namely food producers, profit makers and those that are employed by either the public or private sector. Farmers involved in these different farming styles have different farming objectives and attitudes towards farming and the taking of risks as reflected in their production systems and marketing strategies.

Farmers involved in producing food for their households correspond with the category of subsistence farmers who similarly farm to supply food to their households. Profit makers fit the description of the category of small-scale commercial farmers, who farm for the purpose of selling produce and earning a living from the farming activities. These farmers are in general more market-oriented and farm for a specific market environment (mainly local markets) they are also generally more prepared to take risks such as applying new technology.

The third group of farmers are a different group as these are earning a regular wage through employment with the public or the private sector, running a formal or informal business and/or receiving a huge portion of their household income from the state through social grants and pensions. For these farmers the engagement in off-farm activities is more important that on-farm activities. Many of these farmers have to support their farming enterprises using the income generated from off-farm activities. The implication of this diversity in livelihoods of irrigation landholders on the four irrigation schemes in Lesotho is that the institutional support rendered by research and extension should be aligned to the different needs of farmers.

9.3. CROP PRODUCTION SYSTEMS

9.3.1. Cropping systems

Maize, potatoes, cabbage and beans are the most common crops grown by irrigation farmers in Lesotho. Farmers use recommended varieties although they claim that, the performance of these recommended varieties do not differ from traditional varieties which they have been using before. The role of extension in the use of recommended varieties is minimal. 34% of the farmers perceive climate as the most important factor determining what crop to plant, while 29% of respondents consider potential markets as an important factor in decision-making. The implication is that more attention has to be given to these factors by extensionists. More relevant,

reliable and timely information has to be provided to farmers by extensionists and other relevant role players. Farmers Weekly and Radio Lesotho are two important national sources of information which can be used for up-to-date market performance and weather forecasts.

9.3.2. Cultivation practices

The availability of tractors and animal traction in the four districts suggests different seedbed preparation methods. In Mafeteng, Mohale's Hoek and Quthing farmers primarily use their own tractors and implements for seedbed preparation, while animal traction is generally used in the Maseru district due to the availability of livestock for this purpose. Interesting however is the fact that farms in the Mafeteng, Quthing and Mohale's Hoek districts are relatively small (<15ha).

Most farmers (57%) use organic fertilisers such as kraal manure and compost as opposed to inorganic fertilisers. Basic practices such as conducting soil analysis before applying fertilisers and planting are not implemented by the majority of the farmers (95%). Farmers in general perceive the selection of a specific fertiliser type based on whether it will improve the soil structure (32%) or how easily it could be applied (29%).

9.4. IRRIGATION MANAGEMENT

Irrigation management involves proper use of irrigation systems and water sources to enable good crop performance. The selection of appropriate irrigation scheduling methods and practices is crucial to ensure efficient water use on the farm (Steven, 2006).

9.4.1. Irrigation methods and sources of water

64% of the farmers use rivers as their main source of water while the rest use dams and boreholes. Irrigation water is free of charge with the exception to the fewer farmers located in Maseru district where they irrigate from Mohokahare and Phuthiatsana rivers. 64% of the farmers use sprinkler irrigation because it is perceived to be effective and time-saving compared to other irrigation methods such as furrow and flood. 54% of the farmers use diesel pumps to lift water from water sources while 40% of the farmers use gravity as a means of conveying water to the fields.

9.4.2. Irrigation scheduling practices

40% of the farmers prefer to irrigate once every fortnight or twice a week during the summer production season depending on the stage of the crop growth. During the winter production season farmers prefer to irrigate every fortnight (53%). Farmers use a fixed irrigation calendar where there are no measurements considered at all. Therefore many farmers rely on their experience and intuition as Stevens, (2006) indicates. The implication is that under or over irrigation may be applied since specific crop water requirements and soil water infiltrability is not taken into consideration.

9.4.3. Perceived cost of irrigation

60% of the farmers perceive irrigation as an expensive activity especially those who are using diesel and electricity for pumping. Farmers who perceive irrigation as a cheap activity mainly use gravity to convey water from the sources to their fields. This implies that farmers should be advised to adopt irrigation systems depending on the geographical set-up and location of their farms, to reduce expenses.

Maintenance of irrigation equipment is unavoidable. If no care is taken to maintain irrigation equipment, it can fail completely and become more expensive to erect it afresh. 92% of the respondents maintain their irrigation systems themselves while, the rest rely on government for maintenance of their irrigation facilities. Clearly in this case, most farmers do understand the importance of taking care of their irrigation equipment.

9.5. INFORMATION AND KNOWLEDGE SUPPORT SYSTEM FOR FARMERS

9.5.1. Perceived role of extension support

Extension credibility is highly questionable as 70% of irrigation farmers across all the districts, regard extension as unimportant for irrigation management decisions. Evidence from the respondents with exception from Quthing district, indicates that technical competence of extension staff regarding crop production (selection of crop types, fertiliser management, etc) is inadequate and therefore not perceived as an important source of information for decision-making on the farm.

Also evident is that extensionists do not visit farmers as frequently as expected. In the farmers view, extensionists only visit them during the preparation of national agricultural shows which are held once a year. Findings further indicate that most farmers prefer to get information from fellow farmers with regard to various aspects of farming. These findings should raise a huge concern amongst the extension management of the Ministry of Agriculture, since serious recovery is required in this regard.

9.5.2. Perceived role of extension in the formation of farmer groups

Farmer groups are seen as the simplest way in which information can be disseminated and shared among farmers. 93% of farmers indicate that they do not belong to any farmer groups/association, while 83% of the farmers also indicate that extension staff is not adequately trained to support in this regard and therefore do not encourage them to form farmer groups or associations. These findings indicate the severity of poor communication and networking structures of the farmers at grassroots level. 41% of the extensionists have acquired General Diplomas in Agriculture which alone does not prepare extension staff adequately to fulfil all the roles expected for the specific challenges in extension work.

Further findings illustrate that most extensionists have less than 5 years experience in extension and therefore the necessity for mentorship and in-service training is of utmost importance. Extensionists, except a few who specialised in extension, are mostly trained as subject matter specialists. The implication in the findings is that as much as districts may have good subject matter specialists dissemination of information to the relevant people will remain a problem in the region.

9.6. EFFECTIVENESS OF EXTENSION DELIVERY AS PERCEIVED BY EXTENSION STAFF

9.6.1. Differential perceptions of farmers and extensionists regarding the delivery of extension services

The majority of the farmers are of the opinion that extensionists are not supporting them with decision-making on the farm. Farmers clearly indicate that the technical support from extensionists is not adequate while extensionists believe they are doing well in this regard. Extensionists on the other hand are of the opinion that their general technical knowledge support in crop production is adequate to support farmers in decision-making with the exception of support regarding climatology and irrigation management.

9.6.2. Constraints that impact on effective extension delivery

78% of extension workers indicate that the main problem hindering them from efficient extension delivery is lack of infrastructure and facilities. Vehicles allocated to them to perform field work are sometimes used for other purposes such as transporting directors to attend family matters. Secondly the lack of appropriate in-service training is perceived a major constraint in equipping extension staff with the necessary skills and competencies to serve farmers. These constraints together with other motivational drivers such as dissatisfaction with salaries contribute to the general poor motivational status found amongst the extension staff.

9.6.3. Profile of extension workers

Extension workers are well qualified (certificate, diplomas and degree training). Training of extension workers is mainly general (41%) and in engineering (16%) with the minority of extension (6%) and crops (16%). No in-service training is provided in irrigation management. The majority of extension workers consequently consider themselves not to be competent to provide support for irrigation farming. Effective training of both farmers and extensionists should receive the highest priority to improve irrigation performance. This priority is accentuated with the low percentage of farmers and extensionists recorded, that actually receive training and the related absence of training courses being presented by Colleges or Universities.

9.6.4. Perceived challenges for irrigation management

Extension staff rate the general irrigation performance of farmers as poor with the major constraints perceived as access to financial support (50%) and an inappropriate land tenure system (28%). Also they indicate that irrigation farmers are very much dependent on government or donor subsidies. These constraints, together with the fact that very few farmers (5%) and extensionists (3%) received training in terms of irrigation farming and maintenance of irrigation systems contribute to a situation where many farmers are producing far below the irrigation potential of the respective areas. No specific reasons for this were identified, but in South Africa a study by Stevens and Van Heerden (2007) revealed that tertiary training organizations in general present courses that do not prepare extension staff for the task they have to perform on irrigation schemes and irrigation plots. The study further revealed that training courses offered do not cover the essential areas required for irrigation management. Perhaps the same reasons may also apply for the general poor competency level of extension staff and irrigation farmers in this regard. 75% of extension staff is of the opinion that if these issues can be addressed, irrigation efficiency and water use efficiency will generally improve.

9.7. Main findings of the study

The study clearly identified the critical factors that determine successful irrigation farming in Lesotho. Hypothesis 1 which states that poor extension support to irrigation farmers impacts negatively on irrigation development cannot be rejected due to the substantial proof found in this study that the majority of extensionists consider themselves not to be competent to provide support for irrigation farming. No in-service training is provided for extension workers.

Hypothesis 2 which states that participation by farmers in the planning and implementation of irrigation development programmes is a prerequisite for sustainable irrigation development is also not rejected since 78% of farmers perceived the linkages with researchers and extensionists inadequate and ineffective.

9.8. RECOMMENDATIONS

The following recommendations are proposed regarding the major findings on the possible reasons for poor performance of irrigation farming in Lesotho:

- **Revisiting institutional policy**

It is highly recommended that Agricultural Extension and Research institutions should form very strong linkages in the country in order to help guide farmers to attain their goals and objectives. Greater political and institutional support is recommended to enhance irrigation development in Lesotho. There is a need to design and develop alternative policy instruments and institutions for extension, technical assistance, training and credit service.

- **Land tenure**

It is also recommended that the land tenure system of the country should be reviewed as progressive farmers who tend to expand their farming operations, face challenges related to the land tenure system of the country. Amongst others they indicate that they rent land based on very informal contracts with the landlords.

- **Irrigation management**

Farmers need to understand the basic principles regarding the biological functioning of plants and gain the necessary insight into the complexity of the soil-plant-atmosphere systems and business management skills before entering into a complex irrigation farming system. Knowing the needs of crops, soil types and environmental parameters of an area will enable farmers to deploy relevant irrigation technologies and scheduling.

- **Knowledge support to irrigation farmers**

It is important for the country to develop more agricultural extension institutions with competent staff to address the problems of the farmers. In-service training courses can assist extensionists to be more competent in their service delivery as this was found to be a major constraint to irrigation farmers. Young extensionists should be sent to higher learning institutions to acquire the necessary knowledge and skills of relevant technologies. Extension services are without doubt very important for the country to ensure sustainable food production.

According to the findings, very few farmer associations or groups exist in Lesotho. It is therefore recommended that extensionists should be properly trained on this matter so that farm communities are encouraged to form associations. Further research should be conducted as there

are perhaps other factors which may have a significant influence on the mobilising of the farmers to form farm groups.

- **Financial support**

Mobilising of credit resources from financial institutions such as commercial banks will help small-scale farmers to buy appropriate irrigation equipment, recommended seeds and fertilisers

- **Development of market opportunities and support with market strategy**

It is highly recommended that farmers and extensionists should be trained on how to explore and establish new markets for the farm. This will in turn, add value to farm products and keep customers satisfied with the products produced.

- **Networking with commercial farmers /mentorship**

It is highly recommended that the bond of friendship between South African and Lesotho farmers be encouraged as farmers from Lesotho can learn from South African commercial farmers. Commercial farmers can become involved as mentors to improve small-scale farming in Lesotho. The intervention will not only benefit farmers but also extensionists who appear to be lacking technical knowledge and skills in many aspects of irrigation farming.

- **Breaking of dependency on projects and government support**

From the findings extensionists indicate that irrigation farmers in Lesotho are highly dependent on donors and subsidies from the government. It is therefore recommended that farmers are trained to be independent in decision-making, and to develop their own institutional support systems.

References

ABERA, B. D., 2003. Factors influencing the Adoption of Soil Conservation Practices in the northwest Ethiopia, *Rural Development* University of Gottingen Germany.

ADIGUN, J. A, LAGOTE, S. T. O., & KARIKARI, S. K., 1991. Chemical Weed Control in Irrigated Sweet Pepper (Capsicum annum L.). Trop. *Pest Management*. 37, 155-158.

AGRULTURAL CENSUS, 1996. Maseru Lesotho.

AGRICULTURAL CENSUS, 2000. Maseru Lesotho.

AGRICULTURAL CENSUS MOHALE'S HOEK. 1998/1999.

AGRICULTURAL CENSUS MOHALE'S HOEK. 1995/1997.

AGRICULTURAL EXTENSION REPORT, 2000. Maseru Lesotho.

AGRICULTURAL POLICY AND CAPACITY BUILDING PROJECT, 2001.Maseru Lesotho

ALI, M. H., HOQUE. M. R., HASSAN. A. A., & KHAIR. M.A, 2007. Effects of deficit irrigation on yield, Water Productivity and Economic Returns of Wheat, *Agric. Water Management.* 92, 152-161.

ANTHOLT, C.H. 1994. *Agriculture Extension in Asia*: Modernization for the 21st Century. University of Illinois: Interpaks Digest.

BACKEBERG, G.R.,MEMBRIDGE, T.T.,BENNIE, A.T.P.,GROENEWALD, J.A., HAMMES,P.S.,PULLEN, R.A. AND THOMSON,H., 1996.Policy proposal for irrigated agriculture in South Africa. WRC Report KV 96/96.

BEBBINGTON, A., THIELE, G., DAVIES, P., PRAGER, M., & RIVEROS, H., 1993. Non Governmental Organisations and the State in Latin America: *Rethinking Role of Sustainable Agriculture Development*. Routledge, New York and London.

BENETT, G, F. 1999. Analysing the impact of Extension Programmes Washington D.C World Bank.

BENOR, D & JAMES, H., 1977. Agricultural Extension: *The Training and Visit System* Washington DC World Bank.

BENOR,D & HARRISON.J .Q., 1977. Agricultural Extension: The training and Visit System, Washington. DC. The world book.

BENOR, D. & M. BAXTOR., 1984. Agricultural Extension. The Training and Visit System. Washington, DC: The World Bank.

BLACK, A. W., 2000. Extension Theory and Practice: A review. *Aust. J . Express. Agric*.

BRAUN, A.R., THIELE,R.G.,& FERNADEZ, M., 2000. Farmers Field Schools and Local Agricultural Research Committees. Complementary Platforms for Integrating Decision-making in Sustainable Agriculture. *Agric Network Paper* No 105,77-80

BUREAU OF STATISTICS, 1998-2000. Maseru. Lesotho.

BUREAU OF STATISTICS,1994. Maseru Lesotho.

BUREAU OF STATISTICS,1996. Maseru Lesotho.

CAI, X & ROSEGRANT, M.W., 2003. *World Water Productivity*: Current situation and Future Options. In Kijne, j. w., Barker, R & Molden. D, Editors, Water Productivity in Agriculture: Limits and Opportunities for Improvement, *International Water Management*. Colombo, Sri Lanka, 2003.

CAVIGLIA, J. & KAHN, J., 2001. Diffusion of sustainable agriculture in the Brazilian tropical rain forest: *A discrete choice analysis*. *Econ Dev Cult Change* 49, 311-334.

CENTRAL BANK OF LESOTHO'S ANNUAL REPORT, 1999. Maseru Lesotho.

CHIGERWI, J., MANJENGWA, N., VAN DER ZOAG,P., ZHAKATA, W., & ROCKSTRON,. J., 2004. Low land drip Irrigation kits and treadle pumps for Smallholder Farmers.

CLOVER, D. J., 1983. Contract farming and Trans nationals Unpublished thesis, Department of Political Economy, University of Toronto.

COLLIVER, R., 2001. Building networks. Report for the working the networks' project. Department of Agriculture, Western Australia, Perth Australia.

COX, P., COTTRELL, A., & TIMMS, J., 1996. Strategies for achieving adoption of new technology or alternative management practice. Down stream effects of land use Department of natural resources Queensland, Australia.

DAILY, G., 1997. Nature's services-human dependence on natural ecosystems. Island Press, Washington DC, USA.

DAMIANOS, D.& GIANNAKOPOUS, N., 2002. Farmers' Participation in Agri-environmental Schemes in Greece. *British Food Journal*. 104, 261-274.

DEPARTMENT OF AGRICULTURAL PLANNING MASERU, 2005/2006

DE SHERBININ, A., & DOMPKA,A., 1996.Water and Population Dynamics: Case Study and Policy Implications. *American Association for the Advancement of Science* 1200 New York Avenue, NY Washington DC.

DICK, B. 2002. Action Research: action and research, accessed on Feb. 3 2007 From *http//www.scu. edu.au/school/gcm/ar/arp aandr.html.*

DIXON, J., GULLIVER, A. & GIBBIN, D., 2001. Farming systems and poverty: Improving farmers' livelihoods in a changing World, FAO, Rome, Italy and World Bank, Washington, D.C.U.S.A.

DUNIWAY, J. M., 1983. Role of physical factors in development of Phytophthora fungal diseases. *American phytopathological society*, St Paul

DUSSELDORP, G. & ZIJDERVELD. C,. 1991. Participation in research and the race to save the Planet: Questions, critique, and lessons from the field. *Agriculture and Human Values, Spring-Summer 1994.*

DÜVEL,G.H.,1970. The mediating function of perception in innovation decision making. South African institute for agricultural extension university of Pretoria

DÜVEL G. H,. 1991.Towards a model for the promotion of complex innovations through programmes extension.*South African journal of extension* university of Pretoria.

DÜVEL, G. H., 1999. Extension Evaluation, Study Guide AGV 728, University of Pretoria Department of Economics Extension and Rural Development.

ENHRLICH, R. P., WOLFF.G,DAILY, C. G., HUGHES, B. J, DAILY S, DALTON, & LAWRENCE GOULDER.1999. *Knowledge and Environment. Ecological economics 30, 267 284.*

EXTENSION REPORT, 2000. Maseru Lesotho.

EXTENSION REPORT,2004.Maseru Lesotho.

FAO, 2000. Research, Extension and Training Division., Rome Italy

FAO,2008. Research Extension and Training Division.

FAO, 2000. Agriculture towards 2015/ 2030. *Technical Interim Report. Global Perspectives* Units, FAO, Rome, Italy.

FAO, 2007. Mediating poverty in Africa.

FAO, 2002, 2005 and 2006 . Report, Lesotho.

FAO OF THE UNITED NATIONS,1986.Irrigation in Africa South of Sahara.

FARRINTON, J. & MARTIN, A., 1988. Farm Participatory in Agricultural Research Review Concepts and Practices Agric Administration Unit, Occasional Paper No 9 London Overseas Development institute.

FALKENMARK, M.1989. Fresh water for modified approach, *Ambio* 4, 192-200.

FISCHER, A.J., ARNOLD, A. J & GIBBS,. 1996 . Information and the speed of innovation adoption Am. J. *Agric. Econ*. 78,1073-1081.

FLORE, R., 2001. Emerging and remerging issues in developing countries.

FOOD AND AGRICULTURAL ORGANISATION REPORT. 2004.Maseru Lesotho.

FOOD AND AGRICULTURAL ORGANISATION REPORT. 2007. Maseru Lesotho.

FOOD AND AGRICULTURAL ORGANISATION, 2002. Agriculture Towards 2015/30. Technical Interim Report, FAO, Rome.

FORD DEEP, J. R., 1987. A model for small farmer development in the Caribbean. Common wealth Secretariat, Marlborough House, Pall Mall, London.

FRANK, B., 2010. When the Well is Dry, We Learn the Worth of Water. *The Sustainable Water Resource Hand book South Africa* Volume 1: The essential Guide.

FUJISAKA, S., 1989.The need to build upon farmers practice and knowledge: Reminders from Selected Upland Conservation Projects and Policies. *Agro-forestry, System* 9,141-153.

GLADWIN, C. H., PETERSON, J. S. & MWALE, A. C,. 2002. The quality of Science in Participatory Research: A case study from eastern Zambia. World Development (UK).

GOLDSMITH, A. 1985. The private sector and Rural Development: *Can Agribusiness help Small farmers*? World Development.

GOVERNMENT OF LESOTHO, 2005. Strategies for poverty reduction.

GOVERNMENT OF LESOTHO, Annual Report, 2007.Maseru Lesotho.

GOVERVENMENT OF LESOTHO, 1978. Environmental and water policy.

GOVERNMENT OF LESOTHO,1997.DEPARTMENT OF ENVIRONMENT.

HAGMAN,J., CHUMA, E., MURWIRA, K., & CONOLLY, M. 1999. Putting Process in to Practice: Operationalising Participatory Extension. *Network-Paper-Agricultural Research and Extension Network.*

HARRIS, A., 1983. Organisational effectiveness and improvement in education. Buckingham: Open University Press.

HILL, B. & INGERSENT, K. A., 1982. An economic analysis of agriculture. London: Heinemann Education.

HOFFMAN, G. J, HOWELL, T.A & SOLOMON, K. H, 1992. Management of Farm Irrigation Systems, *American Society of Agricultural Engineeners*.2950 Niles Road St Joseph.

HOWELL, T, 2001. Enhancing Water use efficiency in Irrigated agriculture.

INTERNATIONAL FUND AGRICULTURE DEVELOPMENT REPORT (IFAD), 1997.

INTERNATIONAL FUND AGRICULTURAL DEVELOPMENT REPORT, 2007.

KARAMI, E , & REZAI-MOGHADDAM, K., 2002. The use of Sprinkler irrigation system: *Problems and Obstacles. Q. J. Agric. Development*. 37, 221-245.

KELLY, A., 1995. A mud map for land carers: The technique of participatory research. Australian Academic Press.

KHUSH, G.S., 1999. Green Revolution genes encoded mutant Gibberellin response. Agricultural biotechnology international. Wallingford UK. Cab international.

KIRDA. C & KANBER, R. 1999. Water no longer plentiful resource should be used sparingly in irrigated Agriculture. In Kirda, C., P, Moutonnet,. ,Kluwer Academic publisher Dordrecht.

LACEWELL, R. D,. CONDRA, G. D., HARDEN, D. C., ZAVALETA, L. & PETTY,. J.A,. 1978. The impact of energy shortages and cost of irrigation for the plains and Trans Pecos regions of Texas. Texas Water Institute, Texas A & M University, Collage Station, TX.

LESOTHO METEOROLOGY SERVICES, 2000. Climatic conditions in the mountain Kingdom of Maseru.

LESOTHO AGRICULTURAL CENSUS, 1999/2000.

LESOTHO AGRICULTURAL REPORT, 1996.

LIEU, Z . M., SHAN. L., DENG. X. P., INANAGA. S., SUNOHARA. W., & HARADE. J. 1998. Effects of fertiliser and plant density on the yields of root system and water use spring wheat, *Res. Soil Water Conservation*. 85, 70-75.

MARTINEZ, J. M., BONUS J., QUINONES, A., MARTINEZ, B., PRIMO- MILLO, E. & LEGAZ, F., 2002. Fate and Transformation of 15 November labelled Nitrogen applied in spring to citrus trees. *J. Hort. Science Biotechnology*.

MCINTOSH, R. J ., TAITER, J. A. & MCLNTOSH, S .K., 2000. The way the wind blows: Climate ,history, and human action. Colombia University Press, New York.

MCNIFF, 2002. Action Research For professional development. Accessed on line Feb 2, 2007 at *http: www. Jeanm Quigley.B.2000.* The practitioner-research. a research revolution in literacy. adult learning 11 (3)6-8

MEHTA, L. & SRINIVASAN, B., 2001. Balancing pains and gains. Prospective paper on gender and large dams.

METEOROLOGY LESOTHO 2006. Maseru Lesotho.

METOROLOGY LESOTHO, 1995-1996. Maseru Lesotho.

METTRICK, L., 1997. Development oriented research in agriculture: An ICRA Textbook. Wageningen: institute centre for development oriented research in agriculture.

MINISTRY OF AGRICULTURE COOPERATIVES AND LAND RECLAMATION. 1996. Maseru Lesotho.

MINISTRY OF AGRICULTURE COOPERATIVES AND LAND RECLAMATION. 2002, 20007.

MINISTRY OF AGRICULTURE REPORT. 2002. Maseru Lesotho.

MINISTRY OF ENVIRONMENT IN SPAIN Report .1998.

MOHALE'SHOEK DISTRICT ECONOMIC STRATEGY. 2002/2007, Maseru Lesotho.

MOKONE, G. & STEYN G.J., 2005. An evaluation of extension service in Lesotho. (Master Dissertation). University of Pretoria.

ODEH, I . O. A., TODD, A.J., TRIANTIFILIS, J.,& MCBRATNEY, A.B., 1998. Status and trends of soil salinity at different scales: the case for irrigation cotton growing region of eastern Australia. *Nutrient Cycling in Agro-ecosystem 50, 99-107*

PADRE, S., SUDARSHANA, & TRIPP, R. 2003.Reforming farm journalism: The experience of Adike Pathrike in India. *Network Paper-Agriculture Research and Extension* (ODI) (UK) NO 128, 307-309.

PALA, M., & STUDER. C.,1999. Cropping system management for improved water use efficiency in dry-land Agriculture. In: Paper presented at the international Conference on Water Resources Conservation and Management in Dry areas.

PANIN, A., & ELLIS, A., 1992, Increasing the profitability of draft animal power. Department of Agricultural Economics and Extension, Botswana College of Agriculture.

PARR, J. F., STEWART, B.A.,HORNICK,S.B.& SINGH,R.P.,1990. Improving the sustainability of dry land Farming Systems: a global perspective. In: Singh, R. P., Parr, J.F., Stewart, B. A., (ed): Dry land Agriculture Strategies for Sustainability. Advances in Soil Science. 13, 153-157, New York, USA.

PATANOTHAI, A., 1997. Systems Approaches to Farm Management in variable environments. In: Teng. P. S., Kroff, M. J., Ten Berge, H. F. M., Dent, J.B., Lansigan, F.P., and Van Laar, H. (Editor). Applications of Systems Approaches at the Farm and Regional Levels. Kluwer Academic Publisher.

PERRET, S., FAROLFI. S & HASSAN. R. 2006. Water governance for sustainable development. Earthscan London. Sterling, VA.

PEREIRA, A. R., 1982. Crop planning for different environment Agricultural Meteorology 27, 71-77.

PETER, S., & GLEICK. J. 1993.Guide to the world's fresh water resource. Pacific Institute for Studies in Development, Environment and Security Stockholm environment institute. Oxford University Press New York.

PHYSICAL PLANNING DEPARTMENT,MOHALE'S HOEK, 1997.

PORTELA, H., 1990. Review of the factors related to innovations. Mimeo Bull. A. E Department of Agricultural Economics and Rural Sociology.

POSTEL, S., 2001. Growing more food with less water. *Scientific American*. 284, 46-51.

QHOBELA M., 2005. Training of agriculture in secondary schools in Maseru Lesotho, (Masters Dissertation). University of Pretoria

QUILEY,D., SANCHEZ,V., HANDY,D., & GOBLE,R. 2000.Participatory research strategies.

RAMJI, P., NEUPANE, K. R., & SHARMA, G.B.T., 2002. Adoption of Agro-forestry in the hills of Nepal. *Logistic regression analysis*. 72, 177-196.

RHODES, R. E., 1997. Pathways towards a Sustainable Mountain Agriculture for the 21 Century: The Hindu Kush-Himalaya Experience. International Centre for Intergraded Mountain Development, Kathmandu Nepal.

ROCKSTROM, J., BARRON, J. & FOX, P., 2003. Water productivity in rain fed agriculture: Challenges and Opportunities for Smallholder farmers in drought-prone tropical Agro-ecosystems. In: Kijine, W. J., Barker, R., Molden, D (ed), Water Productivity in Agriculture: Limits and Opportunities for Improvement, Comprehensive Assessment of Water Management in agriculture, 1, 103-107. CABI Publishing Wallingford, UK.

ROGER, E. M., 1972. Communication of Innovation, Free Press. New York.

SAMAKANDE, A. & MANZUNQU, E., 2004.Sustainable water management in smallholder irrigation schemes: understanding the impact of the field water management.

SCARBOROUGH, V., KILLOUGH, S., JOHNSON, D. & FARRINGTON, J. 1997. Farm led Extension : Concepts and Practices. London Intermediate Technology Publications.

SCHUH, G. E. 1989. Extension Support Activities and Technology Utilization for Poor Small Farmers. In Technology Systems for Small Farmers (A.M. Kesseba, ed). Boulder: Westview Press.

SECHABA CONSULTANT REPORT. 1994. Maseru Lesotho.

SHAH, T., VAN KOPPEN, B., MERRY, D., DE LANGE, M.& SAMAD, M. 2001.Institutional alternative in African Smallholder Irrigation: Lessons from international experience in Irrigation Management.

SIDIBE, M. 2005. Farm- level Adoption of soil and Water Conservation techniques in the northern Burkina Faso, *Agric, Water management*.71, 211-224.

SMITH , M.,2000. The application of climatic data for planning and management of sustainable rain fed and irrigated crop Production.
STERN, P. 1979. Small Scale Irrigation Intermediate Technology. Publications Ltd/International Irrigation Information Centre.

STEVENS, J. B., 2007, Group Dynamics Study guide AVG 712. University of Pretoria Department of Economics Extension and Rural Development.

STEVENS, J. B., & TERBLANCHE, S.E. 2004. Sustainable agriculture through effective farmer groups. *South African society for Agricultural Extension.*

STEVENS, J. B., 2006. Adoption of irrigation scheduling in South Africa. PhD thesis.

STEVENS, J. B.,2005.The range, distribution and implementation of models and methods in South Africa.WRC Report No 1137/1/05.

STEVENS, J. B & VAN HEERDEN, P.S., 2007. A conceptual framework of a possible curriculum for training of extensionists and advisors in irrigation management.WRC, No, KV 178/07

SWANSON B, E., 1997. Global review of good agricultural extension and advisory service practices

TASSEW. W., 2004. The role of Schooling in the alleviation of rural poverty in Ethiopia. *Proceeding of 25 international Conference of Agricultural Economists*.

TERBLANCHE, S. E., 2004. A strategy for successful extension and development: A step by step guideline to a simple but scientific procedure to evaluate extension programmes and/ or projects. *South African society for Agricultural Extension.*

TERBLANCHE, S.E., 2007.Lecture notes, University of Pretoria.

THOMAS, D., HOOK, S. E., HOOGENBOOM, G., HARRISON, K.A., & STOOKSBURY, D. 2000. Drought Management Impacts on Irrigation in Southwest Georgia ASAE Paper 00-2015. *American Society of Agricultural Engineers*, St. Joseph, Michigan.

THOMAS, J. A. & STILWELL,G., 1984. Community Participation and Sustainable Development.(WRC Report) Water Research Commission Box 824 Pretoria, South Africa Sugar Association Box 607 Durban 4000.

UNITED NATION DEVELOPMENT PROGRAMME, 1993. Review and Analysis of Land Tenure in Lesotho with Recommendations for Reform.

UNITED NATIONS REPORT, 1980. Maseru Lesotho.

UNITED NATIONS DEVELOPMENT PROGRAMME.1994. Maseru Lesotho.

UNITED NATIONS STATISTICS REPORT, 2004.

VAN ASSELDONK, M. A .P . M.,HUIRNE, R. B. M., DIJKHUINZEN,A. A., BUELEN, A. J. M.,& UDENK TEN CATE, A. J., 1999. Information needs and information technology on dairy farms. *Computer and electronics in agriculture* 22, 97-107.

VAN DER LEEUW, S. E., 2000. Land degradation as a socio natural process. In: McIntosh, J., Tainter, .A. & Mclntosh, S.K. (ed) The way the wind blows: the wind blows: Climate, History and Human Action. Columbia University Press, New York.

VAUGHN, E. H, ORSEN, W. I, & GLEN, E.S. 1980. Irrigation Principles and Practices. John Willey and Sons New York.

VERELA-ORTEGA, C., SUMPSI, D. M., GARRIDO, A., BLANCO, M., & IGLESIAAS, E., 1995.Water Pricing Policies, Public decision-making and farmers response. Implications for water Policy .*Agric Econ 19,139-202.*

WATER AFFAIRS AND RIGHTS., 2005/6. Maseru Lesotho.

WICKHAM, T. H., & TAKASE, K.1976. Some management issues in irrigation development. Paper presented at the CPDS-UPLB-NWRC-NIA Workshop on water resources. November, Los Banos, Laguna, the Philippines.

WILLIAMS, R., & DÜVEL G. H. 2005. The role of opinion leadership among maize farmers in Lesotho,dissertation.

WILSON, G. A., 1997. Factors influencing Farmers Participation in the environmentally sensitive Areas Schemes. *Journal of Environmental Management.*

WORLD BANK DEVELOPMENT REPORT 2000/2001. Attaining Poverty Oxford University Press New York.

WORLD BANK., 2002. Report. From action to impact: The African Region's Rural Strategy. Rural Development Strategy. World Bank, Washington.

WORLD BANK, 2006. Directions in Development, Re-engaging in Agricultural Water Management: Challenges and Options. Washington, DC.U.S.A

WORLD METEOROLOGY ORGANISATION. 2007. Statement on water and sustainable Development Accessed on htt://www.wmo.ch.

Appendix 1

Farmers questionnaire

FARMERS QUESTIONNAIRE			
Section A:	**PERSONAL INFORMATION**	**for office**	
1.	Name of the respondent……	V1	
	Irrigation district……..	V1.1	
2.	Gender of the respondent. Male (1) Female (2)	V 2	
3.	Age of the respondent. ……	V 3	
4.	The highest qualification obtained. < std 7 (1)	V4	
	Std 7-8 (2)		
	Form C (3)		
	Form E (4)		
	Certificate (5)		
	Diploma (6)		
	Degree (7)		
5.	a. What is the size of your household?.....	V5a	
	b. COMPOSITION OF THE HOUSE HOLD.	V5b	
	No of Adults |		
	No of children (<16years) |	V5c	
6.	a. What are the main sources of house hold income? Government work. (1).	V6a.1	
	Taxi business (2)	V6a.2	
	Farming (3)	V6a.3	
	Social grants (4)	V6a.4	
	Others specify (5)	V6a.5	
	b. What percentage of house hold income is derived from farming?.....	V6b	
	c. Are you a full time farmer? Yes (1) No (2)	V6c	
	d. Motivate your reasons for farming?		
	Profit making (1)	V6d	
	Food production (2)		
	Both (3)		
7	a. How many people work on your farm?.....	V7a	
	b. Are the people who work on your farm mainly members from the family or employees from outside?		
	Members of the family (1).	V7b.	
	Outside the family (2)		
	Both (3)		

Section B:	**FARM ACTIVITIES**		
8	a. What is the size of your farm? (ha)	V8a	
	b. What is the size of your arable land? (ha)……	V8b	
	c. Indicate the size of the irrigable land (ha).....	V8c	

9.	a. Estimate the distance between the farm and the dwellings …….m/km				V9a	
	d. Rate your satisfaction with the distance between dwelling and farm on the following scale					
	1	2	3		V9b	
	Very dissatisfied	Fair	Very satisfied			
10	a. Do you keep livestock on the farm? Yes (1) No (2)				V10a	
	b. Do you make use of communal grazing rights? Yes (1) No (2)				V10b	
	c. Are you satisfied with the derived income from livestock? Yes (1) No (2)				V10c	
	d. Rate your knowledge on livestock farming on the following scale?					
	1	2	3		V10d	
	Very poor	Fair	Excellent			
11.	a. Which crops do you usually grow during summer?					
	Crop type	Area	Average yield (bag)/t/ha			
					V11a.1	
					V11a.2	
					V11a.3	
					V11a.4	
					V11a.5	
					V11a.6	
					V11a.7	
					V11a.8	
					V11a.9	
	b. Rate your satisfaction with the summer crop production efficiency.					
	1	2	3		V11b	
	Not satisfied	Moderate	Very satisfied			
12.	a. Which crops do you usually grow during winter?					
	Crop type	Area	Average yield (bag)/ t/ha			
					V12a.1	
					V12a.2	
					V12a.3	
					V12a	
					V12a	
					V12a	
					V12a	
					V12a	
					V12a	

	b. Rate your satisfaction with the winter crop production efficiency.					
	1	2	3		V12b	
	Not satisfied	Moderate	Very satisfied			

Section C.	**SELECTION OF THE CROPS.**					
13.	a. What factors do you take into consideration with the selection of crops to be planted? Market (1)				V13a.1	
	Climatic conditions (2)				V13a.2	
	Seed viability (3)				V13a.3	
	Soil type (4)				V13a.4	
	b. Do you use crop varieties recommended by the extension officer? Yes (1). No (2)				V13b	
	c. If Not what are the situational constraints that prevent you from using recommended varieties? They are expensive (1)				V13c.1	
	satisfied with own varieties (2)				V13c.2	
	lack of knowledge on the recommended ones (3)				V13c.3	
	d. How would you rate the production efficiency of the recommended varieties in comparison to the traditional varieties you plant?					
	1	2	3		V13d	
	Substantially worse than traditional varieties	Same as traditional varieties	Substantially better than traditional varieties			
14.	a. Do you practice crop rotation on the farm? Yes (1) No (2)				V14a	
	b. If Yes what two advantages do you experience from this practice? …… ……				V14b.1	
	…… …….. …….. c. What are the main problems you experience with this practising of crop rotation? …… ……				V14b.2 V14c.1	
	…….. d. Rate the importance of the extension support on crop selection for crop production?				V14c.2	
	1	2	3		V14d	
	Not important	Fairly important	Very important			
Section D.	**SOIL PREPARATION**.					
15	a. How do you usually prepare the seedbed for planting? Use of own tractor (1).				V15a.1	
	Hire a tractor (contractors) (2)				V15a.2	
	Use of animal power draught (3)				V15a.3	
	b. If you make use of contractors, indicate your satisfaction with the service rendered					
	1	2	3		V15b	
	Very dissatisfied	Moderate	Very satisfied			

16.	a. Do you make use of soil analysis before you fertilise a seedbed? Yes (1) No (2)					V16a	
	b. Who usually help you with the interpretation of the soil analysis? Yourself (1)					V16b.1	
	Fellow farmers (2)					V16b.2	
	Extension officers (3)					V16b.3	
	Representative from fertiliser companies (4)					V16b.4	
17.	a. Do you apply fertilizers on your field? Yes (1). No (2)					V17a	
	b. If Yes what fertilizers do you apply?						
	Organic fertilizers (1).					V17b	
	Inorganic fertilizer (2).						
	Both (3)						
	c. Why do you use this specific type of fertiliser? Rich in nutrients (1)					V17c.1	
	Easy to apply (2)					V17c.2	
	Improves soil structure (3)					V17c.3	
	Cheap (4)					V17c.4	
	All of the above (5)					V17c.5	
	d. What type of organic fertiliser do you usually use? Kraal manure (1)					V17d.1	
	Poultry (2)					V17d.2	
	Sheep (3)					V17d.3	
	Compost (4)					V17d.4	
	All of the above (5)					V17d.5	
	e. If you use inorganic fertiliser, who help you with the recommendations on the specific type of fertilisers to use?						
	Fellow farmers (1)					V17e.1	
	Private companies (2)					V17e.2	
	Extensionists (3)					V17e.3	
	Cooperatives (4).					V17e.4	
18.	a. Rate your satisfaction with the current fertilisation management on the farm						
	1	2	3	4	5	V18a	
	Very dissatisfied		Moderate		Very satisfied		
19	a. Rate your satisfaction with the support received from the extensionists in regard to fertiliser application.						
	1	2	3	4	5	V19a	
	Very dissatisfied		Moderate		Very satisfied		
Section E.	**CROP MANAGEMENT**						
20.	a. When do you mainly experience problems with weeds during the summer crop production?						
	Pre planting (1). Post planting (2)						
	b. When do you mainly experience problems with weeds on the farm during the winter crop production?						
	Pre plant (1). Post planting (2)					V20b	

	c. Which weed control method do you apply? Mowing(1).					V20c.1	
	Hoeing/ hand weeding (2)					V20c.2	
	Biological control (3)					V20c.3	
	Chemical application (4)					V20c.4	
	Burning (5)					V20c.5	
	d. If you use chemicals who usually help you with the selection and calibration of such chemicals (herbicides)? Extension officer (1)					V20d.1	
	Fellow farmers (2)					V20d.2	
	Private companies (3)					V20d.3	
	Cooperative (4)					V20d.4	
	Own experience (5)					V20d.5	
21	a. When do you mainly experience problems with diseases and pests during the summer production season?						
	1	2	3			V21a	
	Beginning of the season	Middle of the season	End of the season				
	b. When do you experience problems with diseases and pests during the winter production season?						
	1	2	3			V21b	
	Beginning of the season	Middle of the season	End of the season				
Section F:	**IRRIGATION MANAGEMENT**						
22	a. Which irrigation method do you use on the farm? Sprinkler (1)					V22a.1	
	Drip/Micro (2)					V22a.2	
	Furrow (3)					V22a.3	
	Flood (4)					V22a.4	
	Other (5)					V22a.5	
	b. Why did you choose this specific irrigation method?						
	(1)					V22b	
	(2)					V22b	
	(3)					V22b	
	(4) …… …… …… Rate your satisfaction with the specific irrigation method used on the farm. c.					V22b V22b	
	1	2	3	4	5	V22c	
	Very dissatisfied		Moderate		Very satisfied		
	d. Indicate the main source of water for your irrigation?					V22d	
	Dam (1).						
	River (2).						
	Bore hole (3)						
	e. How do you convey water from the source to the field?						
	Gravity (1)					V22e.1	
	Water Pump (diesel) (2)					V22e.2	
	Electric Pump (3)					V22e.3	
	Others explain (4)					V22e.4	

	f. Is the cost of pumping irrigation water from the source to the field expensive? Yes (1) No (2)		V22f	
	g. Do you receive a specific water allocation per annum? Yes (1) No (2)		V22g	
	h. Do you pay for the irrigation water used on the farm? Yes (1) No (2)		V22h	
23	How often do you irrigate your crops?			
	a. During summer time……(1)			
	Once a week	1	V23a.	
	Twice a week	2		
	Once every fortnight	3		
	Others, specify	4		
	b. During winter time……(2)			
	Once a week	1	V23b.	
	Twice a week	2		
	Once every fortnight	3		
	Others, specify	4		
24	a. Who mainly help you with irrigation management decisions on the farm?			
	Fellow farmers (1).		V24a.1	
	Extension officer (2).		V24a.2	
	Private company (3).		V24a.3	
	Own experience and knowledge (4)		V24a.4	
	b. Rate your efficiency in practising irrigation on the farm			

1	2	3	4	5		
Very dissatisfied		Moderate		Very satisfied	V24b	

	c. Have you attended any training on irrigation management? Yes (1) No (2)		V24c	
	d. Who is responsible for the maintenance of the irrigation supply system on the farm? The farmer (1)		V24d	
	farmers associations (2)			
	government (3)			
	e. Rate your satisfaction with the extension support received regarding irrigation management on the farm?			

1	2	3	4	5		
Very dissatisfied		Fair		Very satisfied		

25	List the major problems which you experience in this regard ……		V25a.1	
	……		V25a.2	
	……		V25a.3	
	……		V25a.4	
Section G	**IRRIGATION ECONOMICS**			
26	a. Do you keep financial and production records on the farm? Yes (1) No (2)		V26a	
27	a. How expensive is irrigation on the farm?		V27a	

1	2	3	4	5		
Very cheap	Cheap	Moderate	Expensive	Very expensive		

28	a. Do you receive any financial assistance as an irrigation farmer? Yes (1) No (2)					V28a	
	b. If yes who provides you with such assistance ?					V28b	
	Government (1)						
	Private sector (2)						
	Others (3)						
	c. Where do you usually apply for the loan?						
	Commercial banks (1)					V28c.1	
	Burial societies (2)					V28c.2	
	Co-operatives (3)					V28c.3	
	Government (4)					V28c.4	
	Others (5)					V28c.5	
29	Are you satisfied with the financial assistance which you receive? Yes (1) No (2)					V29a	
Section H	**MARKETING**						
30	a. Are you happy with the current marketing opportunities? Yes (1) No (2)					V30a	
	b. Where do you usually market your produce?						
	From local communities (1)					V30a.1	
	From other districts (2)					V30a.2	
	Supermarkets (3)					V30a.3	
	Fresh markets (4)					V30a.4	
	Hawkers (5)					V30a.5	
	c. Do you enter into any contracts with potential supply stores and buyers? Yes (1) No (2)					V30c	
	d. Do you ever hold any formal discussion with the traders and wholesalers?						
	Yes (1) No (2)					V30d	
	e. If yes who coordinates the meeting?						
	Fellow farmers (1)					V30e	
	Extensionists (2)						
	Farmers marketing board (3)						
	i. Who usually support you with regard to marketing information in the area?						
	Fellow farmers (1)					V30f.1	
	Trader (2)					V30f.2	
	Extensionists (3)					V30f.3	
	Marketing agents (4)					V30f.4	
	j. How reliable is this information?						
	1	2	3			V30g	
	Very unreliable	Moderate	Very reliable				
Section I	**ACRO-CLIMATE.**						
31	a. Do you have the rain gauge on the farm? Yes (1) No (2)					V31a	
	b. Do you keep the records of the rain fall on the farm? Yes (1) No (2)					V31b	
	c. Rate the support you receive from the local extension officer on the interpretation of the weather data?						
	1	2	3			V31c	
	Very poor	Moderate	Very good				
Section J	**EXTENSION SUPPORT**.						
32	a. How often do you meet with your extension officer?						
	Once a fortnight (1)					V32a	
	Once a month (2)						
	Twice (3)						
	Once a year (4)						
	On ad ho (5)						

	b. Do you belong to any farmers association? Yes (1) No (2)					V32b	
	c. Name such an association…….					V32c	
	d. What problems do you generally experience in your farmers groups?						
	……..					V32d.1	
	……..					V32d	
	……..					V32d	
	……..					V32d	
	d. How effective is the local extension officer in solving these problems?						
	1	2	3			V32e	
	Very poor	Moderate	Very effective				
33	a. Rate the knowledge of your extension officer with regard to forming of farmers groups?						
	1	2	3			V33a	
	Very poor	Moderate	Very good				
34	a. Rate the knowledge of your extension officer with regard to conflicts management						
	1	2	3			V34a	
	Very poor	Moderate	Very good				
	Thank you.						

Appendix 2

EXTENSIONISTS QUESTIONNARE

PERSONAL INFORMATION

			For office
1	Name of the extensionist……..	V1	
	Contact number……		
2	In which district are you working? Maseru (1).	V2	
	Mafeteng (2).		
	Mohale's Hoek (3).		
	Quthing (4).		
3	How old are you? …….	V 3	
4	Gender of the respondent. Male (1) female (2)	V4	
5	The highest qualification obtained:	V 5	
	Std 7 (1)		
	Std 7- 8 (2)		
	Form C (3)		
	Form E (4)		
	Certificate (5)		
	Diploma (6)		
	BSc (7)		
	Honours (8)		
	M Sc (9)		
	PhD (10)		
	None of the above (11)		
6	What is your field of specialization? Animal science (1)	V6	
	Crop science (2)		
	Agric extension (3)		
	Soil science (4)		
	Irrigation engineering (5)		
	Agric economics (6)		
	Agric general (7)		
7	What is your position in your field of specialization? District agricultural officer (1)	V7	
	District extension officer (2)		
	Extension assistant officer (3)		
	Livestock production officer (4)		
	Irrigation officer (5)		
	Crop production officer (6)		
	Supervisor (7)		
8	a. Indicate your experience as an extension worker?.....years.	V8a	
	b. What percentage of your time do you spend serving irrigation farmers?	V8b	

9	Please indicate your level of satisfaction with your extension delivery.					
	1	2	3		V9.	
	Not satisfied	Moderate	Satisfied			
10	Please indicate in order of importance constraints that prevent you from doing your extension work more effectively. ……. ……..				V10.1	
	…… …… ……				V10.2	
	…….. …….. ……..				V10.3	
	……				V10.4	
11	**EVALUATION OF WORK** a. Do you evaluate the impact of the service delivering to the farmers? Yes (1). No (2)				V11a	
	b. How often do you evaluate your work?					
	Monthly (1)				V11b	
	Quarterly (2)					
	After every six months (3)					
	Annually (4)					
	c. Do you benefit from this evaluation and monitoring exercise? Yes (1) No (2)				V11c	
	d. If Yes name the main advantage you gain from this exercise …….. …… ……				V11d	
12	Indicate the level of satisfaction of your clients (farmers) with regard to your work.				V12	
	1	2	3			
	Not satisfied	Moderate	Satisfied			
13	How efficient is your extension delivery according to your own opinion?				V13	
	1	2	3			
	Not efficient	Moderate	Efficient			
CURRENT TRAINING OF EXTENSIONISTS						
14	a. Have you received any formal training related to irrigation management? Yes (1). No (2)				V14a	
	b. If yes, please indicate the type of training in the following table					
	Introductory course to irrigation management 1				V14b.1	
	Advance course in irrigation management 2				V14b.2	
	Irrigation planning and designing 3				V14b.3	
	Maintenance of irrigation system 4				V14b.4	
	Evaluation of irrigation system 5				V14b.5	
15	a. Who offered the irrigation short courses? Companies selling irrigation materials (1)				V15a.1	
	Ministry of agriculture (2)				V15a.2	
	Agricultural institutions (3)				V15a.3	
	Donors (4)				V15a.4	

	b. Is the course material based on local needs or from outside? Local (1) Outside (2)						V15b	
16	Do you have enough training facilities such as buildings, chairs and computers for your training? Yes (1). No (2)						V16	
17	How applicable (relevant) was the information gained from the training for your working situation?							
	1	2	3				V17	
	Not relevant	Moderate	Relevant					
18	Do you regard regular training as an important tool for improve your working performance? Yes (1). No (2)						V18	
IRRIGATION MANAGEMENT								
19	a. Rate your knowledge in regard to				Poor 1	Fair .2	Good .3	
	Irrigation of the crops							V19.1
	Selection of appropriate irrigation system.							V19.2
	The competence you have in planning of the irrigation scheduling for crop production							V19.3
	b. Rate the knowledge support which you receive with the planning of irrigation management from:							
	Researchers of the ministry of agriculture							V19.4
	Subject matter specialist							V19.5
	Private industry							V19.6
20	In your view, why do farmers make use of irrigation in your area? 1……..						V20.1	
	2……						V20.2	
	3…….						V20.3	
21	Do you think irrigation can help in poverty reduction in Lesotho? Yes (1) No (2)						V21	
22	How efficient is irrigation in your area?							
	1	2	3				V22	
	Not efficient	Fair	Efficient					
23	What are the main two sub optimal performances of irrigation farmers in your area? (in priority order) …… …… ……..						V23.1	
	…… …….. …….. …….						V23.2	
24	How you would rate the performance of irrigation in Lesotho?							
	1	2	3				V24	
	Poor	Moderate	Good					

25	List in order of importance three points that you think can make irrigation more effective in Lesotho. 1……				V25.1	
	2……				V25.2	
	3……				V25.3	
26	If Yes how appropriate is the technology used by irrigation farmers in your area?					
	1	2	3		V26	
	Not appropriate	Fair	Appropriate			
IRRICATION ECONOMICS						
27	Rate the costs of irrigation as compared to other production items of farming such as fertilizers and herbicides					
	1	2	3		V27	
	Not expensive	Fair	Expensive			
28	a. Is credit freely available for irrigation farmers in your district? Yes (1). No (2)				V28a	
	b. If yes who usually provides that service?					
	The government (1)				V28b	
	Private sectors (2)					
	Commercial banks (3)					
	Others specify (4)					
29	Are there any maintenance units in Lesotho where farmers can send their irrigation equipment for services? Yes (1) No (2)				V29	
30	Do you encourage your farmers to keep financial records? Yes (1). No (2)				V30	
31	a. To what extend are you competent to help an irrigation farmer with the drafting of the business plan?					
	1	2	3		V31a.	
	Not competent	Fair	Competent			
	b. How often do farmers approach you for assistance with the drafting of the business plan?				V31b	
	1 regularly					
	2 Sporadic					
	3 never					
32	How competent are you in exercising a SWOT analysis of the irrigation business?					
	1	2	3		V32	
	Not competent	Fair	Competent			

IRRIGATION ENGINEERING							
33	a. What factors do you take in to consideration with the planning and layout of an irrigation system?						
	Source of water				(1)	V33a.1	
	Topography				(2)	V33a.2	
	Soil type				(3)	V33a.3	
	Type of the crop				(4)	V33a.4	
	Managerial skills and ability of the farmer				(5)		
	All of the above				(6)		
	b. Rate you competency in supporting the farmers with the evaluation of irrigation system with regard to application and distribution of water						
	1	2	3			V33b	
	Not competent	Moderate	Competent				
	c. Rate your competency in checking the suitability of irrigation water for sustainable irrigation practices						
	1	2	3			V33c	
	Not competent	Moderate	Competent				
34	What impact does water quality have on plant growth?						
	May contain toxic elements				(1)	V34.1	
	It may contain some weeds				(2)	V34.2	
	It may contain some pests				(3)	V34.3	
	It may contain some diseases				(4)	V34.4	
	All of the above				(5)	V34.5	
IRRIGATION MANAGEMENT							
35	a. What do you understand by irrigation scheduling?					V35a	
	Designed irrigation intervals for particular crops				(1)		
	Time and number of irrigation regimes given to crops				(2)		
	b. What determines the irrigation scheduling?						
	Stages of plant growth				(1)	V35b.1	
	Drought				(2)	V35b.2	
	Type of crop				(3)	V35b.3	
	Availability of water				(4)	V35b.4	
	All of the above				(5)	V35b.5	
36	Why is the quality of irrigation water important for sustainable irrigation in your area?						
	Irrigation water may contain toxic elements for plant growth				(1)	V36.1	
	Irrigation water may affect the soil PH				(2)	V36.2	
	Irrigation water may affect the soil microbial activity				(3)	V36.3	
	Some nutrients may not be released for plants to use them				(4)	V36.4	
	Affect the efficiency of irrigation by blocking water supply				(5)	V36.5	
	All of the above				(6)	V36.6	
CROP PRODUCTION							
37	a. Can you help farmers with the selection of adapted crops for the specific irrigation situation that exist in the farm? Yes (1) No (2)					V37a	
	b. How competent are you with knowledge support to farmers in selection of correct crops for irrigation?						
	1	2	3			V37b	
	Not competent	Moderate	Competent				

38	How do you encourage the farmers to manage their crops?		
	Encouraging them to practice weeding (1)	V38.1	
	By encouraging them to control pests (2)	V38.2	
	By encouraging them to control diseases (3)	V38.3	
	All of the above (4)	V38.4	
39	Do you encourage farmers to analyse the soil before planting?		
	Yes (1) No (2)	V39	
	What are the main problems of farmers in this area? (In priority order)……. …… ……..	V39.1	
	…… …….. ……	V39.2	
	…….. ……	V39.3	
AGRO –CLIMATE			
40	What climatic conditions do you advice farmers to take into consideration before planting?..... …… …… ……	V40	
41	What sources of information do you use for predicting weather forecast? 1……..…..	V41.1	
	2……	V41.2	
	3……	V41.3	
	4……	V41.4	
42	What are the possible adverse conditions in each zone? a. Low lands.		
	Summer time (1)……..	V42a.1	
	(2)……..……	V42a.2	
	Winter time (3)……..	V42a.3	
	(4)…….	V42a.4	
	b. Foothills Summer (1)……..……...	V42b.1	
	(2)……	V42b.2	
	Winter (3)……	V42b.3	
	(4)……	V42b.4	
	c. Senqu Valley Summer (1)……...…	V42c.1	
	(2)……...		
	Winter (3)……...	V42c.3	
	(4)……	V42c.4	
	d. Mountains Summer (1)……	V42d.1	
	(2)……	V42d.2	
	Winter (3)……	V42d.3	
	(4)……	V42d.4	

EXTENSION METHODS THAT ARE USED			
43	a. How often to you meet with your farmers?	V43a	
	Once fortnight (1)		
	Once a month (2)		
	Twice a year (3)		
	On ad hoc basis (4)		
	Once a year (5)		
	Twice (6)		
	b. Do you apply a specific extension approach or method in your area? Yes (1) No (2)	43b	
44	What approach is that?		
	Client demand approach (1)	V44.1	
	Training and Visit approach (2)		
	Unified extension approach (3)		
	Top-down approach (4)		
45	On a five point scale rate the efficiency of the method selected above?	V45	

1	2	3	4	5
Very inefficient	inefficient	Reasonably efficient	Efficient	Very inefficient

46	What are the main shortcomings of the current extension method followed? …….. ……	V46.1	
	…… ……	V46.2	
47	To what extend are you sufficiently trained to help farmers with the forming of farmers groups?		

1	2	3		
Not trained	Fairly trained	Trained		V47

48	When do you usually choose the leader of the group? During the first meeting (1)	V48.	
	After discussing the role of the leader (2)		
49	On a ten point scale where would you rate the efficiency of group extension method for serving irrigation farmers in your area?		

1	2	3	4	5		
Very inefficient	Inefficient	Moderate	Efficient	Very efficient		V49.

50	To what degree are you satisfied with the participation of irrigation farmers in the group discussion?		

1	2	3		
Not satisfied	Moderate	Satisfied		V50

51	Is the group size ideal for participation of members in group discussion? Yes (1). No (2)	V51	
52	Do you encourage farmers to form union and associations in your district? Yes (1). No (2)	V 52	
53	a. If yes, state one association that you have in this district. …….. b. To what extend are you trained to help farmer groups with conflict solving?	V53a	

1	2	3		
Not trained	Moderate	Trained		V53b

54	In order of importance state three major constraints of irrigation in this district. 1……	V54a	
	2……	V54b	
	3……	V54c	
55	When evaluating your overall performance of work on a five point scale where can you place yourself? 1 Very poor; 2 Poor; 3 Fair; 4 Good; 5 Very good	V55	

	MARKETING						
56	How efficient is your knowledge support with regard to the planning of an appropriate market strategy for the farmers on ten point scale.						
	1 Not efficient	2 Fair	3 Efficient			V56	
57	How reliable are your marketing opportunities? 1 Very unreliable; 2 unreliable; 3 Fairly reliable; 4 Reliable; 5 Very reliable					V57	
58	a. Through your observations where do farmers get most customers from? From local communities (1)					V58a	
	From other districts (2)						
	Supermarkets (3)						
	b. Do you help your farmers to make any contracts with supply stores and buyers?						
	Yes (1) . No (2)					V58b	
59	Do you help farmer to form farmers groups that help in organising a transport for their produce? Yes (1). No (2)					V59	
60	If no how do farmers transport their produce to the market? Use vehicle (1)					V60.	
	Wheelbarrow (2)						
	Animal drought power (3)						
61	Do you ever organise any formal discussion for traders, wholesaler and farmers? Yes (1). No (2)					V61	
62	Farmers in the republic of south Africa produce a lot of agricultural products; does this not affect the market of your farmers? Yes (1) No (2)					V62	
63	How does this affect your work and relationship to farmers? ……					V63.1	
	……					V63.2	

	……	V63.3
64	What is the main source of marketing information do you have in the area? Processors (1)	V64.
	Traders (2)	
	Government (3)	
	On a one to five point scale indicate the reliability of this source (1-5).	V64.4

1	2	3	4	5
Very unreliable	Unreliable	Reasonable reliable	Reliable	Very reliable

65	Do you think the availability of relevant market information improved or got worse over the last five years? Yes (1). No (2)	V65
66	List major challenges of marketing in this district? ……	V66
	……	V66
	……	V66
STORAGE		
67	Are farmers having stores to keep their produce before taking them to the market? Yes (1). No (2)	V67
68	Have you got any training on the packaging and grading of farmers produce? Yes (1). No (2)	V68
69	Rate your ability to help farmers in the following aspects of irrigation production.	

		Very poor	poor	Fair	Good	Very good	
		1	2	3	4	5	
1	Interpretation of soil analysis						V69.1
2	Soil preparation						V69.2
3	Fertiliser application						V69.3
4	Weed management						V69.4
5	Crop management						V69.5
6	Agro–climatology data (interpretation)						V69.6
7	Planning irrigation system						V69.7
8	Maintenance of irrigation system						V69.8
THANK YOU.							

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