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**The Thabina irrigation scheme
in a context of rehabilitation
and management transfer:
Prospective analysis and local empowerment**

Project number: 2003-068
**Assessing the economic viability
of smallholder irrigation schemes in South Africa:
Prospective analysis and local empowerment**

Department of Water Affairs and Forestry

Final report

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The Thabina irrigation scheme in a context of rehabilitation and management transfer Prospective analysis and local empowerment

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1. Executive summary

This document reports back the results of a research project that took place in the Thabina Irrigation scheme (Limpopo Province, Levuvhu-Letaba water management area) between March and November 2003. The first objective was to describe the current situation of the scheme, in technical, economic and institutional terms, and to develop a model of such situation, making use of the Smile platform. The second objective was to develop a participatory scenario-testing approach, using the model, in order to evaluate options and alternatives towards the development of the scheme.

The research team developed its approach accordingly, i.e. doing a survey through a structured questionnaire, building typologies of cropping systems and farming systems, capturing the whole into the Smile program, reporting back the results to farmers, gathering questions and worth-testing scenarios from the farmers, and analysing the results of simulations in a participative way (workshops).

The report first recapitulates the general conceptual framework underlying the work. Also, it clarifies some concepts and terms that are used within the Smile approach and software. The report then describes the general circumstances of the scheme: bio-physical aspects, land-related elements, infrastructures, social and institutional aspects. Thabina is made of 234 irrigable hectares, which involve 149 beneficiaries (PTO holders).

The main results of the study may be summed up as follows:

The revitalization process is completed in Thabina. It is described into the report. About half of the farmers are not satisfied with its outcomes. Their main complains touches on (1) the lack of levelling, which hinders proper and quick irrigation at plot level, then disturbs collective water sharing processes; (2) the need for main canal upgrading to increase water supply; and (3) the need to upgrade secondary canals. Water supply is the core issue in Thabina, repeatedly mentioned by farmers and management committee members alike. Recent severe drought and vandalism on pumps has even worsened the situation. Besides, farmers also mention mechanization as a major issue, in terms of cost and accessibility.

The Thabina irrigation scheme features characteristics that are quite common to most smallholder schemes in the Limpopo Province: old age of beneficiaries, a large proportion of female farmers, a large average family size, a large proportion of non-farming beneficiaries, a small average farm size, maize as the main crop. Besides, it also shows several interesting and uncommon traits: a significant crop diversification tendency, an operating cost recovery system, and above all, an established Water Users Association, with an operating management committee.

A typology of farmers has been established in order to reflect the diversity of economic and technical circumstances at farm level. It highlights two major traits of the scheme: the large proportion of non-farming beneficiaries, hence a large area that is left unused (fallow), and the commercial orientation of a majority of farmers, exclusive subsistence being a minority feature. The typology also highlights some gender-related and location-related biases for farming potential. The 9 types are thoroughly described. In spite of the small average farm size, even active farmers do not crop their whole land, hence additional land left unused in the scheme.

¹ S. Perret (CIRAD & UP) is the overall coordinator of the project. S. Yokwe (UP) has been coordinating fieldworks and surveying activities. M. Lavigne & N. Stirer (CIRAD) have been involved in data analysis, scenario build-up and report-back sessions. K. S. Dikgale (Limpopo Province Department of Agriculture) has been involved in field surveys.

A typology of cropping systems is established, featuring the main crops grown in Thabina. 17 crop management styles, involving 8 different crops are thoroughly described in agronomic, technical, water-related and economic terms.

The combination of typologies in Smile allows for some calculations at farm and scheme level. At present, the whole scheme requires about 670 000 m³ of irrigation water per year. The total operational costs (fixed and variable) incurred are R41 400, which makes R177 per irrigable ha per year. In other words, supplying 1m³ at plot level costs R0.06. The current water charging system in place covers 68% of these costs. Active farmers make an average profit of R675 per ha per year. Among them, commercially-oriented pensioners are more efficient, with an average profit of R3 092 per ha per year, also achieving the highest water productivity (R0.53 of profit per m³ used).

The combination of typologies also forms a model that allows for further simulations and scenario testing. The management committee members expressed interest onto the following topics and questions, which have been addressed through simulations: What would be the consequences of (1) upgrading the main canal, (2) an increased vegetable production, (3) land re-allocation; what would be the most appropriate (4) water charging system, and (5) farming model for Thabina.

Such questions had to be quantified and translated into scenarios to fit into the model. Simulations were run and results reported back and discussed with the farmers.

Results confirm that crop diversification is definitely a right move. However, it should be carried out along with intensification, since resources are scarce and should be better used, especially water. Also, the current small average land size cannot provide sufficient farming income, especially because farmers do not use the whole of it. In the absence of increased water supply, farmers will have to improve their individual water productivity (crop intensification and more sound water application), but also their collective water sharing practices. This calls for renewed institutional arrangements around water sharing.

The report suggests a mixed system for water charging, so that combined objectives of cost recovery, equity, incentive to farming, and water saving are met. Besides, some simple adjustments in the current system are also proposed.

Finally, the report discusses the question of a best farming system for Thabina. From an intensification point of view, commercial pensioners are the most efficient, although cropping very limited areas. Their know-how and skills probably explain a lot, and should be tapped for training and demonstration purposes, towards younger farmers. From an extensification point of view, larger commercial farming is also quite profitable (3 farmers at the moment). However, it must be kept in mind that such system requires much land (> 5ha), and then raises some equity issues at community level. If such model were to be promoted, a majority of farmers would be set aside from agriculture.

This project formed a renewed application of the Smile approach, since it included farmers' participation since the outset. Such participation has been real and effective, not only during data acquisition phases, but also for validation, scenario-building and discussion of results.

2. Background and terms of reference of the project

This chapter recapitulates the terms of reference of the project.

2.1. Objectives

The overall objective of the project is to assess the economic viability of selected smallholder irrigation schemes in the Limpopo province (namely Thabina, Dingleydale and New Forest), making use of existing models, action-research methodologies and tools. The research aims at two specific objectives, namely:

1. Investigating options towards a viable management of the schemes, using Smile© as a framework for data collection, capture and analysis, then simulation and scenario-testing;
2. Promoting distribution of information and building capacity about the methodology within the provincial Department of Agriculture, and promote participation and empowerment among community members.

2.2. Methodology

The overall methodological framework is the one of action-research. The project will particularly develop intervention-research, which is a form of action-research specialised in management issues, with a strong emphasis on the direct intervention of research operators within the targeted organisation. The methodology implies a collective prospective analysis of managerial processes within organisations, with an emphasis on modelling, simulations, and interactions with local stakeholders. Problem-solving and decision support become on-going, iterative learning processes, and not top-down external prescription. The joint construction of models and representations accounts for the learning and decision-support process.

On a practical basis, the research team will be involved in a close relationship with development operators and local stakeholders of selected irrigation schemes. The major steps will be:

- Collecting information on the socio-economic and technical circumstances at household and scheme level;
- Capturing data into the existing model (Smile©), which calculate a number of indicators, economic figures, at scheme and individual farm levels, allowing for an evaluation of the current situation;
- Organizing workshops first for report back purposes, then for participatory scenario-testing and simulation of realistic changes (alternative decisions, new strategies, technical, institutional or economic change, etc.), evaluating collectively their impacts;
- Getting central, provincial, and local stakeholders involved throughout the project, to ensure skill acquisition and capacity building.

2.3. Significance of the proposed research, expected outcomes

Government smallholder irrigation schemes (SIS) of South Africa are currently facing a very difficult situation, owing to past history and policies, and to technical, social and financial reasons. Furthermore, the institutional and policy-related environment is changing, and most schemes are currently involved in rehabilitation and management transfer.

The selected schemes were among the first being revitalized. Water Users' Associations were established, yet with no sound managerial basis. These associations are supposed to take over management tasks at scheme level. They are experiencing financial problems.

The project aims at investigating the current conditions and future options for a sustainable management of these schemes, though the use of specific tools. Financial viability is especially targeted.

The expected outcomes of the project are as follows:

- to trigger a learning and a problem-solving process within the local emerging organisations in charge of scheme management; the simulation tools may become management tools for these organisations;
- to inform the revitalization processes undertaken by the provincial authorities; the transfer of the tools themselves will be is a key outcome of the project; it supposes involving and training development operators during the project;

- to provide the scientific and technical community with a set of tools and methodologies, adapted to smallholder collective irrigation in South Africa.

2.4. Partners and mode of co-operation

IWMI and DWAF (research and professional costs), and CIRAD with UP (professional costs and other costs) are funding the project.

The University of Pretoria and CIRAD (Prof. S. Perret) will be in charge of the overall coordination, providing guidance, methodology and tools.

Students from Universities of Venda and Pretoria will carry out the bulk of fieldwork and data analysis.

The Limpopo Provincial Department of Agriculture and Environment will monitor the whole process, and some staff members will be involved in data collection, analysis, and the use of the Smile platform.

2.5. Timeframe

For the 3 case study schemes, fieldwork is to be completed by end March 2003. Follow-ups will include a first brief report on the situation, then other publications reporting findings from in-depth data analysis, further workshops and scenario-testing sessions with the local stakeholders. A provisional report is due at the end of April 2003. Full report and project completion should be finalized by November 2003 in Thabina and by February 2004 for Dingleydale and New Forest.

3. Introduction

Government smallholder irrigation schemes (SIS) were developed in former homeland areas of South Africa during the apartheid era, mostly for community food supply purposes. The parastatal entities that used to support them have gradually collapsed from the early 1990's. These schemes are now facing serious problems and an uncertain future, owing to low yields, deteriorating infrastructures, limited access to services, weak and unclear institutions regarding access to water and land, and lack of support (Perret, 2002a).

Although representing a small percentage of irrigated land at country level, their location in deep poor rural areas with semi-arid conditions represents a potential for poverty alleviation and food security in such areas.

The central and provincial governments aim to both revitalise SIS and curtail the financial burden of their maintenance and operation costs. Most schemes are earmarked for rehabilitation and transfer to users' associations in the Limpopo Province. However, most operators involved are still unsure how reform should be implemented, with equity, efficiency and sustainability objectives.

It proves very difficult for decision-makers and operators to evaluate the potential for long-term sustainability, then to organise rehabilitation and transfer accordingly, owing to a context of low participation, weak local institutions, and lack of information regarding farmers' strategies, land tenure arrangements, cropping systems, household socio-economics, and so on, which eventually determine the potential for cost recovery and economic viability (Perret, 2002b).

Since 1998, Thabina has been earmarked for rehabilitation and management transfer, as a pilot scheme in a programme driven by the Limpopo Province Department of Agriculture and Environment. Subsequently, the Thabina Water Users' Association has been the first smallholder WUA in the country to be endorsed by the Department of Water Affairs and Forestry. Therefore, it appears worthwhile to take stock of the current situation, and to learn from that early experience. With regard to persistent issues as perceived by both the authorities and the farmers in Thabina, it also proves necessary to engage into a solution seeking / problem-solving strategy. Such are the objectives of the report.

4. Underlying hypotheses and principles

The following hypotheses and principles underpin the research work.

1. The Thabina irrigation scheme, like any farming community, is not homogenous, although farmers face a common environment and share several common traits;
2. The revitalization process undertaken by the public sector aims at rehabilitating infrastructures, setting up the local management entity, supporting farmers, coordinating and facilitating the transfer of management;
3. The Water Users' Association (the management committee) represents the views and the diversity of its members (fellow farmers) and forms the management entity for the scheme;
4. The scheme's management will increasingly refer to a client-supplier relationship, whereby the management entity supplies water and services to individual farmers, who in turn pay back for such services (although subsidy schemes by DWAF may be introduced; see box 1);
5. All stakeholders agree upon the principles of gradual autonomisation of the scheme;
6. A participatory, action-research, and scenario-testing approach is likely to support the development of institutions and the investigation of pathways towards sustainability.

Box 1. Water pricing system for smallholder farmers (source: DWAF, 2002; 2003)

Following the National Water Act of 1998, the Department of Water Affairs and Forestry has refined a water pricing strategy. With regard to “emerging farmers” (i.e. smallholder irrigation farmers), the principles of the pricing system are as follows:

- In principle, the charges that are payable are (1) a water resource management charge (WRM), to the Catchment Management Agency (CMA), (2) O&M charges, and (3) a depreciation charge;
- The WRM charge will be phased in over 5 years after the WUA is established; a minimum volume for use will be considered for charging (about 10000 m³ per annum); operational subsidies to CMA, and waiving of charges for limited periods may be considered; Thabina belongs to the Luvuvu-Letaba water management area, hence a WRM charge of R0.0078 / m³ (for 2003-2004).
- O&M charges will be phased in over 5 years after the WUA is established and a contract is set up with DWAF; operational subsidies by DWAF on O&M costs will be phased out accordingly;
- A depreciation charge will be introduced in year 6 after the WUA is established, at a maximum of R0.01 per m³ per annum.
- WUAs may receive capital cost subsidies (in the form of construction or rehabilitation, or of grants –R10 000 per ha or R50 000 per member-)

Such principles lie onto the prerequisite of prior full refurbishment of the schemes involved (in case they are not new ones), sponsored by the public sector (e.g. various ministries combining efforts). Besides, the first CMAs and WUAs are currently being established (end 2003).

5. Material and methods

5.1. General approach

The research team, led by CIRAD² and the University of Pretoria staff, proposes an action-research approach of SIS, in three steps (Perret & Le Gal, 1999; Perret, 2002b):

- Collecting information on the socio-economic and technical circumstances at household and scheme level; structuring data into crop management styles and farmers’ types;
- Capturing data into a model that calculates both the costs incurred by scheme management, and the possible contributions by farmers to cover these costs in a context of management by a water users’ association;
- Running the model on a scenario-testing and participatory basis, evaluating the impact of certain measures or decisions, or certain farmers’ strategies.

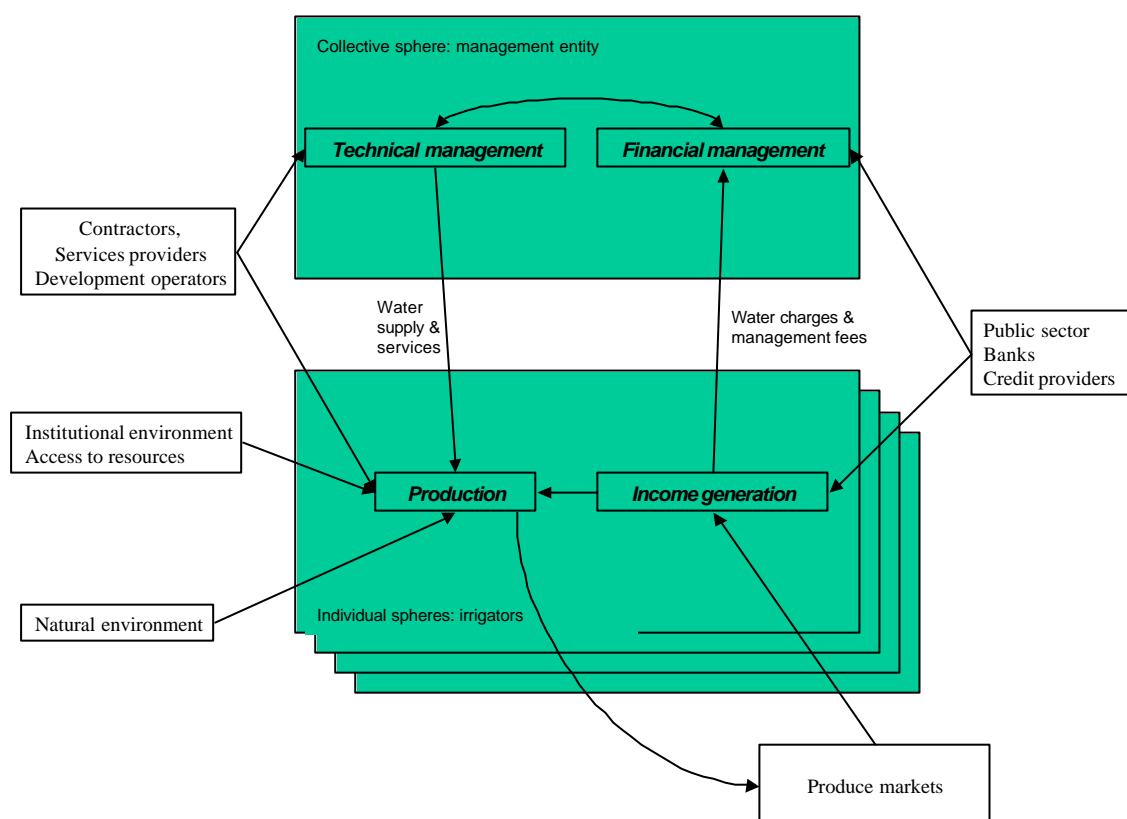
The following principles form the background of the approach:

- Establishing and sustaining multi-disciplinarity and partnership, meaning that engineers, agronomists, extension agents, economists, development operators, farmers, decision and policy makers are involved in the process
- Considering local and specific circumstances, meaning that, although generic, the approach takes account of peculiarities and adapts to local circumstances
- Developing and using a typology of farmers, i.e. groups with similar strategies and characteristics
- Acquiring a managerial vision of the scheme, i.e. the management entity (Water Users’ Association) provides irrigation water and related services to farmers, who, in turn, pay back for such services (client-supplier relationship, although farmers partake to the management) (see figure 1 and box 2)

² CIRAD is a French research organisation, specialised in co-operation on agriculture, animal sciences, forestry, food processing and development support for the developing countries. CIRAD stands for “Centre de Coopération Internationale en Recherche Agronomique pour le Développement”.

- Modelling then running simulations as ways to demonstrate and show the likely results of certain decisions or measures, to fuel discussion and make people interact, to challenge hasty judgements and support sound decisions, to raise new questions, and to foresee issues and problems.

Figure 1. Operation of an irrigation scheme: framework (source: authors, adapted from Le Gal, 2001)



Box 2. Operation of an irrigation scheme: a framework

Figure 1 represents the framework conceptualising the operation of an irrigation scheme. This framework attempts to integrate the different dimensions, stakeholders and functions that take place in a scheme. It is a conceptual framework, and an analytical framework as well, as it provides guidelines for multidisciplinary and comparative analysis.

The management of a scheme involves 3 types of stakeholders: the individual farmers, the management entity and external role-players. These can be the public sector (government, provincial authorities), contractors and service providers, banks, the marketing or food-processing sector. All provide financial or technical support to the management entity and/or to the farmers. Farmers manage production at farm level, possibly market the products, which in turn generate some revenue. The natural environment influences the production process (e.g. climate and soils, weeds, pests). The institutional context also impacts onto production, especially the rules on accessing resources (e.g. land tenure, inner water-sharing features, water rights). Farm profit influences back production, since it defines the level of intensification. Finally, contractors and service providers, the public sector (extension) also influence the production process.

The management entity (a corporation or an irrigation board in the past, a water users' association nowadays) provides irrigation water and related services to the farmers, for them to produce. It technically manages, operates and maintains the scheme as a whole. There are costs incurred by such management. This supposes a financial management. Funds are collected from the farmers, and managed at scheme level. Four major functions may be identified within a scheme: production (farmers), water supply / O&M (WUA), finance (WUA) and commercialisation / input supply (farmers and possibly WUA). These functions generate a number of flows and transfers: water (between WUA and farmers), money (between farmers and WUA, between markets and farmers), products (between farmers and markets), services (between providers and the scheme, between WUA and farmers), etc. Such transfers are conditioned by proper information circulation between all parties.

5.2. Smile: a data-capturing and simulation platform (Perret, 2002c)

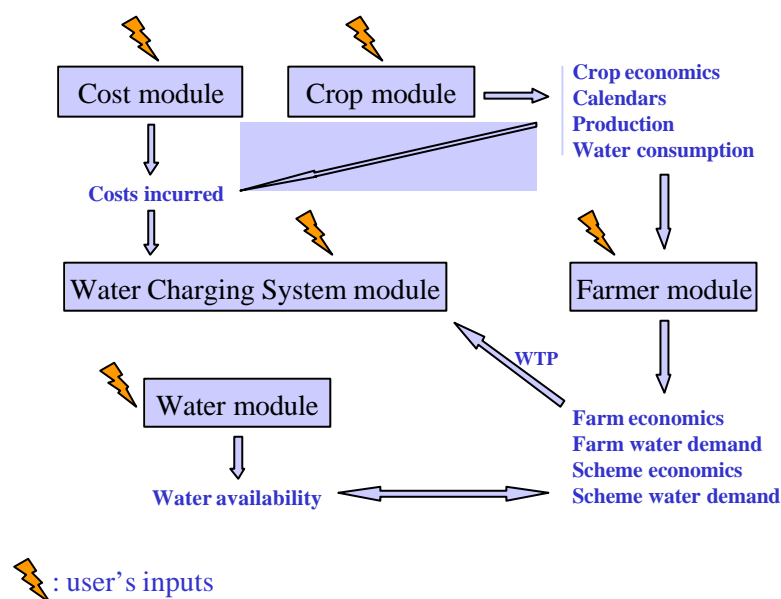
Smile³ consists of five input modules that form the basis of the information system, as interfaces for data capturing by the user (see figure 2). Each cost-generating item is listed in the “Cost” module. This module generates output variables that reckon the costs incurred by the scheme and its management (i.e. capital costs, maintenance costs, operation costs, personnel costs). Such information answer the question as to how much does it cost to operate the scheme in a sustainable manner (regardless of who is going to pay for it).

In the “Crop” module, each potentially productive and water-consuming crop is listed with its technical and economic features (e.g. management style, cropping calendar, water demand, yield, production and marketing costs). This module generates micro-economic output variables (e.g. gross and net margin par ha, and per m³) that allow comparative evaluation of crops in terms of profitability, land productivity, and water productivity.

A “Farmer” module captures the different farmers’ types, with their cropping systems (combination of crops that have been documented in the Crop module), average farm size, percentage of scheme’s size, willingness to pay for irrigation water services. This module generates type-related output variables (e.g. aggregated profit per type, crop calendar) and scheme-related output variables (e.g. number of farmers, aggregated water demand) when combined with the “scheme” module.

A “Water” module deals with water balance at scheme level (rainfall and resource-availability patterns, crop consumptions).

Figure 2. Smile: conceptual framework (source: Perret, 2003)



The “Farmer” and “Cost” modules are combined and used within the “Water charging system” module, and generates output variables on water pricing, tariff, cost recovery rate, contribution per type. This allows answering the question as to who may pay, and how much, for water services. It also generates some social and equity-related indicators, and resource-related indicators (e.g. total number of farmers, area per type, number of farmers per type, profit per type, profit at scheme level, total water consumption, overall weekly water balance).

The initial inputs (real data) form the base scenario. Additional scenarios may be tested through the capture of non-real / prospective data (e.g. alternative crops and cropping systems, emerging farmers’ types, changes in scheme’s management patterns, options for a charging system, new infrastructures, and the like) (see chapter 8).

³ Smile stands for “Sustainable Management of Irrigated Land and Environment”

Box 3. Economic terminology

The following terms have been used in the report:

$$\text{Total Revenue TR} = \text{Product Price} * \text{Output}$$

Example: Total Revenue for dry maize = 154 Rand per bag * 18.2 bag per ha = 2 802.80 Rand per ha

$$\text{Accounting Profit AC} = \text{TR} - \text{Total Costs}$$

AP differs from the Economic Profit for it does not consider implicit costs such as the opportunity costs associated with employing the resources in their current use rather than using these resources in their next best alternative (meaning that some income is forgone). In the report, AP will often just be called Profit P. Also, Total Costs are also called Production Costs.

Example: (Accounting) Profit for dry maize = 2 802.80 Rand per ha – 1 640.00 Rand per ha = 1 162.80 Rand per ha

TR and P apply at crop level (see examples here above), but also at farm and scheme level through simple combination of crops. However, one should not see the Profit as the net income gained at farm level, since it does not take account of further charges possibly shouldered by the farmer, such as taxes, water fees, land fees, depreciation of capital, and the like.

5.3. Data collection

In March 2003, a sample of 60 households has been randomly chosen among the farming beneficiaries. The scheme hosts a total of 149 beneficiaries⁴, yet with a significant proportion not farming at all. The scheme consists of 4 irrigation sections (wards) and interviewees have been selected according to the proportion of farmers onto each of these wards. A long comprehensive questionnaire has been applied (see model in appendices). Besides, several additional shorter questionnaires have been applied to non-farming beneficiaries and to people with no access to the scheme. It proved very difficult to get access to non-farming beneficiaries, owing to their reluctance to explain openly their situation and motives. Interviewees have been mostly farmers and households' heads.

Following this first round of interviews (2 weeks, March), some inaccuracies and lacks have been identified within the questionnaires. A second round of interviews has been carried out in July 2003 (1 week). The origin of such inaccuracies has been quite well elucidated at that stage: (1) some farmers tend to provide answers according to recommendations or best practices, and not according to their actual practices (typically on fertilizers' application), (2) some questions were misunderstood by the farmers (on issues and prospects), (3) some answers were misunderstood by interviewers (especially on mechanisation costs, on areas), and (4) some farmers mixed up and grouped irrigated plots with home yards, food gardens or even rain-fed plots in their answers. Interestingly, most misunderstandings and uncertainties were attached to subsistence farmers.

Most misunderstandings have been clarified after the second round. Remaining uncertainties, lacks, or weird answers led to discarding questionnaires.

In addition to this, extensive interactions with extension staff members at LP-DAE and with members of the management committee (WUA) were undertaken to determine general issues relating to the scheme. Finally, all 4 workshops plus meetings held with the management committee gave opportunities for further information gathering.

5.4. Data analysis

A database has been created on the basis of information collected, in the form of spreadsheets in MS Excel™. The basic cluster is the interviewed household, to which variables and information are attached. This includes information on households' characteristics, production features, resources, assets, and inputs, costs, and the like. More qualitative information is also included such as issues and prospects as seen by the interviewees.

⁴ In the report, a beneficiary is a person who owns an irrigable plot within the scheme. Amongst those, farming beneficiaries are the ones who actually grow crops on these plots.

The first step of analysis consisted of a selection of the most representative and common crops grown in the scheme (each representing more than 1% of the area cropped by the sampled households altogether). Each crop is described thoroughly, in the form of a crop management style (CMS), which includes crop yield, inputs, production costs and budget, water consumption (from standards –SAPWAT-, which uses data from the closest station, Letaba Letsitele, 30°40 E; 23°94 S), calendar, market price, type of product sold or consumed, and the like. Two major criteria have been used to define CMS: average yield and level of inputs for a given crop. Each product has been given a monetary value (even those self-consumed) according to the market prices for equivalent products.

The second step of analysis consisted of the establishment of a farmer typology. Farmers have been grouped into types. The idea is to reflect the diversity of strategies and situations that exist inside the scheme, yet in an intelligible and manageable manner. The typology has been oriented according to the objective of sustainable and autonomous management by the scheme. It includes sources and level of income, number and type of crops grown, proportion of crop sold as key criteria.

Types build-up must also consider the different CMS, as elementary clusters that are combined at farm level and determine farm profit, water consumption, and the like. In practice, any given type amalgamates and adds all economic, hydraulic and agronomic features of the different crops it grows.

Simplification and trade-offs are therefore part of typology build-up, between the complex reality and the model of it (the typology). Overall, the process of developing CMA and farmers typologies lasted from April to August 2003.

5.5. Scenario build-up

All the above forms a base situation, as a model that reflects the current state of affairs. This is captured into the Smile platform. Such base situation has been submitted to the management committee (August 2003). The CMS and farmers' types have been discussed and validated by the farmers. A first series of scenarios have then been submitted to the farmers, just to familiarize them with the exercise.

Scenarios are based on questions, in the form of "What if...?". Smile allows for testing alternatives and the effect of such questions on a number of topics: costs and infrastructures, crops and cropping systems, farmers' strategies and practices, water resource, market features, and the like.

Farmers and management committee members were invited to think about alternatives, ideas and questions they would like to see tested. A specific workshop has been held in September 2003, in order to present and discuss the results of the scenarios they suggested.

5.6. Brief presentation of the scheme

Bio-physical aspects

The Thabina irrigation scheme is located by 30°18 E and 23°58 S. It lies at an altitude of about 560m along the Thabina river, which runs North East towards the Great Letaba. The scheme is located 24km South East from Tzaneen (along the R36). It benefits from sub-tropical, frost-free conditions, and fairly good alluvial soils. Annual rainfall averages around 790mm, yet with drastic inter-annual variations (20-30%), recurrent and severe droughts, and a long dry season (about 90% of rain falls between October and February). The scheme started in 1962, to promote development and food security in impoverished rural areas of former Gazankulu and Lebowa homelands. Thabina lies at the southern edges of the Levhuu-Letaba water management area.

Land

The scheme composes of 234 ha with 149 farmers (PTO beneficiaries with irrigable plots) who are living in the surrounding villages (Lifara, Burgersdorp, Khopo, Mhlaba Kraal and Head/Kraal, Mafarane, Shwapane, Sasekane, Lenyenye, Zanghoma, etc). Initially each farmer was allocated one hectare, but re-allocation occurred afterwards. Some farmers now own more than 1ha. A striking fact is that about 40% of the land lies unused in Thabina, the plot holders not being interested in farming.

The tribal authority in Thabina is chief Mulhaba. His role is prominent in discussions that are underway with the Thabina management committee with regard to land re-allocation options, in order to improve the situation in terms of land use, and to allow new young farmers to settle.

Infrastructures

The infrastructures for water supply include the initial gravity-fed system (weir, dams and a main canal), now combined with 4 pumps (#1 and #2 are diesel pumps; #3 and #4 are electric pumps), which have been installed later to increase water supply to the main canal. The weir has been recently refurbished and upgraded, in the frame of the rehabilitation programme (see figure 3). The canal starts at a weir along the Thabina river downstream a dam. It must be emphasized that the dam was initially devoted to irrigation supply. Then, its purpose has switched totally to domestic supply. It currently does not store water for the scheme. This underpins a basic claim by the farmers, who want some water re-allocated to irrigation.

The length of the main canal is 7000m. About 5000m of it lies outside the scheme, where it used to be almost entirely covered with concrete plates, although now broken from place to place. It passes through a built area (communities) and water extraction and uses for different purposes seem to be usual practices along the canal (especially cloth washing, yard gardening, and even a plant nursery). Community members seem to find it easier to extract water from the canal that to resort to other sources at their disposal. Also, the Thabina dam was initially developed for irrigation purposes. It seems that it now mostly serves communities for domestic water, under municipal control, although its purpose remains officially irrigation water supply (under Dwaf control).

The scheme is about 2000m long. The main canal supplies secondary canals within each irrigation ward. Water bailiffs control each ward's water supply. Irrigation is scheduled on a turn basis among wards. There are four wards, and within each ward some farmers are allowed to irrigate while the rest are to wait for the next turn according to the schedule. Farmers commonly admit that all wards experience water shortages, with ward D being more exposed, as it lies at the ending part of the main canal.

Electric pumps have recently been badly vandalised, to such an extent that it should take quite some time to the farmers to get them repaired, owing to the costs incurred (copper wires being taken away, probably molten and resold for metal value; plus mere vandalism and destruction of the pumping stations). This has become a major source of concern in the scheme, to an extent that it has sometimes been difficult to address other issues with the farmers during the project's workshops.

Finally, it must be be noted that some commercial farmers (3-4) own private small pumps, extracting water from the river bed, especially in winter.

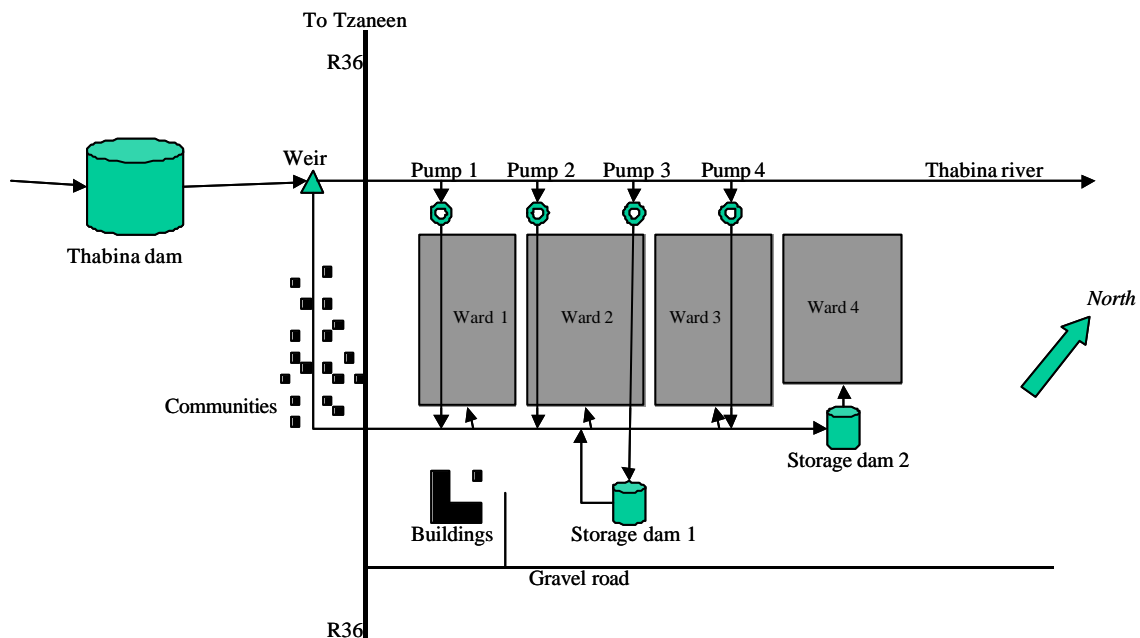


Figure 3. Schematic representation of the infrastructures in Thabina irrigation scheme (source: authors' data and existing maps)

Social and institutional aspects

The population of farmers in Thabina consists of two ethnic groups, Shangaans (majority) and Sothos, who go along and cooperate with no major problem. About a half of beneficiaries are older than 60.

At present, the scheme is the only scheme in the Limpopo province where a WUA has been officially established and endorsed by the Department of Water Affairs and Forestry (DWAF).

As far as management of scheme is concerned, both the management committee for the Water Users' Association and the staff members of the Limpopo Province Department of Agriculture (extension branch) are currently running activities on a daily basis.

Membership to the WUA is restricted to PTO holders, within the scheme. Yet other people from neighbouring communities use water from the same resource. Informal users draw water from the main canal before it enters the scheme (along the 5000m between the weir and the scheme). Communities are also using water from the main dam. They all depend on the same resource, therefore they have legitimate interests in how water is used and managed for irrigation, which remains by far the largest use in the area.

Agricultural products are marketed locally (neighbouring communities), in Lenyenye (a bigger village, some km North), and in Tzaneen (24km North West). Some farmers try and market specific products in Johannesburg, through contractors and hawkers. Most inputs are bought in Tzaneen.

6. Results: general issues and baseline situation

Recent available literature on the Thabina scheme mostly refers to the revitalization process. Besides infrastructural and institutional plans, it shows a number of socio-economic figures that are quite contradictory with the usual features of similar smallholder schemes. Smallholder schemes in South Africa are mostly moribund, with a significant proportion of non-farming beneficiaries, and a marked subsistence orientation. Especially regarding existing farmers' profiles in Thabina, it looks as if there were only two types of beneficiaries: part-time farmers and full-time farmers, both being farmers anyway. Such model also contradicts what local stakeholders' interviewees told the research team at the outset of the study.

A specific objective of the present chapter is to provide a clearer and more accurate description of the different farmer profiles that co-exist within the scheme.

6.1. The institutional environment

Figure 4 provides a simplified representation of the institutional environment surrounding the Thabina WUA. It is important to mention that the WUA is still in its inception phase.

It receives support from different stakeholders and organizations. It has already taken over certain key relationships and functions, such as negotiations with traditional authorities regarding land allocation processes. Farmers still deal with other key functions as individuals, for instance regarding access and relationships with markets. It must also be noted that relationships with other neighbouring users, tapping into the same resource, have not been initiated yet. The Thabina WUA is currently mostly dealing with irrigation water issues, irrigated land issues, and inner management issues (e.g. cost recovery on pump operation). It has initiated some role into input supply, establishing a contractual relationship with NTK for seeds, small implements and input supply. A shop has been established within the scheme's facilities. A monthly rent is paid to the WUA. In turn, farmers access inputs at reasonable prices, and with no transport costs incurred. However, the newly established shop has already been robbed.

In spite of the on-going transfer of management, the Government is still involved in Thabina. One extension officer from the LP-DAE is permanently based in Thabina (Mr. Leonard Rikoto). His role involves the provision of technical advice and training to farmers, yet with very limited means (no vehicle). Officially, Mr. Rikoto's area of intervention includes 3 schemes, including Thabina. With no vehicle on his own, he obviously cannot efficiently serve the schemes. Besides, usual technical functions performed by extension officers do not match the new needs expressed by the management committee, which is willing to acquire economic, financial and managerial skills. Also, the actual function of the extension officer remains quite unfocused and uncomfortable, as he tries to deliver onto different matters of interest, mostly at farmer level and not at WUA level (e.g. input supply, information diffusion, marketing options, etc.).

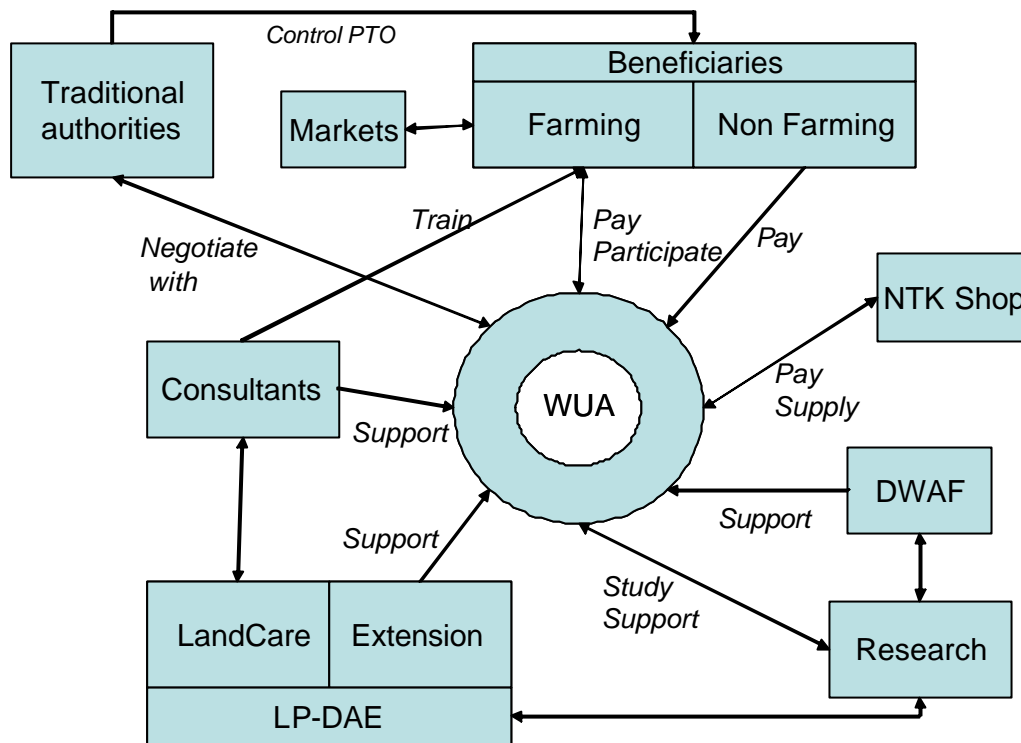


Figure 4. Schematic representation of the institutional environment of the Thabina WUA (source: authors' data)

6.2. The revitalization process: current status

The revitalization process is officially completed in Thabina. It has first addressed infrastructures. According to the revitalization operators, it consisted of:

- (1) installing 2 electric pumps
- (2) repairing existing diesel pumps
- (3) refurbishing / upgrading the weir, the main canal and one of the storage dams
- (4) levelling irrigated plots

The farmers' perspective and evaluation over the work done is slightly different. They acknowledge the improvement in water supply through the pumps, but complain about the resulting costs. Besides, vandalism prevents the electric pumps from operating properly. Their main complains touch on:

- (1) the lack of levelling, which is direly needed to improve furrow irrigation at plot level, and subsequently water sharing at scheme level (according to the farmers, plots that are properly levelled are irrigated more easily and more quickly, hence a quicker rotation among irrigators);
- (2) the need for canal upgrading and heightening, to increase its capacity;
- (3) the need to upgrade the secondary canals, most being in poor conditions, and resulting in water and time lost during irrigation.

It must be noted that farmers mention water shortages and the unfair sharing of water among themselves as background reasons for those works to be carried out. All in all, it has been found that 52% of farmers are not satisfied with the revitalization process. Most of these 52% feel that it has not been carried out and completed as initially promised (44% acknowledge some improvement).

Farmers also mention issues around the access to mechanisation. They feel that tractors have been left not repaired or in poor condition. They believe that the rehabilitation process should have provided at least some equipment in good working condition, for them to start well as autonomous farmers. An underlying issue seems to be the cost of mechanisation, since farmers resort to contractors to have their plots ploughed and prepared.

Crop budget show how expensive this is. As secondary measures, training sessions have taken place with farmers, especially on maize production. An experimental plot has been set up, for training and demonstration purposes. Members of the management committee complain that no training on management skills has taken place so far.

6.3. Descriptive statistics

Table 1 recaps some key information onto the Thabina scheme. The following paragraphs spell out most of the items listed.

The high average age of beneficiaries results from the mode of transmission of the Permit to Occupy, which usually does not occur before the current beneficiary passes away. Lack of interest by the youth is also a factor.

A majority of interviewees believes that more than half of the beneficiaries are actually farming (average: 58%). Such result contradicts the belief that all farmers are either part-time or full-time farmers in Thabina. Actually 42% of PTO holders do not grow anything, leaving their plots turning to fallow land. Management committee members and extension officers have confirmed such fact. Also, significant long term fallow land can be observed through out the scheme.

According to the study sample, the average size of land in Thabina scheme is 1,6 ha. As mentioned above, initially 1.0ha of land was allocated per farmer (PTO plot holders). But, the picture currently looks different after some re-allocation took place. Today, most beneficiaries own more than 1.0ha. Also, 3% of farmers access additional land using other people's PTO plots through leasing agreements (large scale commercial farmers, see typology on chapter 7) . Table 2 shows these land-related figures.

Table 1. Descriptive information on the Thabina irrigation scheme (source: authors' data)

Average age of beneficiaries	58 years
Percentage of female heads of households (beneficiaries, PTO holders)	37%
Average family size (number of people accommodated at household level)	9
Percentage of farming beneficiaries, as opposed to non farming occupiers	58%
Average farm size	1.6ha
Main crop	Dry maize
Crop calendar for the main crop	Mid Sept. to end Dec.
Percentage of sales (main crop) as compared to self consumption	27%
Main marketing channel	Hawkers
Percentage of farmers using loans	20%
Fees paid to the WUA	R120 per annum per ha
Percentage of farmers who think that rehabilitation resulted in improvement	44%
Major concern or issue as perceived by farmers	Lack of water, lack of equipment

Table 2. Figures on land in Thabina (percentage of farmers holding different size of land and tenure systems) (source: authors' data)

Average size of land in the scheme	Farmers owing 1 ha	Farmers with > 1 ha	Farmers with leasing arrangement	Farmers with dryland plots
1,6ha	70%	30%	3,3%	13,3%

Yet again, the figures on average farm size differ from those found in the literature on Thabina, which mentions a 2.2ha average size.

Apart from irrigated plot in the scheme, about 13% of beneficiaries access communal dryland, also through PTO, but they have to pay the initial cost (fees) which is directed to traditional authorities. No initial fee was required for irrigated plots. Most beneficiaries also own homestead yard land around their houses, where they may grow vegetables for own family consumption.

Table 3. Gender and decision-making features of interviewed households in Thabina, according to respondents (source: authors' data)

Declared Head	Actual farmer and main decision maker on farming	Percentage of respondents
Male within a couple	Couple	23,3%
Single Female	Single Female	36,7%
Male within a couple	Female (spouse)	8,3%
Single male	Single male	31,7%

Table 3 shows the gender profile of the interviewed households, as well as the decision-making features on farming. The number of single-person headed household is amazingly high, as compared to the figures collected in other schemes. Also, the proportion of female PTO holders (about 37%) is very high, as compared to other situations.

The total number of blocks held by the sample of interviewees is 960. Table 4 shows land use features in Thabina. Even among farming beneficiaries, there's some land left unused (about 23% of blocks), which adds on to the land unused by non farming beneficiaries.

On average, 10 blocks make up 1.0ha in Thabina.

Also the results indicate that 75% of interviewed farmers in the scheme are growing maize. Maize is mostly grown in summer, although some farmers try winter maize. Summer maize is mainly grown for own family consumption, possible surplus is sold. Winter crops are meant especially for market purpose. Almost all interviewed households grow vegetables such as tomato, spinach, onion, cabbage, etc. A large number of households also grow groundnuts in the scheme (in summer).

Table 4. Land use in Thabina scheme (percentages of blocks from the sample surveyed) (source: authors' data)

Total number of blocks	Number of blocks used	Maize blocks	Farmers who have planted maize	Farmers using at least ½ of their blocks
960	76,6%	31,2%	75%	90%

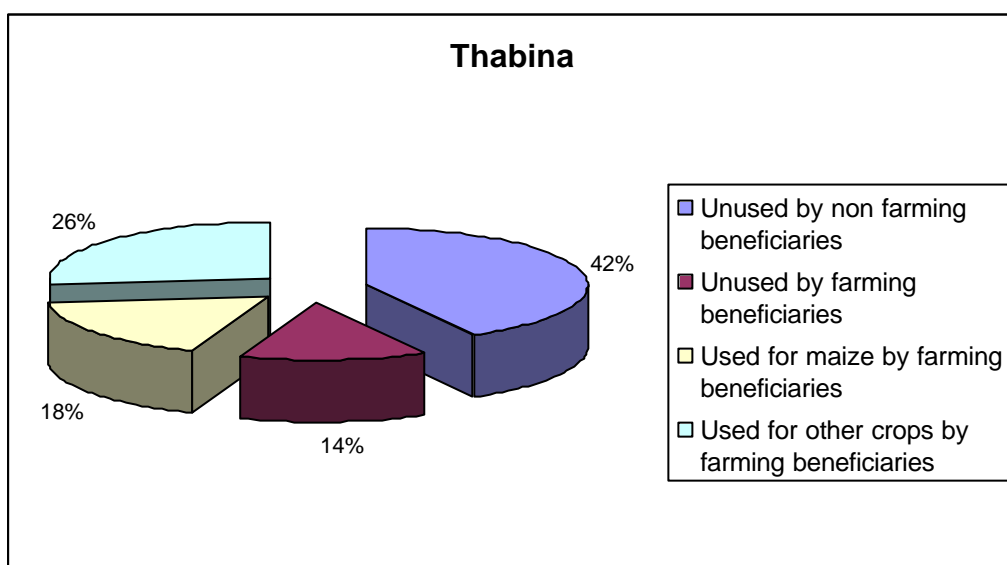
As already mentioned, the average proportions of farming and non-farming beneficiaries have been calculated from data collected during the interviews (farmers' perceptions). According to that calculation, 58% of beneficiaries are farming in Thabina. Assuming that (1) such average makes sense, (2) the sample of interviewees is representative, and (3) the number of blocks owned is even among farming and non farming beneficiaries (which hypothesis may be challenged, as seen below), it is possible to map out land use features (see figure 5).

All in all, irrigation land is better utilized in Thabina than in Dingleydale and New-Forest, for instance. Also, it is interesting to notice that vegetable cropping uses more land than maize cropping. However, yet again, a majority of land remains unused within the scheme.

The picture might well be different if one considers that the number of blocks controlled by non-farming occupiers is slightly lower than the number of block owned by farming beneficiaries. According to interviews and further calculations, the average farm size of the former should be around 1.5ha (as opposed to the 1.6ha average size). Therefore the proportion of unused land by non-farming occupiers should actually be slightly lower than those 42%.

Table 5 gives some more insights onto crop farming styles. It highlights crop diversification as a key feature of farming systems in Thabina, although maize remains the pivot of these systems. There's a significant number of farmers who just grow vegetables and other crops, mostly for marketing purposes, and not maize.

Figure 5. Land use patterns in Thabina (% of blocks used for a given purpose) (source: authors' data)



According to farmers, the land that remains unused by farming beneficiaries (14%) refers to the lack of security in water supply, especially in winter.

Table 5. Crop farming styles in Thabina: proportion of farmers (source: authors' data)

Producing more than 4 maize bags	Growing summer maize	Growing winter maize	Marketing maize	Growing only maize	Growing both maize and vegetables	Growing only vegetables
43.3%	70.0%	10.0%	25.0%	23.3%	55.0%	21.7%

Table 6 sums up some features of other farming activities that are practiced. The results indicate that 2/3 of the farmers keep livestock, 20% own a bakkie, and only about 3,3% own a tractor. Despite the fact that most farmers face lack of cash income, more than half of them hire external labor (most of it as permanent laborers) who have to be paid throughout the seasons. About 92% of farmers in the scheme have hire contractors who provide tractor and implements for plowing, disking and furrowing. Some rare equipped farmers hire out these services to others.

Although farmers already pay for water supply in Thabina (R10 per beneficiary per month per ha), a question was asked as to who should pay for water supply and related services, in order to collect the farmers' feeling (results in table 7). A large majority of farmers believe that all should pay regardless of what a farmer does.

Table 6. Various farming indicators in Thabina scheme (source: authors' data)

LSU / household (average ratio)	Household keeping at least 1 LSU (%)	Household owning a bakkie and/or a tractor (%)	Household hiring paid labour (%)
2,7	66,7	20	58,3

LSU: Large Stock Unit equivalent

Table 7. Opinion of respondents on who should pay for water supply and related services in the context of management transfer (percentage of answers) (source: authors' data)

All beneficiaries	Those who are irrigating	Those who are irrigating a lot	Government
58,4%	20%	8,3%	13,3%

As far as the willingness to pay is concerned, the interviewed households were also asked to evaluate and disclose their possible financial contribution to water supply and related services (results in table 8). The overall response is very positive. Figures go well beyond those collected in Dingleydale and New Forest on the same question. This probably relates to the fact that farmers already pay for water services in Thabina. A majority of farmers are willing to pay between R120 to R240 annually, which falls just above the current fees (R10/ha/month, which makes R120). 10% of farmers are even willing to pay more than R600. Besides, the average willingness to pay (calculated from all answers) is well higher than the figures calculated in Dingleydale and New Forest irrigation schemes.

Table 8. Respondents' willingness to pay for water supply and related services in the frame of local management of the scheme (as per amount class, and average amount unit in R per ha per year) (source: authors' data)

Not willing to pay	Less than R100	R100 to R120	R120 to R240	R240 to R600	More than R600	Willingness to pay (average of all answers)
5.0%	8.3%	3.3%	51.7%	21.7%	10.0%	R235.00

The respondents were asked to list and to rank the problems they perceive with regard to their farming activities in Thabina (see figure 6). Water shortages appear to be the main concern in Thabina, by far. At the same time, management committee members mentioned that there have never been acute water problems in Thabina, as long as pumps were operating. Such contradiction lies on the fact that electric pumps hardly operated properly in recent times, as the power had been cut off by Eskom (no payment of bills), and pumps had ultimately been completely vandalized. This may also reflect that farmers in ward D, and generally subsistence farmers (see chapter 7.1), had an opportunity to tell their views during the interviews. They seem more reluctant to express themselves within the management committee, whereas they are the hardly hit ones in terms of water issues. Each time water sharing rules are infringed upstream the canal (see below), they are the ones most concerned and despoiled. Such discrepancy in views should be addressed within the management committee, since it calls into question its representativity, hence legitimacy and capacity to solve problems.

Further discussions allowed explaining the prominent status of water-related issues. It refers to external issues, to infrastructural issues, and finally to water sharing issues. Farmers are concerned with the increasing competition over the resource with other local users. DWAF is requested to reassert the initial irrigation purpose of the Thabina dam. Even louder, the farmers claim that with no heightening of the main canal, water supply to farmers will always fall short of their needs. Once again DWAF is requested to act towards this end.

Internally, some individual free-riding irrigation practices have been mentioned. Some farmers irrigate by night, regardless of the irrigation turn. Others take more than one day to water their plot, owing to ill-levelled surfaces. This despoils the following farmers, in terms of watering turns. Some others block up the main canal with

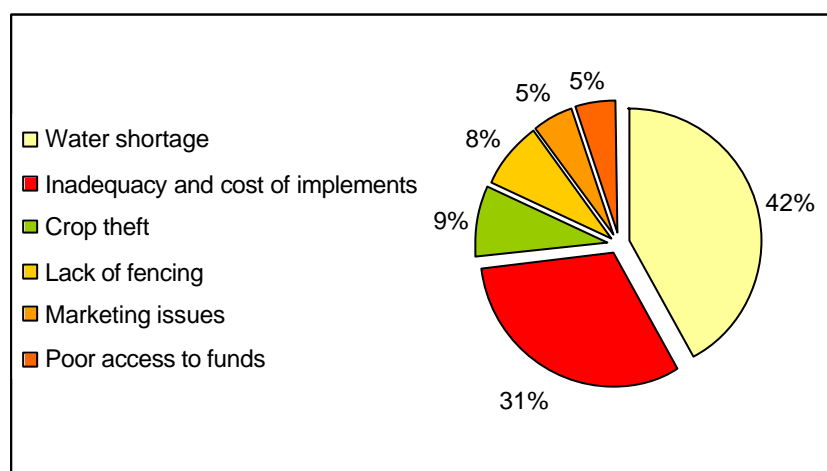
stones, so that water flows more quickly onto their field. This also prevents other farmers downstream from irrigating at the same time. Such practices hit ward D farmers harder than others.

Also, farmers do not actually apply the short-furrow technique when it comes to irrigating, in spite of training and promotion on this water-saving technique. Such technique is also more versatile since it does not require well levelled ground to apply.

Finally, the erratic climatic conditions must also be underlined. The year 2003 has seen a drastic and long drought in the Limpopo. It has undoubtedly sharpened the farmers' sensitivity onto the topic. The low figure on winter crops (more exposed to drought) (see table 4) also reflects such issue.

Interestingly, commercial farmers hardly mentioned any marketing problems, whereas such issue seems crucial for subsistence farmers (see typology on chapter 7).

Figure 6. Farming issues in Thabina as perceived and expressed by farmers (source: authors' data)



7. Results: typologies

7.1. A typology of farmers: farming styles, livelihoods and strategies

In Thabina, the classification process on farms has focused on (1) the level of marketing (as opposed to subsistence), (2) the level of diversification (number of crop sold), and (3) the livelihood system (source of income). It also seemed important to differentiate farms in terms of size, hence the identification of large-scale commercial farms. The typology features 9 types of households, as beneficiaries of the Thabina irrigation scheme, as explained on figures 7 and 8. Further information is provided in table 9. It must be underlined here that attempting to generalize data onto the whole scheme refers to the assumption that the sample of interviewees (60) is representative of the whole scheme (149 farmers). Although the main trends are likely to be properly reported, there might be some differences and uncertainty attached to some figures (e.g. number of farmers per type).

Such typology may be simplified into 4 macro-types: subsistence farmers, specialized farmers, commercial farmers, and non-farming occupiers.

The classification does not make sense only in terms of the above-mentioned criteria. It also reflects strategic elements such as intensification. For example, commercial farmers spend an average of R250 per ha per year on labour, whereas other types spend R41.

The typology highlights two major traits of the scheme, somehow contradictory:

- There's a large proportion of non-farming land occupiers in Thabina, hence a large area that is left unused; such trait is common to a lot of smallholder irrigation schemes in the Limpopo province;
- Most farming beneficiaries are seriously commercially oriented, and subsistence is a minority feature, which are uncommon traits among smallholder irrigation schemes in the Limpopo province.

Figure 7. Typology of households in the Thabina irrigation scheme; criteria for classification and number of farmers per type (based on proxy and calculations, assuming that the sample is representative) (source: authors' data).

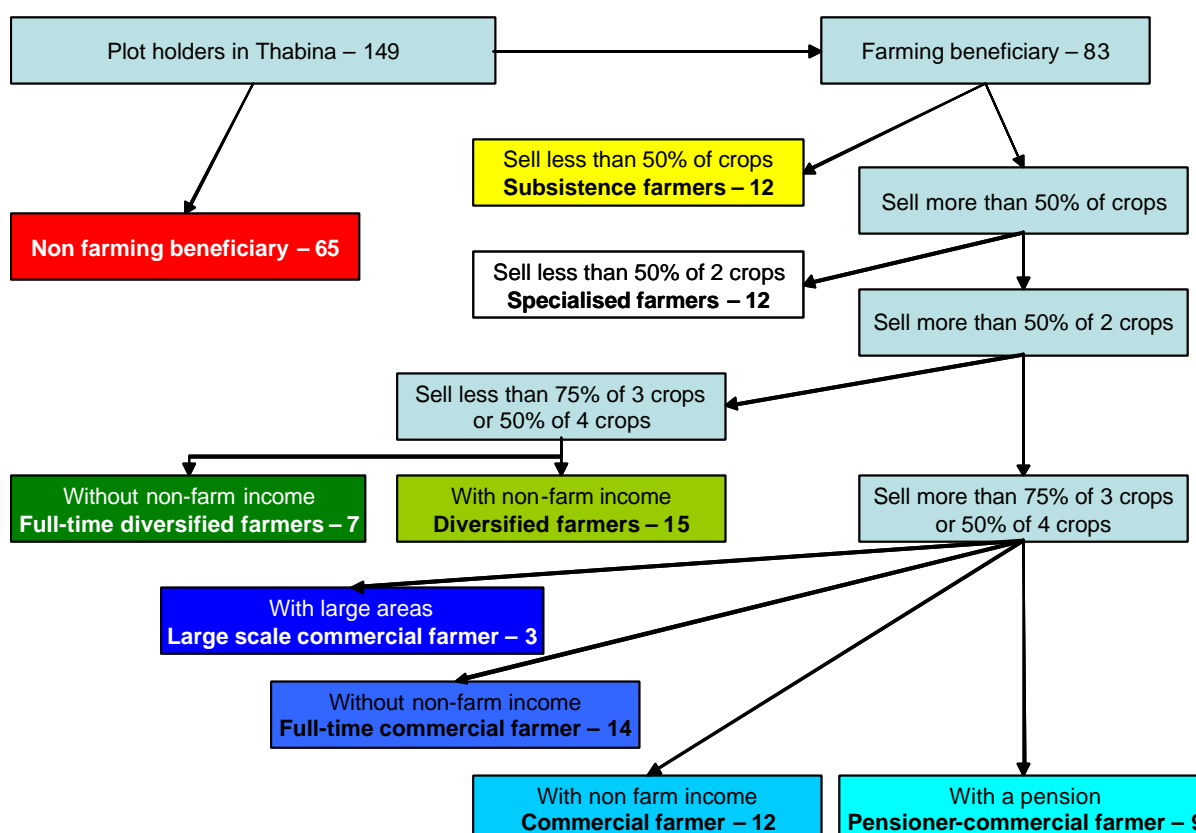


Table 9. Farmer types in Thabina: average farm size, number of farmers involved and area covered per type (source: authors' data).

Farmer types	Average farm size (ha)	Nb. of farmers	Area covered (ha)
Non farming land occupiers	1.5*	65	97.5*
Subsistence farmers	1.0	12	12.0
Specialized farmers	1.4	12	16.8
Diversified farmers with non farm income	1.7	15	25.5
Full-time diversified farmers	1.0	7	7.0
Pensioners – commercial farmers	1.8	9	16.2
Commercial farmers with non farm income	1.6	12	19.2
Full-time commercial farmers	1.2	14	16.8
Large scale commercial farmers	8.0	3	24.0
Whole scheme	1.6	149	235.0

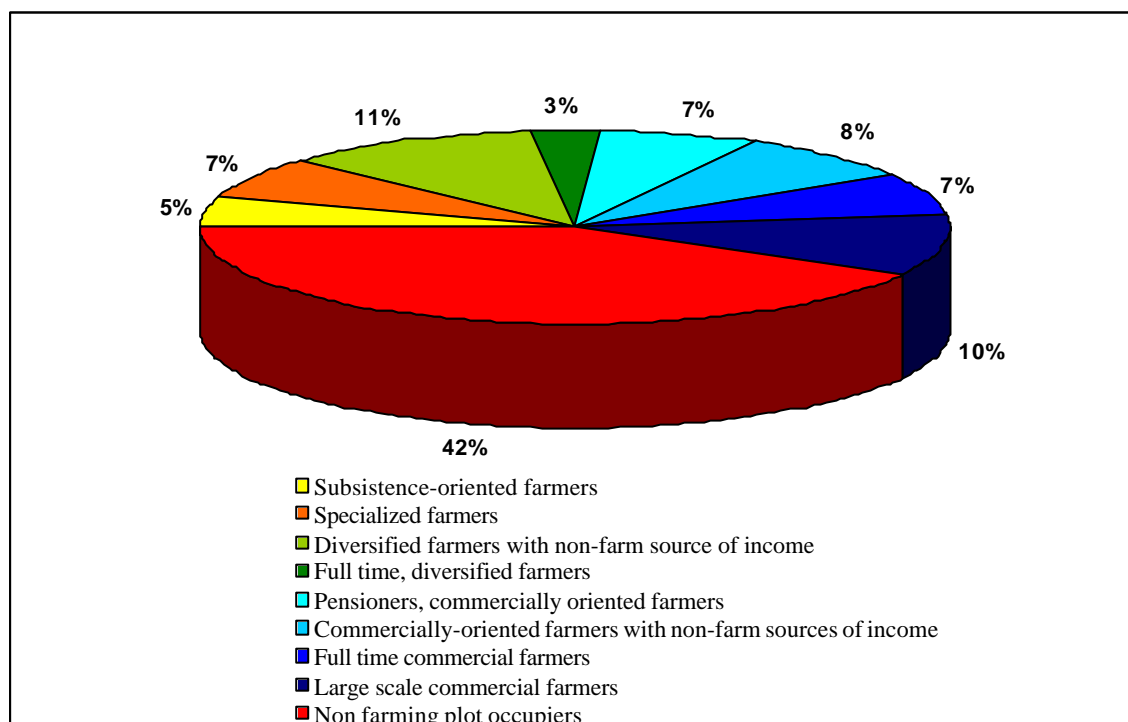
* estimation

As previously indicated and shown in figure 3, irrigation wards A and B are best served in irrigation water, and potentially benefit from the closeness of the R36 road, owing to their location. Ward D is not well served and is

more exposed to water shortages, being at the far end of the canal. Interestingly enough, 65% and 60% of farmers in wards A and B respectively are commercial farmers, whereas ward D has a mere 12% of commercial farmers. It looks as if insurance of supply plays a key role in strategy and farming style definition by farmers.

Also, 37% of PTO holders are women in Thabina. Only 8% of male PTO holders are subsistence oriented, whereas 18% of woman PTO holders are subsistence oriented.

Figure 8. Representing the different types of farmers in Thabina, with the proportion of area covered (source authors' data).



7.2. A typology of cropping systems: crop management styles and crop features

In Thabina, summer dry maize is the main crop grown, like in most smallholder schemes in Limpopo. However, a huge diversity of crops does exist, and more particularly winter crops (vegetables).

Table 10 recaps all major crops that are grown in Thabina (each representing more than 1% of the scheme's area). It must be emphasised here that these data refer to farmers' sayings and remembrance of their cropping systems and performances during the last cropping seasons (i.e. winter 2002 and summer 2002-2003). Therefore, such information should not be taken as generic and ever-standing. It highly depends on circumstances that took place during the given cropping seasons. Such is the case also for market prices. Also, actual water consumptions could not be reached accurately. Standard irrigation requirements for the area, taking into account average rainfall patterns, have been considered. Such figures are probably very wrong and cannot reflect the actual irrigation practices, hence consumption, by farmers. However, they form a starting point, and they will prove very useful during the next simulation phase, for comparison purposes. The absolute figures are not accurate, yet they allow for relative comparison in terms of increasing or decreasing consumption, according to scenarios (see chapter 8).

Finally, all these figures are averages. Choices had to be made in terms of differentiating the main modes of management for any given crop. All crops, except green maize which management style looks quite homogenous among farmers, can be split into 2 main management styles. This sometimes refers to "Low yield" and "High yield", since yields are significantly different whereas management style seem homogenous otherwise. Lack of skills, lack of information (e.g. on diseases), or specific failure on that given cycle (pests, water shortage) may explain such difference. In other instances, the difference refers more directly to a strategy by the farmers, in terms of level of intensification ("Intensive", "Extensive"), hence resulting in significantly different yields.

Such distinct management styles and performances are interesting from a support point of view. CMS that are labelled “Low yield”, hence resulting from a poor performance by farmers, can be spotted for training and technical advice. CMS that are labelled “Extensive” may rather refer to poor access to markets by farmers, hence the resort to an extensive strategy which does not suppose that those farmers are unskilled.

Table 10. Crop management styles in Thabina (source: authors’ data)

Crop management style	Yield (unit)	Market price / unit (Rand)	Production costs (Rand)	Total Revenue (Rand)	Profit (Rand)	Water consumption (m3) **
Dry maize – Low yield *	6.6 bags	166	1470.00	1095.60	-374.40	5840
Dry maize – High yield *	18.20 bags	154	1640.00	2802.80	1162.80	5840
Green maize – Average *	1690 cobs	0.76	1170.00	1284.00	114.00	6520
Groundnut – Extensive *	10 bags	222	230.00	2220.00	1990.00	4190
Groundnut – Intensive *	18 bags	225	630.00	4050.00	3420.00	4190
Cabbage – Extensive	1290 heads	3.30	880.00	4257.00	3377.00	3700
Cabbage – Intensive	1960 heads	3.30	2260.00	6468.00	4208.00	3700
Green beans – Extensive	90 kg	23.70	1980.00	2133.00	153.00	4020
Green beans – Intensive	430 kg	24.20	3110.00	10406.00	7296.00	4020
Onions – Extensive	78.5 kg	22.00	520.00	1727.00	1207.00	2640
Onions – Intensive	287 kg	16.00	1180.00	4592.00	3412.00	2640
Peas – Low yield	32 kg	24.50	940.00	784.00	-156.00	3610
Peas – High yield	135 kg	25.00	1020.00	3375.00	2355.00	3610
Spinach – Extensive	560 bunches	3.80	585.00	2128.00	1543.00	3020
Spinach – Intensive	1010 bunches	4.00	1820.00	4040.00	2220.00	3020
Tomato – Extensive	130 boxes	22.90	1020.00	2977.00	1957.00	3910
Tomato – Intensive	510 boxes	23.50	3530.00	11985.00	8455.00	3910

*All figures are expressed as per ha. All figures are averages obtained from different interviewees (except ** from SAPWAT). * Summer crops*

7.3. Combining typologies, establishing a base situation

The above listed crop management styles form the basic clusters, the bricks that will be combined in order to build the complete farming systems. Further analysis, regrouping and choices allow representing the current farming systems in Thabina, in coherence with the farmer types, as follows:

- Subsistence farmers grow low-yielding maize, with groundnut (extensive), mostly for self consumption;
- Specialized farmers grow low-yielding maize; some of them do grow other crops on small areas (below minimum requirements to be considered though)
- Diversified farmers with non farm income grow high-yielding maize and groundnut (intensive); it looks as if the non-farm income allows them to invest more in production (larger areas, more intensive);
- Full-time diversified farmers grow high-yielding maize, spinach and cabbage (both extensive); maize surplus is sold, as well as vegetables, in order to secure income;

- Pensioners – commercial farmers grow onions (extensive) and green beans (intensive); it looks as if they can take some risks growing these non traditional crops, which transport and marketing are quite easy and profitable; skills probably contribute significantly here;
- Commercial farmers with non farm income grow low-yielding maize (that is self consumed), onions (extensive) and tomato (intensive); they also produce several high value vegetables and fruits on small areas;
- Full-time commercial farmers grow spinach and cabbage (both intensive) and tomato (extensive); most of them have quit growing maize and have turned to profitable vegetable cropping;
- Large-scale commercial farmers grow a wide combination of crops, sometimes non traditional or even exotic ones (e.g. oca, avocado); their core crops are cabbage and green beans (both intensive), tomato and onions (both extensive) and dry maize (low yield). It must be emphasised here that such farmers are very few in Thabina, yet very diverse in their features (e.g. area, crops).

Such representation is a model, which oversimplifies the reality. Discussions with farmers showed that they quite easily see where they stand into the farmer typology, but they may not always agree upon the crop management styles that are attached to them. Details and individual practices are not accommodated into the model, e.g. certain minority or uncommon crops are not considered, the average cropping area allocated to each crop actually varies from farmer to farmer within a given type, etc.

However, once such considerations are exposed, along with the need for such “levelled” representation, the farmers have accepted and validated the model.

The model has been captured into the Smile database and simulation platform (see chapters 5.2. and 5.4.). In the current situation, and assuming that the model captured into Smile reflects the reality, the Thabina scheme features the following traits.

The total annual farming revenue is R191 634 (turn-over), although the profit at farmer level just amounts R73 930 (the difference being absorbed by the surrounding agribusiness and labour sectors, i.e. inputs purchased, mechanization contractors, labour hired). The farmer annual profit per ha (effectively cropped) averages R675, which is very low (an old-age pension amounts 10 times this figure). The profit per ha cropped averages R1 581.

Table 11. Traits and performances of farming styles and strategies in Thabina (source: authors’ data)

Farmer type	Farm area (ha)	Cropped area (ha)	Profit per ha	Profit per farm	Profit per m ³	Water consumption (m ³ per farm)	Number of farmers
Non farm plot occupiers	1.5	0	0	0	-	0	66
Subsistence farmers	1.0	0.67	56	37	0.01	6884	12
Specialized farmers	1.4	0.54	-443	-239	0	5904	12
Diversified farmers with income	1.7	1.0	1 594	1 594	0.15	10315	15
Diversified full-time farmers	1.0	0.57	1 260	718	0.14	4965	7
Full time commercial farmers	1.2	0.5	2 379	1 189	0.34	3467	14
Pensioners commercial farmers	1.8	0.45	3 092	1 391	0.53	2611	9
Commercial farmers with income	1.6	1.15	215	248	0.02	10471	12
Large commercial farmers	8	5.8	903	5 240	0.11	45782	3

The total annual water demand, including losses, amounts 668 150 m³. On a weekly balance basis, and with solely the canal assuring supply, the total demand exceeds water supply from April to early July, and from

October to December. During these times of shortages (which have been acknowledged by the farmers), the pumps must be functioning (see costs incurred below), adaptations and reductions in irrigation, and possibly conflicts occur.

The current costs incurred by management and operation amount R11 400 (fixed operational costs, and personnel) plus R30 000 (variable operational costs, i.e. pumps' electricity and diesel), that is R41400. Assuming that all beneficiaries pay R120 per ha and per year as water and management fees, 68% of those costs are covered in the current situation. The research team understood that some beneficiaries were not paying the fees, and that some others would pay for diesel (influential members of the management committee and/or commercial farmers). The situation is worrying anyway, since bills from Eskom remain unpaid, with the threat of power being cut.

Table 11 recaps the results on the current situation, at farmer type level. The most striking figures that come out are (1) the limited land use by all types (although some areas covered with marginal crops were not considered), and (2) the very low profit made at farm level. Farmers blame water shortages, the low insurance of water supply, the high production costs, and the lack of financial reasons for those shortcomings. Also the huge difference between types' water productivity is worth noticing (roughly calculated as Profit per farm / Water consumption per farm). Pensioners commercial-farmers make R0.53 per m³ used, whereas large commercial farmers make R0.11, subsistence farmers R0.01. For comparison sake, it is worth mentioning that the supply of 1 m³ costs R0.06, according to the current O&M costs incurred.

8. Building scenarios, investigating options and impacts

After the baseline situation was presented and discussed with the management committee (June 2003), the research team first introduced changes onto that baseline situation (or base scenario), for demonstration purpose before the farmers. The idea was to illustrate the concept of scenario, i.e. the possibility to test all sorts of changes, to foresee the impact of such changes onto the situation in Thabina., on a simulation basis.

The farmers were then asked to formulate their own questions. Five types of questions have been expressed (session in August 2003):

- (1) What would be the consequence of **upgrading the main canal** (heightening), with an augmented intake at the weir? This question shows how much the farmers are focusing on the issue. The underlying idea is to use the pumps as little as possible, hence to reduce the operational costs, while limiting water shortages and sharing issues within the scheme. Such idea accompanies all following ideas in terms of increased use of water (more users, more water-consuming crops)
- (2) What would be the consequences of an **increased vegetable production** by most farmers? Faced with the current situation, the management committee acknowledges that most farming systems are not profitable. The underlying idea of the scenario is to investigate possible changes in terms of intensification and shift towards vegetable production, yet with pending questions in terms of water supply, farmers' skills, and marketing.
- (3) What would be the consequences of **land reallocation**, from non farming occupiers to willing new settlers? The proportion of unused land is unacceptable, especially with regard to the long list of applicants. The idea is to investigate the impact of such reallocation. Negotiations have been initiated with the traditional authorities, in order to make this process possible.
- (4) What would be the **appropriate water charging system** for Thabina? In the current situation, non paying beneficiaries and the low fees (R10 per year per ha) allow covering only 68% of the operational costs.
- (5) What would be the **best farming model** in Thabina? The members of the management committee acknowledge the diversity of farming systems that take place, with diverse performance and efficiency. A majority of farming strategies are not profitable, while much land remains uncropped. The idea is to identify the best options and combinations, and to highlight their feasibility.

It must be noted here that these ideas and questions remained unchallenged by the research team. Being realistic or not, feasible or not, they have been tested anyway.

Such questions had to be translated into quantified scenarios that could be simulated into the Smile platform.

8.1. Increased water supply

The first question has been addressed through the simulation of a threefold increase of the water supply flow (scenario 1), assuming that the intake at weir level would be augmented and that all things remain equal (current cropping systems). This has resulted into a fairly simple simulation, which outcome demonstrated that all water shortages are removed. Interestingly, side calculations also demonstrate that as soon as pumping costs are below R17 000 per year, all costs are fully covered through the current charging system (R28400, provided all beneficiaries pay). Scenario 1 will be introduced further in order to check if such option would solve water supply issues when more vegetable production takes place (scenario 2 and 3).

8.2. Increased vegetable production

The second question has been addressed through the introduction of vegetable crops into the scheme. It has been translated as to what if all farmer types grow “extensive spinach” on 0.25 ha each (scenario 2a). A second related scenario considered the additional production of “extensive tomato” on 0.5 ha (scenario 2b). “Extensive spinach” (Swiss chard) has been chosen because it seems easy to grow, yet with a reasonable good return. “Extensive tomato” is already well known by the farmers (44% grow it). The respective areas chosen reflect the current practices, and remain reasonably realistic. Table 12 recaps the results obtained with scenarios 2a and 2b.

Table 12. Comparing results from scenarios 2a (spinach) and 2b (spinach + tomato) with the current situation (source: authors’ data).

	Base situation	Scenario 2a	Scenario 2b
Total water demand (m ³)	668 150	785 366	1 088 893
Total costs incurred (R)	41400	46 665	60 291
Percentage of costs covered	68%	60%	47%
Average cost per irrigable ha (R)	177	199	258
Average profit per irrigated ha (R)	675	690	785
Profit at scheme level (R)	73 930	103 662	180 296

Profit being considered before payment of any water fee (see Box 3).

The results show that growing vegetables, even in an extensive way, leads to a better utilization of resources, i.e. water and land. The increase in the overall profit proportionally outweighs the increase in water consumption. Such outcome owes to increased land utilization (more ha are irrigated and cropped), whereas average profit per irrigated ha just slightly increases.

Scenarios 2a and 2b refers to extensification, whereby increased use of resource leads to more production. This might be a problem in terms of water availability. The total water demand is such that this scenario is feasible only with intensive use of pumping. The mere R120 that are currently paid cannot cover the increasing cost incurred by pumping.

If the hypothesis of a threefold inflow of water in the main canal (scenario 1) is introduced, the water issue is solved (more water), as well as the cost recovery issue (no need for pumping). Scenario 2b results in a light water shortage limited to May, which can be overcome with some pumping and/or crop calendar shifts.

The results on extensive spinach and tomato also show that there’s a need to intensify production systems. Shifting to other crops such as vegetables will prove fully efficient only if intensification takes place (a better use of the same resources leading to increased production).

8.3. Reallocation of unused land

The third question had to be refined with the management committee. What would be the type of farming systems performed by the new comers? What size of unused area would be cropped again? It was decided that the reallocation process would first address half of the unused land, meaning that just 21% of land would remain unused. Also, it was decided that the new comers would be commercially-oriented farmers, assuming that they would perform the same cropping systems as the current farmers in that type (see chapter 8.2). Table 13 recaps the outcome of such simulation (scenario 3)

Through such scenario, full time commercial farmers become the core group of the scheme (55 farmers). A question remains as to is it viable to settle new comers on 1.2 ha, while the current commercial farmers' profit is R1189 per ha per annum. The reallocation of land towards productive use appears to be a sound move, yet with limited impact if intensification is not carried out at the same time, along with a better use of land (commercial farmers currently use only 0.5 of their 1.2 ha). Also, a new paradigm around land size must take place if settlements occur. This will be discussed further in conclusion.

Yet again, the water supply and cost recovery issues would be solved with a significant increase in water inflow (scenario 1). However, the need for an increased fee (up to R204/ha/year, hence R17/ha per month) seems very reasonable with regard to the significant increase in profit per ha.

Table 13. Comparing results from scenario 3 (land reallocation to commercial farmers) with the current situation (source: authors' data).

	Base situation	Reallocation
Unused area by non farming occupiers (ha)	98	49
Number of commercial farmers	14	55 (41 new comers)
Percentage of costs covered	68	59
Average profit per irrigated ha (R)	675	1175
Total costs incurred (R)	41 400	47 774
Average cost per irrigable ha (R)	177	204
Total water demand (m ³)	668 150	810 103

8.4. Best water charging system

As seen in chapter 6, farmers already pay water fees in Thabina (R10 per ha per year). Such fees currently cover 68% of operational and personal costs. Current costs amount R174 per ha per year. To cover them, a fee of R14,50 per ha per month would be required.

It must be mentioned that this R10 fee has initially been established “by the rule of thumb”. Although it does not fall far from calculated requirements, such amount cannot cater for non-ordinary operation and maintenance costs. Recent vandalism imposes the replacement of wires, which in turn requires specific fund raising among farmers.

Tables 12 and 13 show that any attempt towards crop diversification or land reallocation requires more pumping, hence increased fees (in the current state of infrastructures). For instance, scenario 3 (land re-allocation to commercial farmers) would require all to pay R17,00 per ha per month. Scenario 2b (increased tomato and spinach cropping by all) would require R21,50 per ha per month.

Regardless of the amount, the charging system remains the same for all scenarios, i.e. it does make everyone pay, but it does not further charge irrigators that openly commercially-oriented and use more water. It does not generate any incentive towards water saving.

Most farmers indicated that they were ready to pay more if necessary (table 8), yet with some differences among them, depending on their farming profit, and their commitment to the scheme. Also, water demand greatly varies among types.

Some committee members are willing to investigate alternative systems for charging, regardless of the amount required. It has been suggested that farmers pay according to their consumption, so that reasonable use take place. From the simulation and base situation, it is established that 1m^3 costs R0.06. The problem is to evaluate correctly each farmer's consumption. There is no measuring device in Thabina, and the SAPWAT standards are probably too far from reality to be used as references.

Furthermore, establishing water fees from actual consumptions would set aside non-farming plot occupiers. There must be some form of incentive to either make them farm, or leave, or in any case pay their share.

Therefore, if the objective is to combine objectives of (1) reasonable use and fair pricing, and (2) incentive to farm, a mixed charging system could be established, with a fixed component applying to all beneficiaries, and a variable component, increasing along with increased consumption, and applying to irrigators.

Based on this idea, further investigations were done with Smile. The main issue remains the lack of records or measurements on actual consumptions, hence the need to use cropping systems as references. During report back sessions with farmers, such a mixed system has been presented to the farmers and to DWAF, as an example. The system is as follows:

All beneficiaries would pay a fixed component, per ha owned, regardless of what is done (e.g. R10 per ha per month). Then farming beneficiaries would pay an additional variable component, per ha cropped (e.g. R40 per ha per month).

As a result, a non-farming plot occupier with 1 ha would pay $R10 \times 12 = R120$ per year.

A farmer with 1ha, growing maize from September to December (4 months) on 0.5ha, and cabbage on 0.25ha from April to mid June (2,5 months) would pay $(R10 \times 12) + (R40 \times 0.5 \times 4) + (R40 \times 0.25 \times 2.5) = R225$ per year.

If DWAF wants to promote farming, it is suggested that any subsidy on O&M costs only covers the variable component (see box 1). After a 5-year period (subsidy phased out), serious farmers should easily be able to cover the whole fee from their farming income.

This idea of a mixed charging system has been well received by the farmers, while DWAF strongly rejected it under the argument that it penalizes those who actually farm. DWAF supports the idea of a system with a unique fixed fee. It has been suggested that all pay R17 per month per ha.

In the likely case that DWAF introduces subsidies on O&M costs, such system will not be an incitement to farming whatsoever, since non-farming beneficiaries will also benefit from the subsidy. Conversely, a mixed system allows for targeting subsidies towards farming beneficiaries. The matter should be discussed further, taking account of the farmers' perspectives.

Finally, the charging system that DWAF has developed considers the phasing-in of water resource management fee (R0,0078 per m^3 in the Levhuvu-Letaba Water Management Area). This means that ultimately (after 5 years), farmers should pay additionally R22,27 per ha and per annum under the current water consumption. This would amount R26,17 under scenario 2a, and R36,30 under scenario 2b.

8.5. Best farming model for Thabina

The question is difficult as it touches different sectors, i.e. farm size, farmers' strategies. Besides, it depends on who's asking, and on what is the objective behind the so-called model.

At farmer level, there are so many different strategies that take place, that it is unlikely that one "model" would fit all. None of the current types use totally the land at their disposal. In terms of profitability, table 11 provides some answers. Two logics seem reasonably promising and profitable, yet not easily duplicable by other farmers:

- intensive farming systems in small areas; pensioners-commercially oriented farmers have the highest profit per ha, yet cropping less than 0.5 ha; those pensioners can invest in farming, and probably benefit from age-related experience and skills; the (adult) commercial farmer are in the same line, yet slightly less effective; it seems that not all farmers can afford to intensify crop production at the moment;
- mixed farming systems in large areas; a few farmers have managed to enlarge their farms, yet not using the whole of it; this logic is hardly duplicable as such though (owing to the lack of available land, and of water).

If the model supposes full commercial orientation and farming profit, it seems that only the second type listed above makes it, which means 2 or 3 farmers in the whole scheme. If the model supposes some farming income and food supply, yet with external income needed, the first type may be the model. It meets social requirements (more farmers involved) and reasonable water use.

From a whole scheme perspective, the best model is the one that allow farmers to generate high individual profit (so that water fees are paid), to generate food, income and wealth for the surrounding communities (through intensification, which supposes hired labour, higher yields, input purchases). Yet again, commercial farmers and pensioners show the way forward.

The government model might be the one that allow more farmers to make a living, while using water sparingly, and with spill-over benefits towards the communities (job creation, food supply).

Subsistence and specialization do not seem to be chosen strategies as such. They rather result from the perception that farmers develop over their environment. Such perception is based on facts, such as lack of markets or water shortages (see ex. of ward D in Thabina). In no case, these strategies can be considered models.

9. Conclusions and way forward for Thabina

The following graph (figure 9) represents the so-called Thabina trap, which describes how lack of water generates a vicious circle of weak cropping systems, low profit and low cost recovery.

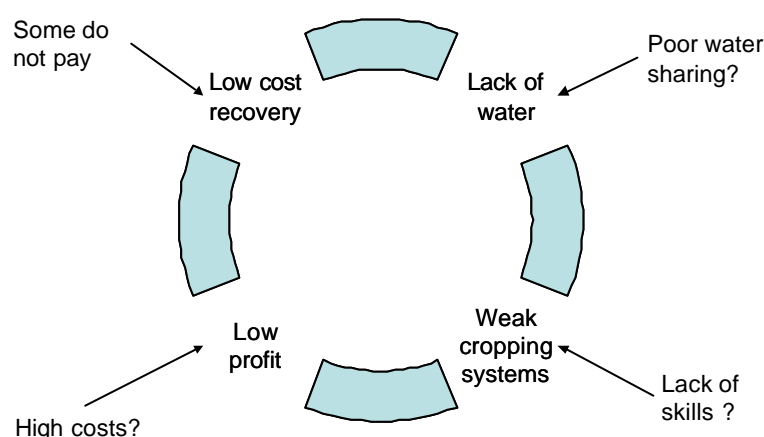


Figure 9. The self-maintaining vicious circle generated by the lack of water in Thabina

Additional inner factors do influence as well each component of that circle. This demonstrates that there is probably no such thing as a unique solution from outside to solve all problems (e.g. improving water inflow). Farmers also have to contribute (enhanced collective action and cooperation), as well as extension operators (training).

Consequently, recommendations can be made at different levels, as follows:

On the authorities' side:

Lacks and limitations as felt and expressed by the farmers should be addressed. In particular, further works are expected in order to alleviate the water issue. Farmers demand levelling works on the plots, upgrading of the canal, some increased rights upon the water stored into the existing dam, and possibly the building of a new dam. However, DWAF has warned that further works should not occur in the short run. The WUA may receive some funds to cover O&M costs, yet this will not solve the water issue. For the coming years, it looks like the farmers will have to rely on themselves on that issue. Recent vandalism and drastic drought have been very discouraging, hence an important role to play for the WUA (see below). The authorities should help the farmers to overcome

this hard period, through concrete partnership and support, with extension officers facilitating, training and accompanying the farmers (see below).

Also, the lack of funds prevents farmers from intensifying on inputs, which leads to low yields and low incomes. Efforts have already been made through facilitating access to cheaper inputs and services. More should be done on adapted credit facilities. Promises were made in terms of mechanization, when the revitalisation process started. Farmers are still waiting for tractors and implements to be fixed.

Finally, new role and functions by the supporting extension officers must be shaped, according to the new collective requirements of the Water Users' Association. Such entity needs to quickly acquire managerial, technical and financial skills. Through training and overall facilitation, the extension officers should play a key role. Such role must shift away from the usual basic service to farmers. Also, proper means should be given to the extension officers for them to perform their tasks (vehicle, limited area of intervention, re-training). Such a shift will undoubtedly occur as part of the overall re-vamping, re-training, re-organisation of provincial extension services that is currently taking place.

If not already done, the WUA will soon be granted a water use licence. This must be done in line with regional basin requirements, but also in line with farmers' prospects. The licence should not be a limitation to farming systems development towards intensification, hence food security, job creation and poverty alleviation around the scheme. Therefore, the current and future needs of the Thabina irrigation scheme must be evaluated thoroughly, with farmers' participation.

The Smile model on Thabina can help on that matter. If one assumes that an extraction right of 3 000 m³ per ha is granted to the scheme, this would correspond to a yearly overall quota of 702 000 m³. The current estimated consumption is 668 150 m³. Any consumption resulting from the scenarios tested exceeds the quota.

On the farmers' side:

The simulations show quite clearly that intensification, diversification and commercialisation of crops seem to be the pathways, along with organised and fair water sharing. All farmers should feel concerned with the future of the scheme. It requires that people start thinking collectively when necessary, and not only about their own businesses. It also requires that farmers generate a significant income through irrigation farming. This does not only depend on the quality and performance of their cropping systems, but also on their livelihood strategies. A lot of beneficiaries see farming as a side, food-providing, occupational activity, while non farm activities and welfare grants provide the bulk of the livelihood. It is no easy task to change existing situations. At least, future land allocations should target full time, willing, and skilled farmers.

On the management committee side:

The very issues of water sharing and cooperation towards more efficient cropping system will soon put the WUA to the test: will it be in a position to set up, organise, manage, coordinate (and enforce) new regulations on water sharing? Will it be in a position to successfully promote coordinated cropping systems?

The negotiation that has been initiated with the traditional authority over unused land is definitely a right move. However, possible new available land should not compulsorily been allocated to new settlers. Existing farmers, willing to extend and intensify should be given a chance.

The WUA must start developing an information system in order to document farmers' decisions and strategies on crops. This supposes that marketing options and prices, input supply alternatives and economies of scale, and the like, are seriously investigated. The management committee cannot do all the work. But it should drive it, with the support of the extension officers.

The management committee should really be custodian of fairness and equity in terms of water sharing, especially during harsh periods of droughts.

A new charging system may be established in order to meet 2 objectives: a fair payment for water used (those who use water pay), and a payment for accessing irrigable land with the scheme regardless of its use (those who do nothing pay or leave). Since there's no measurement device in Thabina, it is suggested that a hectare-based system is established, requiring minimum monitoring (see chapter 8.4). Yet again, the Smile model can help refining the system.

The "1.6ha paradigm" inherited from the Tomlinson commission must leave place to in-depth reflection as to what is it expected from smallholder irrigation schemes, for the benefit of the farmers, and for the whole society.

Preliminary results from Thabina are very interesting and will definitely be followed by in-depth investigations, then report back sessions and workshops with farmers and management committee members.

The Thabina irrigation scheme shows several traits demonstrating that it has been exposed to Irrigation Management Transfer and that it has already adapted to the new requirements and conditions. Very positive trends and facts can be observed and reported:

- Existing farming systems are diversified, although maize for self consumption remains a pivotal crop; winter cropping is fairly common and successful; subsistence farming clearly represent a minority strategy among farmers;
- Non-farming beneficiaries represent less than half the beneficiaries (see below);
- Some farmers appear to be really intensive, market-oriented and successful; especially pensioners play a key role as demonstrators, trainers, leaders for other farmers;
- There's a real entrepreneurial spirit among management committee members; the WUA does exist, with a secretary;
- Farmers already pay for water supply and related services; they seem even ready to contribute more towards cost recovery.

However, some other elements upset such trends, on a more negative tone:

- There's still a significant proportion of non-farming beneficiaries, hence a number of blocks turning to fallow; it looks like most of them are old people with no more interest into farming, while being "protected" by the traditional authorities (they keep their PTO); the management committee is busy creating awareness and negotiating with traditional authorities so that land re-allocation can take place when necessary; there seems to be a long waiting list of applicants, willing to start farming in the scheme;
- Women play a key role in farming; among them, single women represent an amazingly high percentage of the farming household; this situation is not an issue as such; what is an issue is that (1) women form the majority of strict subsistence farmers, and the poorest, and (2) they are not adequately represented within the management committee;
- Marketing of produces is hardly mentioned as a problem by farmers, however, most arrangements lack organization and sustainability, since they are based on opportunities; only few farmers do contract with buyers; access to inputs seems to be a common issue (high cost and lack of transport facilities);
- In spite of rehabilitation works, there seems to remain expectations from the farmers who complain about the low capacity of the main canal, the lack of water in winter (water being diverted / reserved for other uses from the main dam); besides, the lack of cooperation among farmers on water matters has been repeatedly raised as an issue;
- People do pay for water services, but the fees are far too low (R10/ha/month) to cover all costs incurred; the electricity bill alone cannot be covered by such fees (electric pumps supply the canal and a balancing dam); it looks like Eskom did not provide adapted service and infrastructures to the farmers (lack of a day/night main switch, hence differentiated rates); some farmers even question the need for a paid secretary and for a "telematic center" whereas most of them struggle; all in all, farmers would have preferred diesel pumps;
- All in all, it's the overall objective underlying the scheme that remains a bit confused. A diversity of farmer strategies co-exist within the scheme, from commercial / business-like orientations to mere part-time gardening, not to mention land kept unused. It may prove very difficult to identify and implement "one-fits-all" type of policy and support to the scheme.

One possible follow up would be to organize documented workshops with farmers on those issues, not limiting discussions to management committee members.

This project formed a renewed application of the Smile approach, since it included farmers' participation since the outset. Such participation has been real and effective, not only during data acquisition phases, but also for validation, scenario-building and discussion of results. It mostly involved management committee members, who, in turn, must now spread the discussions with the other beneficiaries.

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