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Farmers' strategies and modes of operation in smallholder irrigation schemes in South Africa: A case study of Mamuhohi Irrigation Scheme in Limpopo Province

by

Khathutshelo Seth Mudau

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Pretoria

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Khathutshelo Seth Mudau

Degree: M Inst Agrar Rural Development Planning
Department: Agricultural Economics, Extension and Rural Development
Supervisor: Dr Marietta Geyser

ABSTRACT

This study was undertaken at a smallholder irrigation scheme in the previously disadvantaged rural area of Mamuhohi in the Limpopo Province. Like other smallholder irrigation schemes in South Africa, Mamuhohi Irrigation Scheme has not performed particularly well. The expectations of interveners like politicians, development agencies and planners have not been realised in smallholder irrigation schemes. Constraints faced by smallholder farmers include a history of dependency; the high costs of mechanisation; the absence of credit, inputs, and output markets; insecure land tenure; "hedgehog behaviour" among smallholders; lack of funding; and poor management and maintenance of infrastructure.

The White Paper on Agriculture (NDA, 1995) clearly set out government's intention to withdraw subsidies previously enjoyed by farmers and to ensure that the real costs of natural resources are reflected in the pricing of resources in order to discourage abuse. This resulted in the enacting of laws like the new National Water Act of 1998 (DWAF, 1998), aimed at sustainable water management. This included the rehabilitation of infrastructure prior to transfer, and the establishment of water users' associations amongst farmers, which were to take over ownership and collective management of the schemes. The overall objective of the study was therefore to assess the sustainability and, more specifically, the economic viability of smallholder irrigation schemes in South Africa in the context of irrigation transfer.

Hypothesis to be tested:

> The behaviour of smallholder farmers is diverse and is reflected in the way in which they view farming and engage in agricultural practices.

The study also sought to indicate the existence of diversity in the smallholder irrigation scheme, by exposing different types of smallholder farmers within the scheme. This information should be of great importance in assisting smallholder farmers regarding issues of their own development. The findings will also help to curb the generalisation of developers' perceptions regarding smallholder irrigation farmers.

Smallholder irrigation farmers are feeling the full impact of the withdrawal of government assistance from the irrigation schemes, which have deteriorated to a state of partial collapse. A great need among farmers remains the rehabilitation of irrigation infrastructure, which would enable them to farm their land.

As indicated earlier, the study found that diverse types of smallholder farmers exist within the irrigation scheme. This indicates that appropriate information in this regard is important for government in the formulation of policies aimed at the development of such farmers. Through this study, four types of smallholder farmers were identified within the same irrigation scheme.

The methodology applied in achieving the aforementioned outputs pursued a specific sequence, starting with the formulation of questions. The particular study area was chosen due to the likelihood of the presence of different types of farmers that could be identified through the study. A list of the names of smallholders and other key information was provided by the local agricultural office. This assisted with the identification of people to be interviewed.

The preliminary interviews were conducted with a sample size of 25 farmers and were aimed at gaining a better understanding of the people within the study area. The questionnaire used during these interviews contained open-ended questions that allowed respondents to express their views and make suggestions. This led to the development of a questionnaire consisting of closed-ended questions, aimed at eliciting responses that were relevant to the purpose of the survey. The questions were also as simple as possible to ensure that they would be clearly understood by both the interviewer and the respondents. About four weeks were spent in trying to understand the real setup of the study area and the lifestyle of the local community.

The second step in the methodological sequence was the collection of data from 60 farmers. These interviews were conducted with the assistance of two extension officers. It was not possible to interview all the farmers at once, and it took about two weeks to interview all 60 farmers. Fortunately, the farmers were extremely co-operative throughout the entire interview process.

The third step in the methodological sequence was the processing of the data collected during the interviews. The typology here was developed by means of qualitative analysis and had to be refined over a period of time to ensure a valid typology of farmers. This necessitated the use of other data analysis tools, which ultimately contributed towards the classification of farmers according to different types.

Four types of farmers were eventually identified, namely: Highly intensive maize growers; Vegetable growers; Diversified maize growers; and Intensive diversified growers.

Lastly, the conclusion that can be drawn from the research is that any attempt to develop smallholder irrigation farmers requires an understanding of their diversity – hence this study's intention to identify, in a scientific manner, the existence of such diversity.

Understanding diversity amongst farmers also requires an understanding of the different strategies that farmers employ to ensure their livelihood. This means that both the socio-economic and institutional setting of such farmers must be understood.

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CHAPTER 1: PRESENTATION OF THE RESEARCH PROJECT

1.1 Background

Since the earliest times, man has been known to utilise irrigation resources in order to provide protection against the whims of nature and ensure that food production remains stabilised (Agricultural Use, 1993). In many developing countries, agriculture is regarded as the sole industry of significant magnitude. Approximately 40 % of the world's food production occurs on the 260 million hectares of irrigated land being farmed. Historically, the largest production and the highest farm incomes from irrigation schemes have been in Asia and Latin America (Bembridge, 2000). The distribution of rain over time and space and the non-dependability of rain are major non-human constraints to agricultural production. Irrigation harnesses surface and ground water for agricultural production, thereby offering a means of overcoming the limitations imposed on agricultural production by unreliable, erratic and unpredictable rainfall. However, irrigation has recently encountered severe challenges in light of the growing competition for water resources. Globally water has always been a scarce resource, and with the current global changes, which include emerging environmental issues, irrigation can no longer enjoy its former status in terms of water usage.

Irrigation Management Transfer (IMT) is the option chosen by governments in many countries, with no consideration of the cost for providing water. Rapid expansion in irrigated areas occurred in most countries from the 1950 to the 1980s. Currently, it has become extremely difficult for such countries to finance the cost of irrigation operation and management and to be effective providers of water services to large numbers of small farmers. This is exactly the situation in South Africa, where the greatest concern is the viability of the irrigation schemes, considering their proposed transfer to emerging farmers. Farmers as water users are now expected to shoulder the costs of their water usage. In this regard, the main objective would be to investigate the possibility of matching the operational and maintenance costs after transfer with the intended farmers' willingness and ability to shoulder those costs.

1.2 Problem statement

The White Paper on Agriculture (NDA, 1995) clearly set out government's intention to withdraw the subsidies previously enjoyed by farmers and to ensure that the real costs of natural resources are reflected in the pricing of resources in order to discourage abuse. This has resulted in the enacting of laws like the National Water Act of 1998 (DWAF, 1998), aimed at sustainable water management. This includes the rehabilitation of infrastructure prior to transfer and the establishment of water users' associations, which are to take over ownership and collective management of the schemes.

Scheme rehabilitation can be defined as a process of improving a collapsed or near-collapsed and inefficient irrigation scheme after full diagnosis and investigation of resources such as water, land and human resources, and redesigning wherever necessary the infrastructure of the scheme to meet the current and foreseeable future requirements, while providing the necessary backup services. Such services include the institution of cropping systems and the improvement of institutional and organisational arrangements for operation and maintenance, with beneficiary participation at all levels, in order to meet the ultimate objectives of the scheme (Kamaladasa, Samarasekara & Azharul Haq, 1995).

The end result of this is that farmers will have to take full responsibility for the management of the irrigation schemes and will have to pay the costs of infrastructure maintenance, as well as other related management and operational costs. With schemes in the areas traditionally occupied by White farmers, the perception has always been that such a move is not considered a threat, as they are already organised and independent. The situation in such areas is vastly better than the situation in which smallholder farmers find themselves.

The most worrying situation can be found in the former homelands of South Africa, where the irrigation schemes were previously fully dependent on government, but were still unable to perform well. In a real sense, these schemes are extremely small and not operating effectively. The challenge lies in whether the farmers in question will be able to pay for water and other services and make decisions collectively in the

face of the multitude of constraints. For instance, these farmers lack money, expertise, and a sense of cohesion amongst themselves. They are mostly illiterate and poor, and some are engaged only in subsistence farming. There is a need to further explore the impact that the proposed new water policy, and the transfer of irrigation schemes to smallholder farmers, will have on smallholder irrigation farming in general.

1.3 Objectives of the study

The overall objective was to assess the sustainability and, more specifically, the economic viability of smallholder irrigation schemes in South Africa in the context of irrigation transfer.

The study focused on the following specific aspects of the aforementioned issues, through a local study of Mamuhohi Irrigation Scheme in the Limpopo Province:

- The existence of diversity within the scheme in terms of farming systems;
- The current economic non-viability of most farming systems if not subsidised by off-farm sources of income; and
- The evaluation of the costs incurred through the scheme's operation, maintenance, and possible refurbishment.

1.4 Hypothesis to be tested

The behaviour of smallholder farmers is diverse and is reflected in the way in which they view farming and engage in agricultural practices.

1.5 Study outline

The first chapter constitutes the presentation of the research project, which includes the background, problem statement, objectives of the study, and hypothesis to be tested. The second chapter presents a review of the literature on smallholder irrigation schemes in order to generate a theoretical perspective on the subject. Chapter three presents the case study. The fourth chapter contains a discussion of

the methodology and describes the analytical methods used to identify and verify the data gathered, i.e. typology analysis and simulation. Chapter five presents the results of the study. Chapter six contains the summary, conclusion and recommendation of the study

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter presents the literature review, starting with a global perspective, followed by an African perspective, and finally a South African perspective on smallholder irrigation schemes. This chapter also discusses off-farm sources of income received by smallholder farmers in South Africa, followed by land tenure and Irrigation Management Transfer (IMT), including the financial implications thereof. This is followed by a discussion on obstacles to expansion, the vulnerability of the environment, gender issues and access to land, as well as the production potential of smallholder irrigation schemes. The conclusion forms the final part of the chapter.

2.2 Smallholder irrigation schemes: A global perspective

Smallholder irrigation schemes can be found in most countries, where in some cases they exceed the number and size of individual large-scale irrigation schemes. Smallholder irrigation schemes around the world are faced with numerous problems due to them being too small to have economies of scale and consequently falling into the trap of low levels of technology. They also lack access to proper institutions and organisations that can provide the necessary assistance. In some instances, the situation has been aggravated by irrigation systems that are uneconomic by design. Such schemes experience high production costs with little chance of cost recovery. However, by making use of village-level irrigators and instituting management by village government officials, some countries like Thailand, Indonesia and the Philippines have managed to sustain small irrigation schemes for hundreds of years (Denison & Manona, 2006).

2.3 Smallholder irrigation schemes in Africa

A major limiting factor in crop and livestock production in Africa is rain. Total irrigation area on the African continent is estimated at 12.4 million hectares (FAO, 1995). According to a World Bank study (Serageldin, 1995), the performance of

smallholder irrigation systems has generally failed to meet expectations, producing low economic and financial returns and discouraging investment in irrigation. According to the UK Government's Department for International Development (DFID, 1998), most smallholder irrigation schemes in Africa have performed poorly in terms of production and management and have failed to achieve predicted production levels. One fundamental issue remains the socio-economic situation on smallholder irrigation schemes in Africa.

In Africa, the great majority of people live in rural areas where small-scale agriculture is the main occupation. Most African governments have, as their objectives, the development of the rural sector, the improvement of the standard of living of rural people, and the equitable distribution of social and economic benefits amongst urban and rural areas. Different countries are attending to the food production issue in different ways. However, the underlying problem of substantial poverty, and the large numbers of people without sufficient food, remains. Africa is characterised by rapid population growth and ongoing conflict, which result in widespread poverty.

Most countries are currently in the process of liberalising, decentralising and privatising their agricultural sectors. This has a strong impact on irrigation schemes, which are left to their own devices. According to the South African government's plan in this respect, after rehabilitation the irrigation schemes would be handed over to farmers who would then be responsible for the daily operational costs of running the schemes. In many respects, the situation of the smallholder in sub-Saharan Africa differs from that of the smallholder in areas where IMT has proven successful (Johnson, 2001). Johnson (2001) further argued that "the path to sustainable institutional evolution for farmer-managed irrigation in the African smallholder context needs to take full cognisance of the differences and devise strategies that are appropriate to the special challenges faced by these schemes".

2.4 Smallholder irrigation farming in South Africa

Hugo (1995) stated that, "Irrigation development has gone through different stages in the history of South Africa. At present, economic realities make it very difficult to justify new irrigation developments and the risk of such new developments is

relatively high both for the state and the farmer". According to the Food and Agriculture Organisation of the United Nations (FAO, 2000), an important component of South African agricultural policy is to increase the incomes of the poorest groups in society through opportunities for small-/medium-scale farmers. The Strategic Plan for South African Agriculture (NDA, 2000) gives particular attention to small-scale agriculture, with three strategic aims: making the sector more efficient and internationally competitive, supporting production and stimulating an increase in the number of new small-scale and medium-scale farmers, and conserving natural agricultural resources.

South Africa's first Irrigation and Water Conservation Act, which was promulgated in 1912, was characterised by large-scale, uncoordinated private irrigation development. This resulted in the construction of such schemes as Great Fish, Clan William, Graaff-Reinet, Lower Sundays River, and Hartebeespoort. Dams were constructed as Irrigation Board schemes.

The 1930s saw numerous farmers suffering bankruptcy, which led the government to initiate irrigation schemes such as Boegoeberg, Riet River, Pongola and Vaalharts in an effort to create jobs for those seeking short-term solutions and even for those wanting to make a living through farming (Agricultural Use, 1993). The 1950s was to be a milestone in the history of smallholder irrigation schemes in South Africa, since it was during this period that the government once again started establishing irrigation schemes. This decision on the part of government resulted from a report published by the Tomlinson Commission (Van Averbeke, M'Marete, Igodan & Belete, 1998), which suggested that irrigation holdings of between 1.3 and 1.7 hectares were adequate to provide a "Bantu" (African) family with a living. The following proposals made by the Tomlinson Commission at the time have strong implications for the way in which irrigation schemes are operated today:

- That determined action be taken to improve and re-plan all existing schemes, so that each holding can provide a full-time living to a Bantu family;
- That new schemes, which can be operated by a simple diversion of weirs and furrows, be developed within the next ten years;

- That the Trusts (Native Trust and Land Act of 1936 and South African Development Trust) acquire ownership of the land, with all land belonging to individuals or tribes and falling under the proposed schemes being bought up, and former owners being given preference when holdings are allotted on completion of the schemes; and
- That all schemes be placed under proper control and supervision, with uniform regulations regarding water rates, credit facilities, and conditions of settlement.

Unfortunately, the Commission's recommendations were eventually implemented, which later led to the establishment of the smallholder irrigation schemes found exclusively in the former homelands of South Africa. Such schemes were developed through the employment of relatively inexpensive designs aimed at a family's subsistence through the surface irrigation of farming activities (Perret, 2002).

Smallholder irrigation schemes in South Africa have never been impressive in terms of performance. As indicated by Bembridge (2000), the economic successes of smallholder irrigation schemes in South Africa fall far short of the expectations of planners, politicians, development agencies, and the participants themselves.

Smallholder irrigation schemes in South Africa comprise only approximately 46 000 hectares, or 4 % of the total area under irrigation (Bembridge, 2000). While the total area occupied by smallholder irrigation schemes may seem small, its importance cannot be ignored when considering that rural development and rural livelihoods to a great extent depend upon such schemes in the semi-arid areas of South Africa. Bembridge (2000) went on to indicate that the near or complete collapse of such schemes can be attributed to a combination of lack of funding and poor management and maintenance of infrastructure, leading to low productivity and poverty.

With the government seemingly having no choice but to adopt the idea or the principles of IMT, it is important to examine the reality of smallholder irrigation farming in South Africa and to address the many challenges that exist, including a history of dependency; the high costs of mechanisation; the absence of credit,

inputs, and output markets; insecure land tenure, and hedgehog behaviour on the part of smallholders.

Today, the major dilemma for a government faced with budget constraints and social pressures is to reconcile a social, rights-based, gap-filling and developmental approach with an approach that is based on productivity and economic efficiency. This dilemma is reflected in the difficult circumstances in which smallholder irrigation farmers in South Africa currently find themselves (Perret, 2002).

As indicated earlier, the smallholder irrigation schemes are situated exclusively in the former Black rural areas. In the former White areas, one finds more extensive schemes that are composed of large holdings and integrated in commercial circuits. These schemes are operated by commercial farmers who are well organised and properly registered and, unlike smallholder farmers, do not depend on the government for their daily operation.

2.5 Off-farm sources of income received by smallholder farmers in South Africa

According to Baiphethi and Jacobs (2009), subsistence production has proven important for household food security, but the productivity of smallholder agriculture remains quite low and, in some cases, is given as the reason for the abandonment of agricultural production by both urban and rural households and their subsequent reliance on off-farm sources of income. According to a report by the International Water Management Institute (IWMI, 2003), farmers who work plots smaller than one hectare must, in the African smallholder context, depend on a variety of sources to earn a livelihood. The inability to depend upon irrigated farming for all or a substantial proportion of the family income means that the male members of the household are often forced to leave home to seek employment in urban areas, while the women remain behind to cultivate the family plot. Off-farm income substantially complements the limited income derived from agricultural production. Smallholder farming systems are characterised by low yields and a high risk of crop failure, thereby threatening family food security (Magombeyi, Taigbenu, Cheron & Morardet, 2009). Off-farm income is also important because it can be used for investment

purposes and to purchase farm inputs, thus improving food security (Baiphethi & Jacobs, 2009).

2.6 Land tenure in the former homelands, the transfer of such land, and the financial implications of this

The policies and actions of the former government of apartheid South Africa in pursuit of racial segregation and the promotion of an oppressive migrant labour system directly influenced the pattern and forms of landholdings and land use in the former homelands. In 1948, the state instituted a policy on land in the "reserves" (or homelands) that was based on a number of key elements, described by Hendricks (1990) as the "three rural pillars of apartheid": the so-called communal form of tenure; the system of tribal administration ("chieftaincy"); and various forms of rural planning and development, generally referred to as "betterment".

To this may be added a fourth important element, namely the forced removal of millions of Black people from the newly designated White areas and towns, and their subsequent displacement to the reserves ("homelands"). This process began in earnest in the then Orange Free State Province with the Natives Land Act of 1913, and it accelerated dramatically throughout the country in the 1960s and 1970s (Lahiff, 1999). Most of the communal lands in the homelands were owned by the government and held in trust for specific tribal communities, to be allocated by the chiefs to people residing under their jurisdiction. The district magistrate would then issue a permission-to-occupy (PTO) certificate to an individual who had been given a piece of land.

In order to join the mainstream South African economy, the small-scale farmer must ensure sufficient production and apply good entrepreneurial skills. However, such farmers face numerous constraints in this endeavour, including limited access to agricultural inputs and services due to a combination of political, economic, social and climatic challenges, amongst other things. A small-scale farmer can be defined as an individual who predominantly operates on a land area of two to five hectares or less. Abbot (1984), on the other hand, defined a small-scale farmer as one who is handicapped by a lack of economic resources and therefore has a reduced ability to

take risks, compounded by a sense of inferiority, a limited education, and lack of access to technical and economic information.

The governments of many countries around the world have always regarded IMT, which is the process of turning over government-run irrigation schemes to organised groups of users, to be the only available option (IWMI, 2002). Since it has become increasingly difficult for many countries to finance the irrigation, management and operational costs of such schemes, the only option remaining has been for the governments to offload this responsibility to the farmers themselves. However, to ensure that IMT occurs in an appropriate manner, the following guidelines must be followed (IWMI, 2002):

- IMT should make good economic sense to the farmers.
- The more farmers involved, the higher the management costs.
- IMT must offer an improved livelihood at an acceptable cost.
- Institutional reforms must go beyond the issue of irrigation management.

2.7 Obstacles to expansion and the vulnerability of the environment

Research conducted by Bembridge (2000) found that most of the smallholder irrigation schemes included in the study were facing similar constraints or obstacles, including lack of fencing, theft of farm produce, poor maintenance of infrastructure, lack of credit, lack of access to markets, water shortages, poor access roads, inadequate soil conservation, lack of adequate draught power, and lack of good management.

According to Botha, Steyn and Stevens (2000), water management in South Africa is increasingly shifting from supply management to demand management. Irrigation scheme farmers will have to ensure appropriate consumption of water, as they will be forced to pay for the water used. According to Du Plessis (1998), irrigation schemes will increasingly be forced to compete on an equal footing with other sectors for the available water supplies. Increasing the price of water on irrigation schemes will help to ensure more efficient water usage. However, it will become increasingly difficult for irrigation schemes to sustain the economic production of low-value crops.

A study conducted in South Africa by Merle, Oudot and Perret (2000) on the Dingledale and New Forest irrigation schemes, which were under rehabilitation at the time, found that those schemes were being threatened by a lack of discipline and organisation. It was also found that the development of water users' associations could be hindered by undisciplined and individualistic behaviour on the part of the farmers concerned. Moreover, since the farmers involved were not accustomed to voting and defending their rights, the representativity of the associations could be endangered.

Merle *et al.* (2000) also found that the farms included in their study were not very productive, and that the farmers were finding it difficult to integrate into the markets and were struggling to pay their bills and cover their other expenses since the withdrawal of government assistance. These farmers would most likely find it impossible to comply with the new National Water Act, in terms of which they would be required to pay for water and cover the running costs of the irrigation scheme. Moreover, their agricultural margins would likely suffer due to limited outlets.

The environment within which the smallholder irrigation farmer operates remains vulnerable. The progress of such farmers depends to a great extent on rainfall. The probability of rain is usually uncertain, and other climatic conditions can also have a negative impact on the sustainability of smallholder irrigation farming. Smallholder irrigation schemes are mainly dominated by women farmers who in many cases are still denied access to credit facilities. In most cases, farmers' crops are not insured, and in the event of a disaster like severe drought, flooding or thunderstorms, the farmers risk losing everything. Most farmers in remote areas still have no access to input supplies, credit facilities and adequate extension services. Outbreaks of diseases or other destructive pests may deal a severe blow to such farmers.

2.8 Gender issues and access to land

Bembridge (2000) found that women generally have to shoulder a heavier work burden than men and that they work longer hours engaged in tasks like weeding and harvesting. Women also have less access to land, are inclined to be more dependent on their husbands, and earn a lower personal income. These findings point to an urgent need for the greater involvement of women in the relevant issues.

According to Chancellor (2001), women provide the majority of human labour in smallholder agriculture, and their labour on irrigated holdings is on the increase, thus adding to their burden of work. Irrigation farming demands more from women in terms of labour, for the following reasons:

- The year-round nature of cultivation;
- The extra weed growth resulting from the application of water; and
- The extra burden of land preparation and levelling.

Despite their labour, women are generally excluded from decision-making and control due to their own and others' perceptions of their role as assistants to male farmers. Women tend to benefit less than would be expected, which can be attributed to social and institutional arrangements in terms of land tenure, credit and training that were established in the past. Even cropping patterns have historically been gender oriented (Van Koppen, 1998), and women have regularly found themselves being subdued by male participants when it comes to the allocation of irrigation water.

2.9 Production potential and socio-economic situation of smallholder irrigation scheme farmers

Unfortunately, production from smallholder irrigation schemes has been extremely poor thus far. It has always been considered important to try and establish the extent to which irrigation farming contributes to income generation amongst smallholder farmers. However, a review of the available literature on the subject reveals that little is known about the performance of smallholder irrigation schemes

and that there is relatively little dissemination of information about the experiences of such farmers. Few studies have been conducted on the problems and the impact of smallholder irrigation schemes – information that could be put to good use by planners and developers (Bembridge, 2000).

The study conducted by Merle *et al.* (2000) found that the cancellation of mechanisation and input supply services has raised the production costs of farmers who must now use private operators. Most smallholder irrigation scheme farmers operate as subsistence farmers. Their land is marginal and small in area, preventing them from operating as commercial farmers. While there are some smallholder irrigation schemes that are situated in areas with good, fertile soil, many are unfortunately situated in areas with poor soil that is not productive. Failure to control soil erosion has also depleted some irrigation schemes of their fertile topsoil, which is essential for plant growth. In some irrigation schemes, incorrect application of chemicals and fertilisers has had a negative impact on the productivity of the soil.

A study conducted by Mpahlele, Malakalaka and Hedden-Dunkhorst (2000) found that smallholder irrigation farmers derive their livelihood from a number of income sources. Based on crop budget analysis, it was estimated that "irrigation farming could contribute about 37 % of household income of 2.5 hectare farmers, 21 % of food plot farmers, and 13 % of 5 hectare farmers" (Mpahlele *et al.*, 2000). The study furthermore found that "gross margins per hectare for vegetables investigated range from R8 000 to R20 000, whereas maize and wheat provided returns of about R500 and R1 450 respectively" (Mpahlele *et al.*, 2000).

Most smallholder irrigation schemes are not economically viable because of their subsistence nature, requiring farmers to engage in other activities in order to make a living. The research of Bembridge (2000) revealed that most farmers who rely on some form of off-farm income generally live in varying degrees of poverty. Some are involved in livestock farming, while others are dependent on their children who are employed elsewhere. A high percentage of smallholder irrigation farmers are pensioners who receive a monthly grant from the government.

2.10 Conclusion

Generally, smallholder farmers perform poorly in terms of production. The production of individual smallholder farmers also differs due to differences in technical skills, inputs used, age, socio-economic situation, etc. Ways must be found to ensure that smallholder irrigation schemes become more productive and sustainable. Various scenarios must therefore be explored in the effort to ensure sustainable operation of irrigation schemes. The case study presented in the next chapter will assist in relating these findings to the situation of smallholder farmers in general.

CHAPTER 3: PRESENTATION OF THE CASE STUDY

3.1 Introduction

In this chapter, the broad description of the study area is separated into fourteen sections, the first of which is a description of the area at provincial level. This is followed by sections describing the economic contribution of agriculture to the province's gross geographic product (GGP); field-crop production and horticulture in the province; physical attributes of the province; smallholder irrigation schemes in the province; the new water policy; location of the case-study irrigation scheme; brief description of the village at which the case-study irrigation scheme is located; climatic conditions: land tenure system; layout of the scheme; access to markets; rules governing water distribution; and access to extension services. The conclusion comprises the final section of the chapter.

3.2 Broad description of the study area

3.2.1 Description of the study area at provincial level

The Limpopo Province (formerly known as the Northern Province) covers an area of 123 910 km², representing 10 % of the total land area of South Africa. Of this area, 10 % is classified as arable land, 67 % is used for natural grazing, 0.9 % is used for forestry production, and 12.7 % is unclassified or not suitable for agriculture. Of the 10 % arable land, only 1.1 % is under irrigation and the remaining 7.8 %, approximately, is suitable for dry-land production (LDA, 2003). The population density is 44 people per km², somewhat higher than the national average of 34 people per km². Polokwane, the capital city, experiences its highest rainfall in the summer months, with an average rainfall in January of 82 mm. Sepedi is the home language of 57 % of the population, followed by Xitsonga (23 %) and Tshivenda (12 %). The inhabitants of the province have an average life expectancy at birth of 62.7 years, which is similar to that of the South African population as a whole (i.e. 62.8 years). The adult literacy rate (persons 15 years and older able to read, write and speak their home language) is 74 %, compared to the national average of 82 % (Orkin, 1998).

3.2.2 Economic contribution of agriculture to the province's gross geographic product

According to a report released in 2000 by the Northern Province Department of Agriculture, Land and Environment (now known as the Limpopo Department of Agriculture), over the preceding five years, the contribution of agriculture to the province's gross geographic product (GGP) had ranged from 1 % to 30 % depending on the magisterial district concerned. The GGP contribution of the Phalaborwa, Ellisras, Thabazimbi, Warmbaths, Thohoyandou, Giyani and Mapulaneng districts had been less than 10 %. The Messina magisterial district, on the other hand, had made the highest contribution to GGP, followed by the Letaba district.

Also according to that report, the agricultural and mining sectors had made the second highest contribution to GGP after the tertiary sector consisting of trade, transport, finance, community services, general government and other producers. At the time, about 17.5 % of the economically active population were employed in the agricultural sector (Northern Province Department of Agriculture, Land and Environment, 2000).

3.2.3 Field-crop production and horticulture in the province

The main field-crops produced in the province are maize (17.4 %), tobacco (21.1 %) and sunflower seeds (10.7 %). In the year 2000, the contribution of field-crops to GGP stood at 22.7 %, with cotton contributing 5.9 %, tobacco 4.7 % and maize 4 % (Northern Province Department of Agriculture, Land and Environment, 2000).

At that time, vegetable production in the province was estimated to contribute an average of 22 % to the GGP derived from agriculture, and approximately 18 % to the total income derived from vegetables in South Africa as a whole.

3.2.4 Physical attributes of the province

According to the Northern Province Department of Agriculture, Land and Environment, 2000), the topography of the province is characterised by different topographic zones. The north-western zone is a flat to undulating plain, with slopes down to the north and west, at 800 to 1 000 metres. The eastern zone is a flat to gently undulating lowveld plain, at an altitude of 300 to 600 metres and bordered in the west by the northern Drakensberg escarpment and the Soutpansberg, with steep slopes and peaks of up to 2 000 metres. To the south lie the Springbok flats at an altitude of 900 metres, which varies slightly and is bounded by the Waterberg to the west and the Blouberg to the north, featuring an undulating, steep terrain reaching 2 000 metres in places.

The Highveld, Lowveld and Middleveld are identified as existing climatic regions. The province is a summer rainfall area with an average rainfall of 500 mm per annum, with hot and dry conditions in the lowveld region. However, the mountainous regions are cooler with a higher annual rainfall of up to 1 500 mm in some places. The north-west experiences an average annual rainfall varying from 600 mm on the Springbok flats to less than 400 mm on the border with Botswana.

3.2.5 Smallholder irrigation schemes in the province

The Limpopo Province houses about 171 small-scale irrigation schemes, most of which are not operating effectively. However, the Northern Province Department of Agriculture, Land and Environment (2000) claimed to be intensifying the process of rehabilitating the irrigation schemes in the province. In the far north (Vhembe district), the two irrigation scheme projects (Cape Thorn and Morgan) that had been earmarked for rehabilitation and restructuring through the flood and relief programme were completed, and project management committees were put in place. Applications for the registration of those project management committees as legal entities (water users' associations) were submitted to the Department of Water Affairs and Forestry for approval. The projects were jointly implemented with Loxton, Venn and Associates (LVA), the service providers appointed for the WaterCare programme.

Other schemes that benefited from the flood and relief programme in the Limpopo Province included Metz and Madeira irrigation schemes in the Lowveld region and Dingledale and New Forest irrigation schemes in the Bushbuckridge region. Similar programmes were also implemented at Thabina and Boschkloof irrigation schemes.

Information provided by local extension officers indicated that, although Tshiombo and Mphaila irrigation schemes had not been identified as priority areas due to infrastructural damage that had made farming impossible, some essential rehabilitation work was nonetheless carried out. At Tshiombo, the canal was repaired and completed with the assistance of the Department of Water Affairs and Forestry. At Mphaila, the Provincial Department of Agriculture worked together with the farmers to reconstruct the pump-house, which had been completely eroded. Farmers contributed money for cement and other materials, while the Department provided expertise and specialised labour to construct the pump-house. The repairs were completed in October 2001.

Generally, the process of rehabilitating irrigation schemes in the Limpopo Province has shown some progress. The main objective remains the transferral of irrigation scheme ownership to the community. Before such transfer takes place, the government is committed to providing the relevant communities with assistance in the form of finance, equipment and technical know-how necessary to revitalise these schemes. The programme is funded by the National Department of Agriculture, as part of the Land Care programme.

The Provincial Department of Agriculture appointed LVA to facilitate the implementation of the programme, to undertake the overall training and capacity-building of the communities in question, and to assist with the establishment of institutional structures such as developmental committees, technical committees and water users' associations. In this regard, two organisations were approached to provide LVA with the necessary assistance: The first was the Institute of Agricultural Engineering (IAE) of the Agricultural Research Council (ARC), which was responsible for the technical evaluation of the infrastructure, the planning and design of any rehabilitation decided on by the water users, and the provision of training on

the management of irrigation water. The second was WOMIWU Rural Development, which was responsible for empowering water users to manage the infrastructure rehabilitation programme and to maintain that infrastructure in the future.

About eleven irrigation schemes, including Mamuhohi Irrigation Scheme, were identified for the second phase of rehabilitation, following a pre-development survey process. Table 1 below shows the cost estimates for the reconstruction of Raliphaswa weir and siphon, while Table 2 shows the estimated cost summary for the rehabilitation of Mamuhohi Irrigation Scheme.

Communities in the Limpopo Province were given the opportunity to apply for departmental assistance as long as they were prepared to take ownership of the irrigation schemes and contribute to the rehabilitation process. The initial aim of the provincial Department of Agriculture was to assist farmers with the formation of scheme management structures. Once such committees were in place, they would be assisted to identify the revitalisation needs of the irrigation scheme. Once the water users' associations had been established, they would be registered with the Department of Water Affairs and Forestry. Such registration would enable the farmers to access grants for any additional infrastructure rehabilitation that might occur.

Table 1: Raliphaswa Weir and Siphon: Cost estimate for reconstruction (2000)

Description	Unit	Quantity	Rate	Cost in Rand
Clear and grub	m^3	1.600.00	6.00	9 600.00
Excavation: Dam	m^3	400.00	40.00	16 000.00
Siphon	m^3	72.00	110.00	7 920.00
Concrete				
Weir	m^3	528.80	900.00	475 920.00
Flank walls	m^3	350.00	900.00	315 000.00
Embankment	m^3	15.000.00	15.00	225 000.00
Pipe and valve	sum			100 000.00
River diversion	sum			40 000.00

Raliphaswa Siphon	m	200.00	400.00	40 000.00
Subtotal				1 229 440.00
Contingencies	0.15			184 416.00
Subtotal				1 413 856.00
Contractor's establishment	0.30			424 156.80
Subtotal				1 838 012.80
Engineering fees and supervision	0.14			257 321.79
Subtotal				2095334.59

Source: Sebego, Maloka and Viljoen Civil Engineers CC (2000)

Table 2: Estimated cost summary for rehabilitation (2003)

	Description	**Amount in Rand**
1	Secondary canals	110 000.00
2	Backfill canal banks	20 000.00
3	Siphon	8 000.00
4	Main canal	75 000.00
5	Long weirs	18 000.00
6	Outlet valves	12 000.00
7	Small canal bridge	8 000.00
8	Soil conservation work	70 000.00
9	Fences	41 000.00
10	Roads	33 000.00
11	Water measurements	3 000.00
12	Plot demarcation	8 000.00
	Total	**443 000.00**

Source: LVA (2003)

3.2.6 New water policy

According to the White Paper on a National Water Policy for South Africa (DWAF, 1995), irrigation is by far the largest consumer of South Africa's limited water

resources. The best opportunity for irrigation expansion lies in improving the efficiency of the use of existing water resources. There are already many areas in South Africa where the community's need for water for their own consumption is in conflict with the water requirements of established irrigation agriculture (Muller & Hollingsworth, 1995).

According to Backeberg and Groenewald (1995), in terms of the plan to execute a new national irrigation policy, priority ought to be given to a programme of improved utilisation and rehabilitation of existing schemes. For this purpose, it is necessary to implement projects that are aimed at specific problems and which provide suitable solutions for different schemes within the various catchment areas. This would also entail consultation with stakeholders on a local level, as well as their involvement and input.

According to the White Paper on Agriculture (NDA, 1995), water in South Africa is a limited natural resource that is essential for life in both rural and urban areas, and as such water is bound to be a source of conflict among users. The White Paper (NDA, 1995) also states government's intention to ensure that the benefits and real costs of natural resources are reflected in the pricing of resources so as to discourage abuse. Moreover, the White Paper (NDA, 1995) notes that agriculture, which accounts for half the nation's water use, will have to re-evaluate this usage and that the price paid for water will have to reflect the real economic cost thereof, including the cost to society and the environment. Government stated the intention for water to be allocated through a new licensing system founded on achieving beneficial use in the public interest. Such licences would be granted for an appropriate period of time that recognises the substantial investment requirement in certain sections. The price of water would include operating, maintenance, and capital costs, as well as a water resource management levy and a resource conservation charge. The price of water on government water schemes would be adjusted over a period of time to cover operating and maintenance costs, as well as interest and the redemption of loans.

These water-reform ideas resulted in the promulgation of the new National Water Act in 1998, which necessitated the establishment of new water regulations and defined the basis for sustainable water management. This resulted in the establishment of

bodies known as catchment management agencies and water users' associations. The government pledged to ensure full representation of the catchment management agencies in catchment areas, irrespective of the members' gender, class or race. The National Water Act of 1998 clearly defines government's intention to withdraw its ownership and commitment from smallholder irrigation schemes. However, the greatest challenge lay in whether such catchment management agencies and water users' associations would be able to effectively represent and serve the best interests of the water users concerned. It is understood that some of the most advanced pilot schemes recently presented the Department of Water Affairs and Forestry with their proposed constitutions for their water users' associations.

At present, irrigation and irrigation development in the Limpopo Province is the combined responsibility of the Department of Water Affairs and Forestry, the National Department of Agriculture, and the Limpopo Department of Agriculture. The Department of Water Affairs and Forestry is responsible for the development of national water infrastructure, and for the allocation and control of scarce water resources. The National Department of Agriculture is responsible for national strategies such as marketing standards and norms, while the Limpopo Department of Agriculture is responsible for supporting and developing irrigation farming in the province (DWAF, 1995). The end result in this regard is that farmers will have to take full responsibility for the management of irrigation schemes and will have to cover the costs of infrastructure maintenance, as well as other related management and operating costs.

3.2.7 Location of the case-study irrigation scheme

Mamuhohi Irrigation Scheme is located in an area of the present-day Limpopo Province that was previously known as the Nzhelele region of the former homeland of Venda. The scheme, which was established near the village of Mamuhohi in 1960, consists of 60 farmers who have each been allocated a plot of 1.286 hectares. The total area under irrigation measures 77.160 hectares. Mamuhohi Irrigation Scheme is a member of the proposed Nzhelele Catchment Water Users' Association and falls under the proposed Limpopo Water Management Area in the province. Eleven schemes in the Nzhelele area, including Mamuhohi Irrigation Scheme, have been

identified for the second phase of irrigation scheme revitalisation. Together with the adjacent scheme (Mandiwana Irrigation Scheme), Mamuhohi Irrigation Scheme sources its water from the Nzhelele River.

3.2.8 Brief description of the village at which the case-study irrigation scheme is located

The village of Mamuhohi is one of the villages falling under the Mphephu Territorial Council. The village, which consists of approximately 266 households, comprising an estimated 1 250 people, shares a boundary with the village of Mandiwana. The community members are generally poor and rely to a great extent on crop farming, livestock farming and pension grants. A few community members rely on other means of making a living. There are a number of smallholder community projects within the community, including pig farming, poultry farming, peanut-butter making, juice making, brick making, etc. The community structures available include the civic association, political parties, traditional council, etc. Of the 266 households in the village, 199 households are classified as poor (total monthly income under R700).

3.2.9 Climatic conditions

The climate in the region is suitable for a wide range of field and vegetable crops. The area is also frost-free and experiences mild to cold winters and very warm to hot summers. The region can generally be classified as a summer rainfall area, often characterised by thunderstorms with quick run-offs. While there are months that experience no rainfall, a good month might expect to see rainfall exceeding 170 mm. The average rainfall for 1999 was 622.1 mm, while the mean rainfall for 2001 was 518.7 mm. The average temperature for 1999 was 21.25 ^{o}C, while the mean temperature for 2001 was 20.85 ^{o}C. In general, the high-rainfall months in the area are October to March, while the low-rainfall months are April to September.

3.2.10 Land tenure system

In terms of this system, the chief would allocate irrigation plots to the prospective male farmers in the area. Each plot-holder would then be issued with a permission-

to-occupy (PTO) certificate by the local magistrate. This traditional system has resulted in most irrigation plots being registered in the names of men, but it is mainly women who regularly work the plots. In the event of a woman's husband passing away, she is most likely to register the plot in her son's name as an inheritance. A young man who is not yet married may also own a plot of land, as long as his parents have named him as the beneficiary of that particular plot of land. In some instances, it can be extremely difficult to identify the real owner of a plot of land belonging to a household. A situation that was encountered throughout the course of the study was that although many of the plots are owned by men, they are worked by women. Two issues seem to have contributed to this situation: Firstly, the PTO certificates issued in the past were not properly recorded by the extension officer, and many of the relevant documents are missing. Secondly, although some plot owners have passed away, their plots are still registered under their names. To date, not a single plot has been allocated to an unmarried young woman.

Up until 2000, farmers in the Mamuhohi Irrigation Scheme were required to pay an annual land rental fee of R12.00, which was collected by the Provincial Department of Agriculture. More than 95 % of plot owners reside in the village of Mamuhohi, with only a few plot owners having recently relocated from the village of Mamuhohi to neighbouring villages. The chief has no direct control or influence over any piece of land allocated to a farmer. However, no farmer may sell his plot of land to any other person – he may only surrender his plot to relatives or allow them to occupy it.

3.2.11 Layout of the scheme

The scheme is situated close to the residential area, about 20 metres from the village. When conducting the study, it proved extremely difficult to reach the irrigation scheme by vehicle, due to the appallingly poor condition of the access road to the scheme.

The farmers make use of furrow irrigation systems, and there is an earth dam in which water is contained before being released to the plots through canals. An irrigation schedule has been drawn up, according to which the farmers are divided into blocks that are each scheduled to utilise water on a specific day. There is also a

water bailiff employed by the government to oversee water distribution. Together with the extension officer and the irrigation scheme committee, the water bailiff arbitrates any conflict concerning water usage. Irrigation infrastructure is also poor, and the irrigation system does not allow every farmer to plough or utilise his entire plot – a situation that becomes even worse in the dry seasons. To aggravate matters, the floods of February 2000 destroyed most of the irrigation infrastructure in the Vhembe district, preventing farmers from planting their crops in that year. Moreover, the maize crop planted during the summer of 2001 failed as a result of drought, because the flood-damaged irrigation system had not yet been repaired.

The crops most commonly planted in the scheme are maize, tomatoes, vegetables, sugar-beans, groundnuts and onions, but the irrigation network setup allows for the planting of only two crop types per year. Production at Mamuhohi Irrigation Scheme is extremely low, which can be attributed to the old age of most of the farmers and the fact that the availability of irrigation water has never been reliable. If every farmer were to plant the entire 1.286 hectares available to him, the irrigation system would not be able to cater to all 60 farmers. The year 2000 saw the planning of the temporary reconstruction of the irrigation infrastructure in the scheme, with BKS Consultburo (Pty) as principal consultants, and Sebego, Maloka and Viljoen Civil Engineers CC as sub-consultants. However, even after such reconstruction, the farmers themselves would have to see to the regular maintenance of the infrastructure.

3.2.12 Access to markets

Farmers in the scheme have traditionally relied on local markets. They have been discouraged from selling their products to distant markets by a number of factors, including low production, high railway fees, and market fluctuations. The once-prominent tomato factory in the town of Makhado, which previously played a significant role in the marketing of tomatoes, has since ceased operations. The closure of this factory contributed to the decline in the production of tomatoes, and smallholder tomato farmers are still struggling to find suitable markets for their produce.

3.2.13 Rules governing water distribution

While other schemes have a written set of rules governing water distribution, this is not the case with Mamuhohi Irrigation Scheme. However, the water bailiff and the farmers are aware of the schedule according to which water is distributed. The water bailiff always ensures that he opens and closes the water valves at the prescribed times. However, there have been some instances of farmers unlawfully opening the valves or blocking the flow of water. Some farmers have been known to illegally create outlets to secretly irrigate cleared plots on the outskirts of the irrigation scheme. To this end, farmers have been known to break concrete canals, and block or divert water using sandbags, rocks or pieces of corrugated iron. Farmers situated closer to the dam are the usual culprits in this regard.

Over the years, some farmers have failed to plant the entire 1.286 hectares of land available to them. While in certain cases this might be due to a shortage of water, especially during the winter months, some farmers are simply unwilling or unable to efficiently utilise the entire plot of land available to them.

3.2.14 Access to extension services

Farmers in Mamuhohi Irrigation Scheme are provided with agricultural extension services by the Limpopo Department of Agriculture. Such services have always been rendered free of charge to the community. Mamuhohi Irrigation Scheme falls under the Makhado municipality in the Vhembe district. There is an agricultural office located in the village of Mamuhohi, and an extension officer and a water bailiff are usually available to service the community. The extension officer works directly with the farmers and encourages them to elect a strong committee that will take responsibility for addressing some of the disputes that might arise amongst the farmers.

Usually, the extension officer renders the necessary services through personal visits, meetings, demonstrations, lectures, workshops and tours. Previously there was a demonstration plot where the extension officer would demonstrate whatever

innovation he felt was relevant to the farmers. Unfortunately, due to pressure from the farmers, the demonstration plot has since been reallocated to somebody else, because the farmers felt that they were spending most of their time at the demonstration plot and thus neglecting their own plots. They complained that the extension officer was making it compulsory for all farmers to work on the demonstration plot, performing the tasks of weeding, irrigating, fertilising, spraying and even harvesting. They perceived their work on the demonstration plot to be a form of punishment.

3.3 Conclusion

This chapter gave a broad description of the study area, making it clear that Mamuhohi irrigation scheme is a small scheme with similar challenges and opportunities to other irrigation schemes in the Nzhelele cluster. The next chapter discusses the research methodology, with the focus on farming system analysis, typology development, questionnaire development, and the methodological sequence of the research process.

CHAPTER 4: METHODOLOGY

4.1 Introduction

The overall objective of this study was to investigate the possibility of matching a cost-recovery strategy at scheme level with the farmers' capacity and willingness to cover such costs. The farmers' capacity and willingness to pay for water supply and related services depends to a great extent on the contribution of irrigated farming systems to their livelihoods – hence the necessity of investigating the cropping systems, farming systems and livelihood systems involved.

The methodologies used to describe and analyse these different systems are discussed in this chapter. The focus is firstly on the analysis of farming systems in typology development, followed by an explanation of the reasons for the choice of irrigation scheme studied. Following a discussion of the sequence of data collection, data processing (scenario development) and simulation, the chapter culminates in a conclusion.

4.2 Analysis of farming systems

This study identified the need to firstly analyse farming systems and then to represent them for further modelling purposes. A typology of farmers was constructed on the basis of a typology of cropping systems.

Typology is an attempt to group activity units according to their main modes of operation and their common characteristics (Perret, 1999). Through typology, decision-makers at regional level can be given an image or vision of local agricultural activities (Perret, 1999). While typology can serve as a guideline for initiating specific development operations and for focusing the total project (Laurent, Van Rooyen, Madikizela, Bonnal & Carsten, 1998), it also seeks to constitute a range of types that simplify reality whilst accounting for the main particularities which allow for the classification and analysis of each type in a collection to be studied (Perrot & Landais, 1993).

Whatever the method chosen, the analysis of all the socio-economic components is a necessary first step in constructing a diagnosis. A schematic representation of the diversity of rural systems can then be suggested as an outcome, but also as a starting point for further studies.

However, it is important to note some of the limitations of typology – for instance, it is clear that the results are valid only for few years. While it may be of importance in giving an instant picture of farm diversity, it cannot be a long-term tool destined for routine use (Perrot & Landais, 1993). Admittedly, it can be understood that there is diversity inside each and every type identified through typology.

Finally, it is important to underline that any typology remains relative and questionable. From the same sample and the same questionnaire, different typologies may be constructed, depending on the objectives, viewpoints or prospects of the surveyors (Perrot & Landais, 1993).

4.3 Typology development

Typology development takes place through sampling, questionnaires, surveys/interviews, and data analysis. The typology of the Mamuhohi Irrigation Scheme was built with the objective of identifying different types of farmers operating within the scheme. The procedure was the following: The first survey was conducted to provide a general description of activities and plots within the irrigation scheme, after which the data was processed and the results tabulated. The second survey was conducted by means of questionnaires completed by all 60 farmers operating within Mamuhohi Irrigation Scheme. Variables were identified through observations from the data available in respect of the irrigation scheme. It also emerged that the variables, e.g. productive activity, source of income, off-farm activities, etc., were technically related. This resulted in a rough identification of types, which were later refined until an appropriate classification of well-defined types was achieved.

4.4 Choice of case-study irrigation scheme

The irrigation scheme chosen for purposes of this study was Mamuhohi Irrigation Scheme, which is one of the irrigation schemes that source their water from the Nzhelele River. Data related to this scheme was first collected in 1999 by the Mamuhohi Agricultural Office. In 2000, heavy flooding destroyed the scheme's irrigation infrastructure. At the time, it was hoped that the destruction would only be temporary, since the Department of Water Affairs and Forestry started making immediate plans for the temporary reconstruction of the irrigation infrastructure, through the appointment of BKS Consultburo (Pty) as principal consultants and Sebego, Maloka and Viljoen Civil Engineers CC as sub-consultants. Unfortunately, for reasons unknown, the appointed consultants were unable to complete the job in 2001, and farmers were not able to plant their crops before mid-2002.

The data on scheme production was therefore based on 1999 production, since 2000 production had been disturbed by heavy rainfall. Some relevant information on crop production for the year 1999 was also acquired from the local agricultural office. However, there is hope for the irrigation scheme, as it has been included in the second phase of the Irrigation Schemes Rehabilitation Programme. Predevelopment surveys have already been conducted, and farmers are undergoing predevelopment training to ensure sustainability of the project.

4.5 Questionnaire development

The questionnaire used during the preliminary interviews consisted of open-ended questions whereby farmers were given the opportunity to express their needs. This allowed for the formulation of a questionnaire consisting of closed-ended questions relating to decision-making in respect of on farming matters, land area, sources of income, age, etc.

4.6 Methodological sequence of the research process

As indicated in Figure 1, a specific methodological sequence was followed. The first step in the sequence was the formulation of the questions to be included in the

questionnaires. The particular study area was chosen in view of identifying the different farmer types that exist. A list of the names of the smallholders and other key information was provided by the local agricultural office. This assisted with the identification of people to be interviewed.

The preliminary interviews were conducted by means of open-ended questions put to a sample size of 25 farmers and were aimed at gaining a better understanding of the people within the study area. The subsequent formulation of a close-ended questionnaire was done so as to ensure that the information gathered was relevant to the purpose of the survey. The questions were kept as simple as possible so that they would be clearly understood by both the interviewer and the respondents. About four weeks were spent in trying to understand the real setup of the study area and the lifestyle of the local community.

The second step in the methodological sequence was the gathering of data from 60 farmers. These interviews were conducted with the assistance of two extension officers. It was not possible to interview the entire group of farmers at once, and it took about two weeks for all 60 farmers to be interviewed. Fortunately, the farmers were extremely co-operative throughout the interview process.

The third step in the methodological sequence was the processing of the data. Farmers develop strategies as a means of dealing with a changing and uncertain environment, allowing them to duplicate or transform a given lifestyle that corresponds to a particular objective, either as a group or as individuals (Perret & Touchain, 2002). It took some time to refine the typology to the required validity.

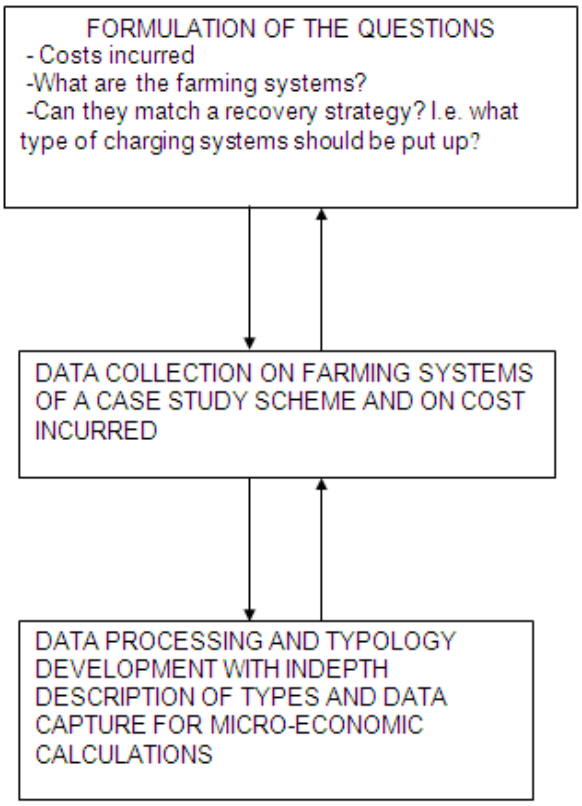

Figure 1: Methodological sequence of the research process

4.7 Conclusion

By applying the various methodologies it was possible to address the problem statement and achieve the objectives of the study. Typology analysis assisted greatly in the process of organising the diverse farming situations into the types described. Ultimately, it was also possible to make some recommendations and draw certain conclusions based on the outcome of the study undertaken. The overall approach also proved valuable in confirming the relevance of the types within the typology. The next chapter contains a discussion of the results, with the focus on the main characteristics of the farmers in the irrigation scheme, followed by diverse sources of income and activities, age differences, as well as plot ownership and workers of the land. Lastly, the chapter defines the typology of farmers according to different cropping systems, before culminating in a conclusion.

CHAPTER 5: RESULTS

5.1 Introduction

This chapter reports on the analysis, major findings and results of the study. Using the various techniques discussed in the previous chapter, a synthesis can be drawn from the data analysis. The first step is to ensure the construction of a typology of all farmers farming at Mamuhohi Irrigation Scheme, followed by the testing of the hypothesis that the behaviour of the smallholder farmers is diverse and is reflected in the way in which the different farmers view farming and engage in agricultural practices. The preliminary interview results are also tabulated and discussed in this chapter. However, it is the results of the typology analysis that are discussed in the greatest detail.

5.2 Main characteristics of irrigation scheme farmers

This section reflects the important characteristics of the farmers as a whole, without necessarily specifying or defining the different types of farmers within the irrigation scheme. However, during the upcoming discussion on the identification of these different types, some these characteristics are likely to be accounted for in terms of their contribution towards such identification.

5.2.1 Diverse sources of income and activities

Most of the farmers operating within the Mamuhohi Irrigation Scheme are not solely dependent on farming for their household income. Diverse off-farm strategies and modes of operation help the farmers to secure the maximum income possible for their households. Figure 2 below shows that only 10 % of the farmers rely on farming as their only source of income, while 25 % receive a pension grant, 21 % receive remittances from working spouses, 12 % earn salaries and wages from permanent local employment, and 32 % own small businesses. Without such off-farm activities, the farmers would not be able to support their households, since the money earned through smallholder production is not sufficient.

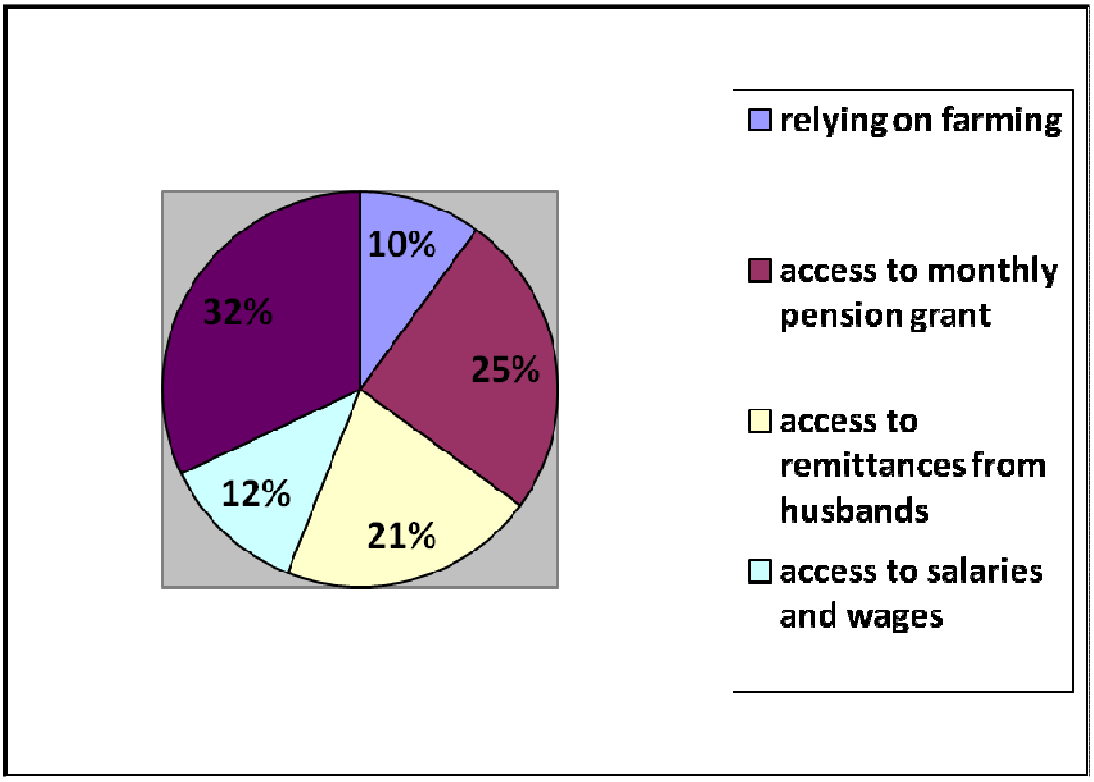

Figure 2: Farmers' diverse sources of income

Besides irrigation farming, some farmers are also involved in livestock production, as illustrated in Table 3 below.

Table 3: Livestock farming activities of irrigation scheme farmers

Livestock farmed	*No. of farmers*	*%*	*No. of livestock*
Indigenous chickens	14	23 %	109
Pigs	7	12 %	13
Goats	19	32 %	109
Cattle	22	37 %	164
Donkeys	3	1 %	21

5.2.2 Age differences

It is mostly the older individuals, and not the youth, who are engaged in farming or who own plots of land. In fact, approximately 50 % of plot owners in the irrigation scheme are above the age of 50 years. Only 7 % of farmers are under the age of 30 years, while 37 % are between the ages of 30 and 50 years, 18 % are between the ages of 50 and 60 years, and the majority (38 %) are aged 60 years and above (Table 4). When asked about their willingness to cover the operating costs of the irrigation scheme, the farmers generally responded positively – which may have been triggered by the government's proviso that the rehabilitation of irrigation schemes would only become a reality if the farmers were willing to take full ownership of the schemes after rehabilitation.

Table 4: Age distribution amongst farmers of the Mamuhohi Irrigation Scheme

Age distribution	Number of farmers	Percentage of farmers
20 – 30	4	7 %
30 – 50	22	37 %
50 – 60	11	18 %
> 60	23	38 %
Total	60	100 %

5.2.3 Plot ownership and workers of the land

The majority (87 %) of plots within Mamuhohi Irrigation Scheme are owned by men (Figure 3). This situation has its roots in the prevailing culture, which has historically dictated that land ownership is reserved exclusively for males.

While men overwhelmingly dominate plot ownership in the scheme, it is the women who are mostly responsible for working the land (53 % overall) (Figure 3). The majority of the work on the land involves weeding and irrigation, because the scheme makes use of a furrow irrigation system. This is menial work, which is

usually carried out by women. In general, the only time when men become involved in farming activities is the crop-planting season, when they are usually seen operating heavy machinery like tractors.

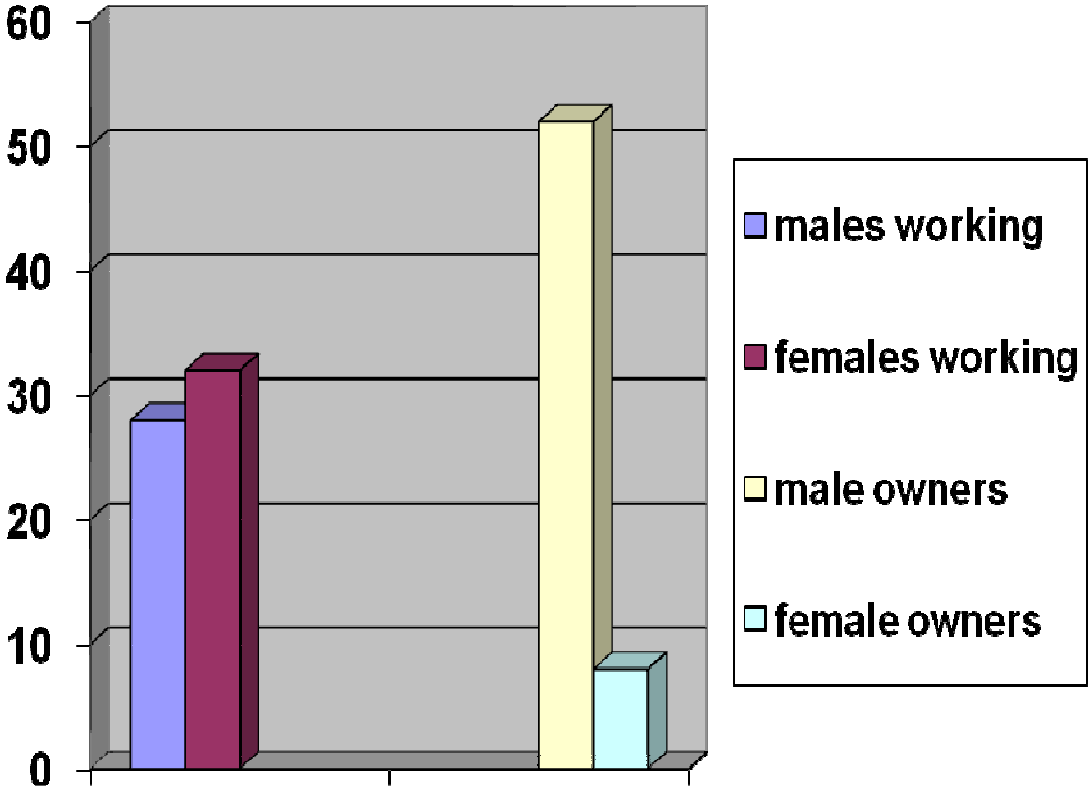

Figure 3: Number of males and females working the land, and number of males and females owning plots

5.3 Typology of farmers according to different cropping systems

5.3.1 Description of farmer types

Type 1: Highly intensive maize growers (7 %)

This group, which is comprised of four farmers, produces maize exclusively. Their crops are planted during the summer season only, with no crops whatsoever being planted in the winter season. As a group, these farmers are only able to plant about 2.14 hectares of maize, yielding an estimated one ton per hectare and earning an income of R2 800.00 for the group. The production costs incurred amount to

R1 795.00 for the group, yielding a net income of R1 005.00 for the group. The average net income per farmer is therefore R251.25.

These farmers seem to be less engaged in irrigation farming, as they only plant maize, and in very low quantities. This group derives some income from other sources; for instance, one member works as a civil servant, two members receive monthly pension grants, and one member works as a migrant labourer. Table 5 below gives a summary of the area planted and the net income for Type 1 farmers.

Table 5: Type 1: Area planted and net income

Type 1		Maize	Ground-nuts	Onions	Tomatoes	Sugar-beans	Vegetables	Total
7 %	Area planted (ha)	2.140	0	0	0	0	0	2.140
4 farmers	Net income (R)	1 005.00	0	0	0	0	0	1 005.00

Type 2: Vegetable growers (23 %)

This group, which is composed of 14 farmers, plant less in summer and more in winter. As a group, these farmers plant only about 4.280 hectares during the summer months, but about 8.607 hectares during the winter months. The group is able to plant about 3.424 hectares of maize, yielding an estimated 1.3 tons per hectare and earning an income of R1 652.74 for the group. The production costs incurred amount to R600.00 for the group, while the net income earned for the group amounts to R1 050.74. The average net income per farmer is therefore R75.05.

This group of farmers also produces groundnuts. In this regard, the group is able to plant about 1.070 hectares, yielding an estimated 1.8 tons per hectare and earning an income of R6 586.93 for the group. The production costs incurred amount to R2 133.00 for the group, leaving a net income of R4 454.14 for the group. The average net income per farmer is thus R318.15.

With regard to vegetable production, the group is only able to plant about 3.675 hectares, yielding an estimated 25 tons per hectare and earning R7 090.84 in income for the group. The production costs incurred amount to R2 536.68 for the group, which is then left with a net income of R4 483.15. The average net income per farmer is therefore R320.22. The major vegetable produced by this group is "*muxe"*, a type of green leafy vegetable, which is sold locally to vendors.

With regard to sugar-bean production, the group is only able to plant about 1.070 hectares, yielding an estimated one ton per hectare and earning the group an income of R2 977.17. The production costs incurred amount to R1 560.83 for the group, which is then left with a net income of R1 416.13. The average net income per farmer is thus R101.15.

With regard to tomato production, the group is only able to plant about 3.220 hectares, yielding an estimated 10.5 tons per hectare and earning the group an income of R5 250.30. The production costs incurred amount to R2 364.65 for the group, which is then left with a net income of R2 885.65. The average net income per farmer is thus R206.11.

With regard to onion production, the group is only able to plant about 0.856 hectares, yielding an estimated one ton of onions and earning an income of R750.00 for the group. The production costs incurred amount to R194.20 for the group, which is then left with a net income of R555.80. The average net income per farmer is thus R39.70.

Table 6 gives a summary of the area planted and the net income for Type 2 farmers.

Table 6: Type 2: Area planted and net income

Type 2		Maize	Ground-nuts	Onions	Tomatoes	Sugar-beans	Vegetables	Total
23 %	Area planted (ha)	3.424	1.070	0.856	3.220	1.070	3.675	13.315
14 farmers	Net income (R)	1 050.64	4 454.14	555.8	2 885.65	1 416.13	4 483.15	14 845.51

Type 3: Diversified maize growers (13 %)

This is a group of eight farmers who plant less in winter but more during summer. As a group, the farmers plant about 8.675 hectares during the summer months, but only about 1.712 hectares during the winter months. With regard to maize production, the group is able to plant about 7.926 hectares, yielding an estimated 1.5 tons per hectare and earning an income of R3 200.00 for the group. The production costs incurred amount to R1 524.00 for the group, which is left with a net income of R1 676.00. The average net income per farmer is thus R209.50.

With regard to groundnut production, the group is only able to plant about 0.749 hectares, yielding an estimated 1.7 tons of groundnuts and earning an income of R2 040.00 for the group. The production costs incurred amount to R900.00 for the group, which is then left with a net income of R1 140.00. The average net income per farmer is thus R142.50.

With regard to vegetable production, the group is only able to plant about 0.321 hectares, yielding an estimated 80 tons of vegetables and earning the group an income of R1 035.60. The production costs incurred amount to R335.33 for the group, which is then left with a net income of R700.27. The average net income per farmer is thus R87.53.

With regard to sugar-bean production, the group is only able to plant about 0.749 hectares, yielding an estimated one ton of sugar-beans and earning an income of R1 400.00 for the group. The production costs incurred amount to R600.00 for the

group, which is left with a net income of R800.00. The average net income per farmer is thus R100.00.

With regard to tomato production, the group is only able to plant about 0.535 hectares, yielding an estimated ten tons of tomatoes and earning an income of R3 400.00 for the group. The production costs incurred amount to R700.00 for the group, which is left with a net income of R2 800.00. The average net income per farmer is thus R350.00.

Only one farmer in the group is engaged in onion production. This farmer is able to plant about 0.107 hectares, yielding an estimated one ton of onions and earning an income of R700.00 for the group. The production costs incurred amount to R250.00 for the group, which is left with a net income of R450.00. The average net income per farmer is thus R56.25.

Table 7 below gives a summary of the area planted and the net income for Type 3 farmers.

Table 7: Type 3: Area planted and net income

Type 3		Maize	Ground-nuts	Onions	Tomatoes	Sugar-beans	Vegetables	Total
13 %	Area planted (ha)	7.926	0.749	0.107	0.535	0.749	0.321	10.387
8 Farmers	Net income (R)	1 676.00	1 140.00	450.00	2 800.00	800.00	700.27	7 566.27

Type 4: Intensive diversified growers (57 %)

This is a group composed of 34 farmers who plant more or less the same quantities of crops in both the summer and winter seasons. This group plants greater quantities of crops than any other group. With regard to maize production, the group is able to plant about 18.866 hectares, yielding an estimated one and a half tons per hectare

and earning an income of R8 780.00 for the group. The production costs incurred amount to R1 200.00 for the group, which is left with a net income of R7 580.00. The average net income per farmer is thus R222.94.

With regard to groundnut production, the group is only able to plant about 4.068 hectares, yielding an estimated 1.8 tons per hectare and earning an income of R8 037.00 for the group. The production costs incurred amount to R1 172.00 for the group, which is left with a net income of R6 865.00. The average net income per farmer is thus R201.91.

With regard to vegetable production, the group is only able to plant about 4.815 hectares, yielding an estimated 575 tons per hectare and earning the group an income of R6 933.26. The production costs incurred amount to R2 462.08 for the group, which is left with a net income of R4 526.53. The average net income per farmer is thus R133.13.

With regard to sugar-bean production, the group is only able to plant about 4.601 hectares, yielding an estimated 1.1 tons per hectare and earning an income of R9 740.00 for the group. The production costs incurred amount to R1 611.33 for the group, which is left with a net income of R6 050.00. The average net income per farmer is thus R177.94.

With regard to tomato production, the group is only able to plant about 7.371 hectares, yielding an estimated six tons per hectare and earning an income of R23 627.00 per group. The production costs incurred amount to R6 000.00 for the group, which is left with a net income of R17 627.00. The average net income per farmer is thus R518.44.

With regard to onion production, the group is only able to plant about 2.033 hectares, yielding an estimated nine tons per hectare and earning an income of R2 000.00 for the group. The production costs incurred amount to R800.00 for the group, which is left with a net income of R1 200.00. The average net income per farmer is thus R352.94.

Table 8 below gives a summary of the area planted and the net income for Type 4 farmers.

Table 8: Type 4: Area planted and net income

Type 4		Maize	Ground-nuts	Onions	Tomatoes	Sugar-beans	Vegetables	Total
57 %	Area planted (ha)	18.866	4.068	2.033	7.371	4.601	4.815	41.754
34 farmers	Net income (R)	7 580.00	6 865.00	1 200.00	17 627.00	6 050.00	4 526.53	43 848.53

5.3.2 Descriptive statistics

The typology consists of four types of irrigation farmers, with Table 5 to Table 8 above showing the area planted and net income per type. A statistical summary of the area planted per crop per type, as well as the total area planted by each type during the summer and winter seasons, is given in Table 9 below, while Table 10 depicts the different types in terms of net income per crop, as well as the overall income derived per type from winter and summer production. Table 11 shows total income, expenditure and net income (in R), total area planted (ha) and livestock production (numbers) per type.

Table 9: Area (in ha) planted per crop per type

	%	Maize	Ground-nuts	Tomatoes	Onions	Sugar-beans	Vegetables	Summer	Winter
Type 1	7	2.014	0	0	0	0	0	2.014	0
Type 2	23	3.424	1.070	3.022	0.856	1.070	3.675	4.494	8.821
Type 3	13	7.926	0.749	0.535	0.107	0.749	0.321	8.675	1.712
Type 4	57	18.866	4.068	7.371	2.033	4.601	4.815	22.934	18.082
TOTAL	**100**	**32.356**	**5.887**	**11.126**	**2.996**	**6.42**	**8.811**	**38.243**	**29.353**

The table above depicts the four distinctive types in terms of the percentage of farmers per type. The total area planted per crop is also given, demarcated according to summer crops and winter crops. It is quite evident that the production of summer crops, especially maize, exceeds the production of winter crops. Of the 38.243 hectares of land planted to summer crops, maize covers almost 32.356 hectares.

Table 10: Net income (in R) per crop per type, as well as overall income earned per type from summer and winter production

	%	Maize	Ground-nuts	Tomatoes	Onions	Sugar-beans	Vegetables	Summer	Winter
Type 1	7	1 005.00	0	0	0	0	0	1 005.00	0
Type 2	23	1 050.64	4 454.14	555.80	2 885.65	1 416.13	4 483.15	5 504.78	9 340.73
Type 3	13	1 676.00	1 140.00	450.00	2 800.00	800.00	700.27	2 816.00	4 750.27
Type 4	57	6 865.00	1 200.00	17 627.00	6 050.00	4 526.53	6 865.00	8 065.00	35 069.00
TOTAL	**100**	**10 597.00**	**6 794.14**	**18 632.80**	**11 735.65**	**6 742.66**	**12 048.42**	**17 391.00**	**49 159.53**

Table 10 above shows each type's net income per crop. The total net income derived from summer crops and winter crops per type is also depicted. Again it is quite clear that while summer crops (especially maize) are planted in abundance, winter crops are more profitable – i.e. summer crop production yielded an income of only R17 391.00, while winter cropping yielded an income of R49 159.58. The winter crop that yielded the highest income was tomatoes, with R18 632.80.

Table 11: Total farm income, expenditure and net income (in R), total area planted (ha) and livestock production (numbers) per type

	Type 1	Type 2	Type 3	Type 4
Total farm income (R)	4 429.75	6 007.15	8 406.75	5 864.81
Production costs (R)	1 795.00	2 006.65	2 408.72	1 958.55
Net income (R)	2 634.75	3 826.13	5 683.03	3 787.50
Area planted (ha)	2.14	12.887	10.387	20.555
Number of cattle	0	44	52	69
Number of goats	0	37	16	51
Number of chickens	0	33	14	67
Number of donkeys	0	0	6	15
Number of pigs	0	0	5	9

Note: All figures given are averages

5.4 Conclusion

This chapter focused on the analysis, major findings and results of the study. A synthesis was also drawn from the data analysis. The construction of a typology of all farmers farming at Mamuhohi Irrigation Scheme was thoroughly articulated, including the testing of the hypothesis that the behaviour of the smallholder farmers is diverse and is reflected in the way in which the farmers view farming and engage in agricultural practises. The typology offered four distinct types of irrigation farmers. The issues raised through the problem statement were also addressed.

The next chapter contains an overview of the study, as well as a discussion of the major findings, conclusions and recommendations of the study.

CHAPTER 6: RECOMMENDATIONS AND CONCLUSIONS

The chapter provides an overview of the study, as well as a discussion of the major findings, conclusions and recommendations of the study.

6.1 Overview

This study focused on smallholder irrigation schemes, their rehabilitation and the process of handing over such schemes to the communities. The study also highlighted the implications arising from the farmers' ability to sustain the rehabilitated irrigation schemes after the handing over of such.

This dissertation started with a broad description of smallholder irrigation schemes globally, on the African continent, in South Africa, and lastly in the local Limpopo Province. Unfortunately, a review of the available literature on smallholder irrigation schemes revealed that not much is known about the performance of such schemes. There is also a lack of information flow on the experience gained and lessons learned from the smallholder irrigation schemes in operation.

Nevertheless, much was explored and explained with regard the emergence of smallholder irrigation schemes in South Africa, seen in the context of the former apartheid government's policies that deprived Black people of equal opportunities in terms of commercial farming ventures. Various theoretical and conceptual issues pertaining to smallholder irrigation schemes were then explored, which provided a broader perspective on the situation of smallholder irrigation schemes from both a local and international perspective. At the very least, this study went some way towards evaluating the constraints and needs of farmers operating in smallholder irrigation schemes. The formulation of the hypothesis on smallholder irrigation schemes, and a description of the diversity of the farmers in question, was followed by a discussion of the methodology used to describe and analyse such diversity.

Smallholder irrigation schemes, especially in rural areas, can play a tremendously important role in creating job opportunities and contributing towards poverty alleviation. However, if this is to become a reality, it is essential that the positions of the farmers within the smallholder irrigation schemes are identified. It would be a serious mistake to stereotypically consider all farmers within the irrigation schemes to be similar, without investigating the diversity that exists amongst different farmers in the same area. If these farmers are to be successfully developed, the diversity that exists amongst individual farmers must be thoroughly understood – hence this study's aim to identify, in a scientific manner, the existence of such diversity.

Understanding diversity amongst farmers also requires an understanding of the different strategies employed by farmers in their efforts to secure their livelihoods. This means that both the socio-economic and institutional settings of such farmers must be examined and understood.

Over the years, the general lack of information on smallholder irrigation schemes in South Africa has severely constrained previous attempts to research this issue. As indicated earlier, it is extremely important for more extensive information on smallholder irrigation farming to be gathered. It is important that appropriate national policies are formulated to address the real needs of all smallholder irrigation farmers in every province of South Africa, and towards this end, the National Department of Agriculture, Forestry and Fisheries will need as much relevant information as possible. In this regard, the Department could make use of field extension officers to ensure that the real setup of smallholder farmers is properly understood. In the Limpopo Province, for instance, the necessary information could be acquired through the provincial Water Care Programme and Participatory Extension Approach.

One of the aims of this study was to address the issue of the farmers' ability to afford the costs of the necessary services following the proposed transfer of the rehabilitated schemes to the farmers themselves. The findings of the case study revealed that the income from production currently being earned by the farmers would not match the expenditure to be incurred in operating the irrigation scheme. Although the farmers indicated during the interviews that they would be willing to pay the operating costs involved, according to their production potential they would not,

in fact, be able to finance these costs. However, it must be kept in mind that before the irrigation schemes are actually handed over to them, the farmers will undergo the appropriate training to ensure that they are empowered to operate the scheme successfully. Loxton, Venn and Associates (LVA) will also present a three-year programme aimed at equipping farmers with the necessary skills to manage their irrigation scheme.

Merle *et al.* (2000) encountered several constraints faced by the smallholder irrigation schemes included in their study – for instance, when government made the decision to withdraw its assistance from farmers, it did so without any clear strategy, with land reform still pending. On the other hand, Mamuhohi Irrigation Scheme, which was used as the case study for purposes of this research project, had been operating quite efficiently, despite facing the usual constraints suffered by any other small irrigation scheme, until the heavy flooding of 2000 destroyed the irrigation infrastructure and caused the scheme to become dysfunctional. (It is for this reason that the study drew on the 1999 production data, since no production had occurred in 2000 or 2001.)

6.2 Major findings

The overall objective of the study was to assess the sustainability and, more specifically, the economic viability of smallholder irrigation schemes in South Africa in the context of irrigation transfer. In pursuit of this objective, the study aimed to point out the existence of diversity within such schemes in terms of farming systems, as well as the fact that currently, most farming systems are not economically viable if not subsidised by off-farm sources of income. The final specific objective was to evaluate the costs incurred by the scheme's operation, maintenance and possible refurbishment. The process of achieving the study's objectives is outlined below.

6.2.1 Existence of diversity

The profile of Mamuhohi Irrigation Scheme, exposing the different types of farmers operating within the scheme, was drawn up through the identification and description of the socio-economic and production diversity that exists amongst the farmers. This

information should prove extremely valuable in the effort to assist smallholder farmers with their own development. These findings will also help to curb the generalisation of developers' perceptions regarding smallholder irrigation farmers.

6.2.2 Typology of diversity

This study identified four types of smallholder farmers in the irrigation scheme, namely: Type 1 – Highly intensive maize growers (7 %); Type 2 – Vegetable growers (23 %); Type 3 – Diversified maize growers (13 %); and Type 4 – Intensive diversified growers (57 %). Each type has its own survival strategies and means of earning an extra income, including monthly pension grants, involvement in community projects, livestock farming, migrant labour earnings, and civil service employment. The different types also differ in terms of production and land area use.

6.2.3 Production potential of the irrigation scheme

The study found that the current production level of the irrigation scheme is extremely low. For instance, in the case of Type 2 farmers, the average net income per farmer from maize production is R75.05. This situation is the result of a combination of factors such as poor access to agricultural inputs, incorrect planting methods, insufficient extension services, unreliable supply of irrigation water, the advanced age of most farmers, failure to plant at the right time, failure to plant all the available land, and, at the worst, failure to plant at all.

Land tenure remains a constraint to the case-study farmers. The average plot size of 1.286 hectares is too small to generate a living income. This situation compels farmers to devise other strategies to earn a living. The existing irrigation infrastructure also does not allow farmers to make simultaneous use of the entire land area of 77 hectares.

Despite the farmers' low levels of production, the cost of production seems to be high and does not correlate with the production potential of the farmers. While the farmers did indicate their willingness to pay for irrigation services, it seems likely that this was said purely out of desperation. The farmers are eager to have their irrigation

infrastructure rehabilitated so that they can once again engage in farming. The reality remains that the income earned by the farmers through their current levels of production could not possibly match the costs of running the scheme. This again confirms the study's specific objective to point out that under the current circumstances, most farming systems within the irrigation scheme are not economically viable if not subsidised by off-farm sources of income, and farmers therefore have to seek other ways of earning an income to supplement their farming activities.

6.2.4 Policy and strategies

The farmers belonging to the irrigation scheme are feeling the full impact of government's withdrawal of its assistance, and the irrigation scheme has deteriorated to a state of partial collapse. A great need amongst the farmers remains the rehabilitation of the irrigation infrastructure so that they are able to return to farming.

As indicated earlier, the information that was gathered on the diverse types of farmers that exist within the irrigation scheme studied should prove important for government in the formulation of development policies for farmers in smallholder irrigation schemes. This study identified four different types of farmers within the same irrigation scheme.

The information gathered on the diverse survival strategies employed by farmers would also assist the government in its planning for poor rural farmers. The study found that most farmers in the scheme rely on a monthly pension grant, with no other source of income existing in some cases. There is a serious need to improve credit facilities so as to make them compatible with these farmers' circumstances.

Extension services must be rendered, but with due consideration of the existing diversity among farmers. Extension services have seldom proven effective, as they tend to be biased and sometimes miss the target completely, because in their conventional form they fail to take such diversity into account.

Agricultural development should also include strategies to address other related aspects of the farmers' lives and environment. A variety of constraints have a negative impact on farming in the area, and it would be appropriate for agricultural development to be accompanied by, amongst other things, development initiatives in respect of marketing, credit facilities, and land tenure systems.

It can be stated that the study did manage to achieve the overall objective, namely to assess the sustainability and, more specifically, the economic viability of smallholder irrigation schemes in South Africa in the context of irrigation transfer. As such, the study focused on the following specific aspects by means of a local case-study conducted at Mamuhohi Irrigation Scheme in the Limpopo Province:

- In pointing out the diversity that exists within irrigation schemes in terms of farming systems, four main types of farmers were identified from amongst the 60 farmers in the irrigation scheme studied. This extensive diversity within irrigation schemes will have to be taken into account in the event of development interventions.
- Under the current circumstances, most farming systems are not economically viable if not subsidised by off-farm sources of income. The study clearly revealed that the farmers in the irrigation scheme do not rely solely on farming, but are instead involved in other activities in order to supplement their income. Amongst the farmers interviewed, 25 % have access to pension grants, 21 % have access to remittances from working spouses, 12 % have access to salaries and wages from permanent local employment, and 32 % are small business owners.
- The study also evaluated the costs that will be incurred by the farmers in the scheme's operation, maintenance and possible refurbishment. The cost of the reconstruction of Raliphaswa Weir and Siphon and the rehabilitation of the scheme was estimated at more than R600 000 – an amount that the farmers cannot possibly match in terms of production earnings.

It is clear from the discussion above that there is diversity within irrigation schemes in terms of farming systems, and that under the current circumstances, most farming systems are not economically viable if not subsidised by off-farm sources of income.

6.3 Recommendations

6.3.1 Integrated approach

The study found that for a smallholder irrigation scheme to be successful, there must be integration between management, participants, technology, extension services, and the socio-economic situation of the farmers.

6.3.2 Agricultural research to focus on smallholder irrigation schemes

While there seems to be adequate agricultural research work in South Africa, not much has been done in terms of researching smallholder irrigation schemes. More research into smallholder irrigation schemes will assist in improving the understanding of the situation within which smallholder farmers find themselves, thus ensuring appropriate policy formulation by the government.

6.3.3 Marketing

Farmers should be encouraged and assisted in the effort to increase their market-oriented production. The farmers at Mamuhohi Irrigation Scheme are mostly involved in maize production, which does not earn an adequate profit. Farmers can also be assisted to make contact with prospective markets. Farming is a business, and those engaged in subsistence farming must convert to commercial farming.

6.3.4 Training

For smallholder irrigation farmers to improve their farming practices, they must be given appropriate training in the technical aspects of farming, as well as irrigation scheme management. Field extension officers must also undergo proper training that will enable them to offer the necessary assistance to farmers. Lack of extension

services is also regarded as a constraint to the performance of smallholder irrigation scheme farmers.

6.4 Limitations of the research, and suggestions for future research

The research conducted at Mamuhohi Irrigation Scheme was constrained by the fact that since the year 2000, the farmers have not been able to plough their lands or access their fields to check on any crops planted. This study therefore had to rely on production data for the year 1999. While the farmers offered adequate information during the interviews, additional data on production was acquired from the Mamuhohi Agricultural Office. However, some of the data provided by the farmers might have been based on estimations, due to a general lack of recordkeeping by farmers.

During the course of the study, it also came to light that Loxton, Venn and Associates (LVA) had not yet produced a full technical survey report on the rehabilitation of the irrigation infrastructure. The costs predicted for the project were therefore based on estimations, taking into account similar projects conducted previously.

6.5 Conclusion

The conclusion that can be drawn from this study is that under the current circumstances, most farming systems are not economically viable if not subsidised by off-farm sources of income. It is also clear that there is diversity amongst farmers within irrigation schemes in terms of farming systems. Under the current circumstances, smallholder farmers are not able to sustain the viability of their plots in the absence of government support.

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