AN INVESTIGATION INTO FOOD PLOT PRODUCTION AT IRRIGATION SCHEMES IN CENTRAL EASTERN CAPE

W van Averbeke · CK M'Marete ·
CO Igodan · A Belete

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Water Research Commission

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by

W van Averbeke, CK M'Marete, CO Igodan & A Belete

Report to the

WATER RESEARCH COMMISSION

on the project entitled:
"An investigation into food plot production
at irrigation schemes in central Eastern Cape"

by the

Faculty of Agriculture
and
Agricultural and Rural Development Research Institute (ARDRI)
University of Fort Hare

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FOREWORD

In 1994 the Water Research Commission invited the University of Fort Hare to renew its involvement in water-related research and make use of the Water Research Commission's research fund. The intention of the invitation was to explore the potential for the development of a centre of expertise in water-related research at the University of Fort Hare.

The University responded by submitting two research proposals, one of which proposed an investigation into food plot production on irrigation schemes in central Eastern Cape. Conceived as a short one-year project the study ultimately took two years to reach report stage. Still, the study is not really complete. Readers will observe that the report mainly deals with differences between schemes using "average farmer values" to represent each scheme, and tends to be silent on variability among farmers within each scheme. The data enabling assessment of in-scheme variability were collected but the analysis has not yet been conducted. It is the intention to communicate the results of an analysis of in-scheme variability among farmers by means of future journal publications.

Responsibility for the project rested with a team of principal researcher, consisting initially of five and later in the project of four members of academic staff, each representing a discipline considered important to aspects of the study. The leadership provided by a multi-disciplinary team contributed to the breadth of the study.

Field work was conducted mainly by ARDRI staff and young unemployed graduates and diplomates hired for this purpose using project funds. The research contributed in a major way to capacity building and has subsequently assisted two of the four hired researchers to secure permanent employment and encouraged a third to further his studies. The capacity building aspect of the project was an important benefit to field researchers and also to some members of the management team.

The work itself has been a resource to suppliers of information and decision makers who have been giving their attention to the future of Eastern Cape agricultural parastatals and the projects they manage. Some of the issues raised by these groupings had an influence on the analysis and interpretation of the study results.

The team of researchers and support staff that have contributed to the study is presented.

Project co-ordination and principal researchers

The project was co-ordinated by W van Averbeke and the principal researchers consisted of the following members:

Dr W Van Averbeke:	Acting Director ARDRI
Prof. CO Igodan:	Dean of the Faculty of Agriculture and Professor in the Department of Agricultural Extension and Rural Development
Mr CK M'Marete	Department of Agronomy
Dr A Belete	Department of Agricultural Economics

Within the project team the responsibilities were allocated as follows:

Prof. CO Igodan:	Human, social and institutional factors
Dr A Belete:	Economic and financial factors
Mr CK M'Marete:	Infrastructural factors and irrigation
Mr JLH Williams:	Extension and data analysis by computer
Dr D Eaton:	Extension and data analysis by computer
Dr W Van Averbeke:	Physical factors, land tenure and agricultural practices, historical factors, team and project coordination and editing of the final report

Field work

Field work for the questionnaire survey was conducted by Ms P Mei (field team leader), Ms JV Mafu, Ms F Blie, Mr S Tuwana and Ms T Nqodi.

Data capture

Capturing of the questionnaire data was done by Ms JV Mafu and Ms T Nqodi, who also assisted in data analysis.

Miss P Mei, Ms JV Mafu and Ms T Nqodi contributed to the study by conducting selected literature searches and by compiling some of the sections of the report.

Support services and compilation of reports

Ms NE Jawe of the Department of Agricultural Extension and Rural Development was responsible for typing the first and second progress reports. Mr S Yoganathan of ARDRI compiled the draft final report. Mrs EM Danckwerts (ARDRI) assisted by Ms NH Ngcuka (ARDRI) compiled the final report.

ACKNOWLEDGEMENTS

The research in this report emanated from a project funded by the Water Research Commission entitled:

"An investigation into food plot production at irrigation schemes in central Eastern Cape."

The Steering Committee responsible for this project consisted of the following persons:

Dr GR Backeberg	Water Research Commission (Chairperson)
Mr FP Marais	Water Research Commission (Secretary)
Mr DS Van Der Merwe	Water Research Commission
Prof MC Laker	University of Pretoria
Prof M Lyne	University of Natal
Mr GJ De Waal	Development Bank Southern Africa
Prof CJ Van Rooyen	University of Pretoria
Dr S Walker	University of Free State
Mrs V Kwaru	Department of Agriculture and Land Affairs (Eastern Cape)

The financing of the project by the Water Research Commission and the contribution of the Members of the Steering Committee is acknowledged gratefully.

This project was made possible as a result of the co-operation of many individuals and institutions. The authors, therefore, wish to record their sincere thanks to the following:

Mr B Phillips, Mr S Farrow and Mr M Copeland and their staff at Ulimocor Head Office who contributed in a major way to the desk study by providing access to information and allowing one of the project researchers to make use of the Ulimocor facilities to study and capture this information.

Mr M Fihla and the Ulimocor staff at Tyefu Irrigation Scheme for assisting with research work at the scheme.

Mr F Van Aardt and Mr A Longo and the Ulimocor staff at Horseshoe Irrigation for their interest and support towards the study.

Mr D Bosman and the Ulimocor staff at Zanyokwe Irrigation Scheme for technical information on the scheme.

The management and extension staff at Shiloh Irrigation Scheme for assisting with organizing meetings with farmers and their interaction with the research team.

The Executive members of the Hertzog Agricultural Cooperative for their interest and cooperation in the study.

The Chairperson and executive members of the Upper Gxulu cooperative for assisting the research team in conducting work at the Scheme.

A special thanks is due to all the farmers at the Tyefu, Keiskammahoek (Upper Gxulu), Shiloh, HACOP, Horseshoe and Zanyokwe (Lenye) Irrigation Schemes, who willingly gave the research team some of their valuable time to respond to the questionnaire. It is sincerely hoped that this report will contribute in some way to progress at their schemes.

The research team is also most grateful to Dr GR Backeberg, Prof M Lyne and Mr GJ De Waal for the valuable information they supplied the team with in times of need. Their interest and active support are sincerely appreciated.

An investigation into food plot production at irrigation schemes in central Eastern Cape

Executive summary

1. Introduction

Irrigation schemes in former Ciskei and Transkei did not bring about the expected social and economic development. This raises doubts about irrigation being a suitable option for rural development in these regions. Internationally, on the other hand, irrigated agriculture is still recommended as an appropriate way of addressing rural poverty and unemployment in areas where sustained rainfed production of crops is limited by water deficits (Lipton, 1996). Land reform is an integral part of the rural development policy of the South African Government. In a rural context, providing access to land will bring about economic development only when it is accompanied by productive use of the acquired land resources by the new holders. Providing rural households with access to small parcels of irrigated land is one of the models that could be considered by the South African land reform programme. One of the main apparent advantages of the food plot scheme model is that relatively small areas of land can be of benefit to a large number of households. This enables distribution of the capital expense incurred in the development of an irrigation scheme over a substantial group of beneficiaries. At present, little is known about the factors influencing food plot production and about the benefits food plot holding households derive from their plots. For this reason the present study was initiated.

2. Objectives of the study and the research approach

The objectives of the study were:

* To determine the physical, infrastructural, economic, institutional and social factors of food plot production at irrigation schemes in central Eastern Cape.

* To analyse and assess the above factors, including economic feasibility, in order to identify potential practical applications of these to irrigation scheme planning.

* To formulate guidelines for irrigated food plot policy.

These objectives were pursued by means of an investigation consisting of two phases. During the first phase secondary sources of information were consulted with a view of identifying the range of factors that influence food plot production. This information was updated by means of field visits and interviews with key informants. The results of the first phase were used in developing the research tool for the second phase of the study, which consisted of a questionnaire survey administered to 269 plot holding households. The survey covered six irrigation schemes in central Eastern Cape where small scale crop production is being practiced, namely the schemes at Tyefu (TIS), Shiloh (SIS), Upper Gxulu at Keiskammahoek (KIS), HACOP near Balfour (HAIS), Zanyokwe (ZIS) and Horseshoe (HOIS). The results of this survey were analyzed and this analysis forms the main body of the report.

3. Content of the report

The report consists of seven chapters. Chapter one is a brief sketch of irrigation developments in South Africa in general and the former Eastern Cape homelands in particular. Chapter two presents a summary overview of literature related to factors influencing small scale irrigation developments. The methodology used in the study is explained in chapter three and a general overview of the six irrigation schemes covered by the study is presented in chapter four. Empirical findings based on the questionnaire survey are discussed in chapter five and chapter six presents a critical assessment of irrigated food plot production as an agricultural development model. In the last chapter an attempt was made to formulate recommendations for existing schemes, future irrigation developments and for additional research work.

4. The schemes

Table 0.4.1.1 presents some important characteristics of food plot developments at the six irrigation schemes that were investigated.

Table 0.4.1.1 Some important characteristics of food plot developments at six irrigation schemes in central Eastern Cape.

Scheme	Scheme area (ha)	Area under food plots (ha)	Number of food plot holders	Mean size of food plots (ha)
TIS	644	279,9	1 487	0,1882
KIS	805	22,0	88	0,2500
SIS	455	113,8	455	0,2500
HAIS	81	81,0	81	1,0000
HOIS	50	36	18	2,0000
ZIS	412	34,8	174	0,2000
Total	2 447	567,5	2 303	-

5. Main findings

Farming systems at the schemes

Overall, 90 to 95% of the food plot area at the six schemes was planted to three crops only, namely maize, potatoes and cabbage. At schemes with small plots (0,25ha or less) all three crops were prominent and often grown as part of a rotation. At schemes with large plots cabbage was usually the main crop.

Under irrigated conditions in central Eastern Cape it is possible to grow two crops per year, which would result in a land use intensity of 200%. The overall land use intensity on the food plots was about half of that. The overall mean yield of maize was 3,6 tons per ha, cabbage 30,1 tons per ha and potatoes 9,5 tons per ha. With the exception of cabbage yields, the average crop yields were well below potential.

On nearly all food plots (97%) the land was prepared by means of a tractor. Food plot production systems resembled those used in the medium to large scale commercial sector. This appeared to be caused by the relationship between food plot production and the activities and services at the central unit of the schemes. Most food plot sections of schemes were designed to be supported in terms of services by a central unit. At inception of the schemes, the central unit was mainly responsible for market oriented production using labour and management and modern technology. Access to the use of this modern technology was extended to food plot holders on the scheme. The centrally controlled, market oriented component of the scheme used an estate approach to production, and was designed to be the economic component of the scheme. The food plot section was referred to as the social component. At all five schemes where a central unit formed part of scheme design, centrally controlled estate farming has been discontinued. At one scheme some of the vacated estate land has been converted to food plots. In recent years, farmer support services provided by the parastatal managing four of the six schemes have declined, because of financial difficulties. In response to a decline in services, food plot holders modified their farming system by reducing use of external inputs. Most respondents (88%) identified weeding as the activity demanding most labour.

The study identified the main constraints in irrigated food plot production to be delays in ploughing (causing long fallow periods), theft of produce, ineffective plant pest control, water supply problems, absence of effective extension and in some cases limited access to markets.

Physical factors

At this stage of its development, food plot production generally did not appear to be constrained by physical factors. Exceptions were saline water at TIS and damage caused by insects, birds and fungi at most schemes.

Social factors

The mean household size of food plot holders was 5,45. Heads of households were mostly male (68%), old (59 years) and had spent an average of 4 years at school. Amongst plot holders the main household needs were good quality housing, livestock and access to water and electricity. The main community needs were access to electricity and water.

Work on food plots was done mostly by husband, wife or a combination of both. Children contributed labour, but their importance in agriculture on the plots was secondary. Men appeared to be relatively more involved in irrigated crop production than is reportedly the case in rainfed cropping. Generally, hiring of labour by plot holders did not contribute meaningfully to employment in the area around the scheme.

Institutional and organizational factors

Inadequate security of tenure was found to be a source of conflict at some schemes. At all schemes tenure security problems appeared to prevent the development of a market for land rentals, TIS being the main exception. As a result, there was little evidence of plot holders enlarging their land holding by renting in additional plots.

Past institutional arrangements have resulted in farmers developing a high degree of dependency on scheme services with respect to water supply and land preparation. Restructuring of the parastatals threatens delivery of these services and deterioration in the quality of these services is of great concern to farmers.

CAB was found to be the main source of formal credit, but was accessed mainly by holders of large plots (HAIS, HOIS).

Schemes services were found to play a supplementary role in marketing of produce and provision of transport. Marketing by plot holders themselves was the main channel of marketing at the schemes. At this stage, the role of scheme services in the input market is considerable, but there was evidence that this function could be taken over by other suppliers, including local shops and farmer co-operatives.

The performance of extension at schemes with small plots was found to be very poor, but extension services appeared to be more appreciated by holders of large plots.

Membership of farmers organizations was generally low (17%) and the main functions of these associations were farmer representation and access to finance.

Infrastructural factors

Local irrigation schemes tend to be well supplied with agriculture-related infrastructure. Whilst deterioration has occurred over time, most infrastructure was in reasonable working order, tractors being the main exception.

Amongst farmers, the sense of ownership and responsibility for the available irrigation infrastructure was found to be extremely low, and its maintenance was considered to be a government function.

Economic factors

Overall plot holding households were found to be poor, the weighted mean gross cash income being R5717 per annum, which for an average family size of 5,45 is below the poverty line (May 1996). Cash income derived from food plot production amounted to 11% of total household income, pensions 52%, remittances 1% and salaries, wages and other off-farm activities 35%. Households reported to spend their income on food and groceries (57%), furniture (10%), home maintenance (9%), clothing (7%) and agricultural inputs (6%).

At all schemes farmers apportioned produce obtained from the plots to sales, home consumption and gifts (see Table 0.5.1.1). Home consumption of produce was more important at schemes with small plots than at schemes with large plots, where most of the produce was marketed. Generally, there was a positive relationship between plot size and the contribution irrigated agriculture made to household income (in cash). At HOIS, where plots are 2ha in size, irrigated cropping was the main source of household cash income. It appears, therefore, that an increase in plot size is an important factor influencing the shift in production objectives of farmers from mainly subsistence to mainly market oriented production.

Table 0.5.1.1 Apportioning to sales, donations and home consumption of crops produced by plot holders at six irrigation schemes in central Eastern Cape (proportions are based on the monetary value of crops as determined by the sale price).

Use	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	ALL n=269
Sales	41%	48%	70%	83%	98%	69%	52,9%
Donations	3%	10%	2%	7%	1%	4%	4,1%
Home consumption	56%	42%	28%	10%	1%	27%	43,0%

The original food plot concept was aimed mainly at enabling farmers to produce food for their households, with maize being the main summer crop. The results showed that not all food requirements of the plot holding households were being met by crop production on the plots, but the amount of produce consumed by the plot holder households was considerable, and contributed significantly to household food security, as is shown in Table 0.5.1.2.

Table 0.5.1.2 Mean quantities of plot produce of maize, cabbage and potatoes plot holding households at six irrigation schemes in central Eastern Cape consumed at home (1995/96).

Crop	TIS n=149	KIS n=29	SIS n=33	HAIS n=28	HOIS n=7	ZIS n=13	ALL n=259
Maize (kg)	363	260	208	33	0	286	282
Cabbage (kg)	241	155	67	182	52	84	190
Potatoes (kg)	197	90	42	492	0	107	187

At this stage, the subsidy requirements of irrigated food plot schemes that are managed by parastatals are too high to warrant continued existence of these schemes. In some instances the annual subsidy exceeded the combined gross income of all farmers. Generally, the high subsidy requirements relate to political decisions, which prevented the parastatal from reducing staff working at the scheme, when the decision was made to discontinue production by central unit. Reduction of scheme staff to the numbers required to maintain an effective water supply, land preparation and advisory service to farmers would limit the subsidy requirements of the schemes. This would contribute in a major way to making food plot schemes financially more desirable. It is, however, unlikely that any of the schemes covered by the study will ever achieve full financial self-sustainability.

6. General assessment and recommendations

Conceived as the social component of irrigation scheme development, food plot sections were introduced into irrigation scheme design primarily to compensate land right holders for making available their land for the development the scheme. Yet, food plots have been one of the relatively successful aspects of irrigation scheme development in central Eastern Cape. Food plot developments offer a high degree of equity. This makes them attractive under conditions where land earmarked for irrigation is pre-owned and held under communal tenure or a modification thereof.

In schemes developed on land held in common property there is a need to strengthen the security by which food plots are held. This can be achieved by addressing limitations in the breadth, duration and assurance of the rights plot holders have over their plots. Enhancing security of tenure may lead to the development of a market for land rentals. Land transaction through rentals preserve equity and are expected to increase allocative efficiency (Thomson and Lyne, 1995).

The results of the study suggested that an increase in the size of land holdings would be accompanied by a shift in the production objectives of farmers from subsistence to market oriented production, and a concomitant increase in the proportional contribution of agriculture to household income. This shift was found to expose farmers to a number of new challenges, of which production practices, marketing and financial management were the most important. The shift was also found to create new demands in terms of scheme organisation and supply of support services. Factors such as ready access to inputs, good quality land preparation, a reliable water supply and expert extension co-determine successful small scale irrigated cropping. Well organised farmers organisations were found to be able to handle many of these new challenges, and their development needs to be encouraged and supported.

Designed to be a trap, by failing to incorporate the progression of farmers from subsistence oriented to market oriented producers into their design, food plot schemes do offer the possibility for progression. For progression to occur at these schemes suitable institutional reforms with respect to land tenure will need to be developed and adopted by land right holders.

Whereas food plot schemes appear to be a suitable model of introducing irrigation on land held under communal tenure, it is not recommended for settlement schemes. The size of standard food plots (0,25ha or less) is just too small to make irrigated agriculture a viable livelihood option. From the study it appeared that a minimum plot size of 2ha is required in order for agriculture to become the main source of income for farming households.

On settlement schemes farmer selection is of major concern. The experience at Horseshoe Irrigation Scheme showed that a system of voluntary entry and exit, whereby participation in the scheme demands farmers to make regular financial contributions towards the cost of water supply and its maintenance, had the desired results without causing undue social conflict. The success of this self-regulating system of farmer selection appeared to be heavily reliant on the presence of experienced farmer trainers and a good overall support system at the scheme.

Generally, timely access to good quality land preparation services and to a ready supply of irrigation water were the two most important factors determining success in food plot production.

At present, water supply is subsidized at all six schemes. At the two schemes with large plots, farmers contribute meaningfully towards the cost of in-scheme water supply and its maintenance, but not to the cost of water itself. At the four schemes with standard food plots, farmers do not pay at all towards this service. Considering the economics of irrigated crop production on schemes with standard food plots, and the prevalence of poverty amongst plot holding households, it is unlikely that farmers could contribute anything more than a token fee at this stage. It is, therefore, recommended that state subsidization of water, its supply and its maintenance is continued and is considered as being a social welfare service. It may be desirable to introduce a system of payment for water. This might be in the form of water right vouchers. It is important that farmers are introduced to the idea that water is a scarce resource and needs to be paid for. Plot holders could be required to purchase water right vouchers annually for a small fee. Such a system would make water rights transferable. However, the cost of implementing the required administrative and monitoring system may prove prohibitive, adding further to the cost of irrigation water, without much hope for higher levels of recovery in future.

Timely access to good quality land preparation is a major concern in food plot production. At present the use of tractors prevails at all schemes. At some schemes, including the standard food plot scheme at Upper Gxulu, farmers were able to secure this service without outside assistance. At the other standard food plot schemes intervention (and subsidy) by the parastatal is necessary to maintain the service. Institutional reforms aimed at making the tractor service self-financing are certainly possible and should be pursued. In the mean time, it is crucial that this service is maintained at those schemes where parastatals were responsible for offering the service. Alternative systems of land preparation, involving systems based on animal draught, have not received much attention at the schemes. A feasibility study of these alternative systems based on on-farm experimentation is urgently needed.

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INTRODUCTION

1.1. IRRIGATION DEVELOPMENT IN SOUTH AFRICA

In most of South Africa climatic conditions are dry and crops are subject to water deficits during part or all of the growing season. Under such conditions full or supplementary irrigation is an attractive technological approach to increasing food and fibre production. At present South Africa has an estimated 1,2 million ha of land under irrigation. On 33% of this total area surface irrigation is practised. The rest is under overhead irrigation (55%) and micro-irrigation (12%). Full irrigation is practised on about 3/4 of the total land area (78%), supplementary irrigation on 14% and opportunistic irrigation on 8% (Bruwer and Van Heerden, 1995).

Irrigation was introduced to South Africa soon after the arrival of European settlers. Several small scale irrigation projects were developed during the period 1652 to 1912. These projects were often part of town developments, whereby canals enabled plot owners to irrigate their gardens (Bruwer et al., 1995).

From 1912 to the 1930s, development of irrigated land became more co-ordinated, and several large scale irrigation projects were established, involving the erection of fairly large scale dams (e.g. Great Fish scheme under the Lake Arthur and Grassridge dams). In many of these early schemes, water allocations were inadequate to practice full irrigation, and irrigators often failed to meet repayments of the infrastructure, debts which were written off by the State (Bruwer et al, 1995).

The Great depression of the 1930s, caused by drought and a world-wide decline in the economy, gave rise to the "poor white" problem in South Africa. The "poor white" grouping consisted mainly of unskilled people who had very little opportunity to find employment. The development of large scale irrigation schemes was one the ways in which the South African Government tried to address the "poor white" problem. Examples of schemes developed during that period are Vioolsdrift, Boegoeberg, Rietrivier, Pongola Boskop and Vaalharts (Bruwer et al, 1995). Settling farmers were usually allocated irrigated holdings of about 30 to 40ha. All these schemes practised surface irrigation.

Subsequent evaluations of these irrigation schemes showed that their irrigation efficiency was generally low (usually less than 50%), a problem caused by two factors mainly, namely inappropriate design of the scheme and low aptitudes of participating farmers. Scheme design usually ignored differences in soil properties in favour of a simple, usually square shaped farm layout. In-field variation in soil properties combined with surface irrigation resulted in low irrigation efficiency, mainly caused by under-irrigation of some parts of the fields and waterlogging in others. Older schemes also often over-estimated the available water supply, causing deficits during years of drought. The plot sizes were found to be too small to form economically viable units, mainly because farmers were growing relatively cheap staple foods such as maize and wheat. Extension surveys showed participating farmers to be quite old, having a low level of education and lacking ambition, factors which were thought to have a negative influence on progress at these schemes. Over time, many farmers left the schemes whilst new-comers or those remaining at the scheme consolidated their holdings by buying up vacated land (Bruwer et al, 1995).

These findings were taken into account in the planning of subsequent schemes (1970s until present). Planners tried to ensure that water was adequately available, often through inter-basin transfers, and conscious attempts have been made to attract young people with reasonably high educational levels. Through the application of research results, suitable irrigation scheduling advice was made available. Efforts were made to encourage the use of overhead irrigation methods in favour of surface irrigation and to get farmers to grow profitable market oriented crops rather than staples. Sharing of mechanical equipment, or the use of contractors has also been promoted (Bruwer et al, 1995).

1.2. IRRIGATION DEVELOPMENT IN THE FORMER "BANTUSTANS"

In the former "Bantustans" or "Native Areas" minor irrigation developments occurred before 1950, but most irrigation schemes were started after the publication in 1955 of the report of the Commission for the socio-economic development of the bantustans, the so-called Tomlinson Commission. The publication of this report and the implementation of some of its recommendations had a major effect on the settlement and land use patterns in black-owned South Africa, because it provided renewed vigour to the implementation of Betterment planning in terms of Proclamations Nos 31 of 1939 and 116 of 1949.

At the time of publication, the Commission estimated the total area under irrigation in the "Bantustans" at 11 400ha (13 366 morgen) farmed by 7 538 plot holders, resulting in an average irrigated land holding of about 1,5ha per farmer. Of the total area under irrigation, 5277ha were found in the northern part of South Africa (Northern Province), 4 323ha in the western part (North West Province), 1499ha in Natal, 173ha in Ciskei and 103ha in Transkei (Commission for the Socio-Economic Development of the Bantu Area within the Union of South Africa, 1955).

The Commission indicated that interest and success of irrigated cropping differed widely from region to region. The most successful irrigation developments were found in the north of South Africa. In Ciskei and Transkei interest in irrigation was considered to be low, with 28 out of 37 existing small schemes having fallen into disuse.

Based on information collected at existing schemes, the Commission suggested that irrigated holdings of 1,5 to 2 morgen (1,3 to 1,7ha) were adequate to "*provide a family with a living that would satisfy them, whereby the whole family would work on the holding*". Preliminary surveys suggested that the irrigable potential of the bantustans was about 54000ha, sufficient to settle 36 000 farming families.

The Commission consequently recommended that:

1) "*determined action be taken to improve and replan all existing schemes, so that each holding can provide a full-time living to a Bantu family;*

2) *new schemes, which can be operated by simple diversion weirs and furrows, be developed during the next 10 years;*

3) *irrigation schemes be regarded as integral parts of rehabilitation schemes, which will embrace the preservation of water sources and "sponges" in the catchment areas;*

4) *the Trust*[1] *should acquire ownership of the land before fresh irrigation schemes are developed, all lands belonging to individual Bantu or tribes, and which fall under the proposed schemes, should be bought up to permit unhindered development of the scheme, while former owners of such lands should be given preference when holdings are allotted on completion of the scheme;*

5) *all schemes should be placed under proper control and supervision, with uniform regulations as regards water rates, credit facilities and conditions of settlement;*

6) *all schemes, including commonage attached to the schemes which are not Trust land, should be proclaimed betterment areas in terms of Proclamation No 116 of 1949.*

7) *those to whom irrigation holdings are allotted should be required to relinquish all agricultural interests they may have in the remainder of the Bantu areas, in order to give their full time and attention to their holdings, and*

8) *an agricultural officer should be appointed as superintendent of each large irrigation scheme or group of smaller schemes in a single district. In the first instance, European technical officers should be employed, until trained Bantu with sufficient expertise, are able to take charge."*

Schemes developed during the late 1950s and 1960s followed the recommendations of the Tomlinson Commission closely. They would employ a relatively inexpensive design, using furrows to convey water from a weir or dam to holdings usually 1,5 to 2 morgen in size, on which surface irrigation was practised. Examples of such schemes are Qamata Irrigation Scheme in Cofimvaba (former Transkei) and the irrigation schemes at Cata and Upper Gxulu in Keiskammahoek (former Ciskei).

During the 1970s, political and administrative independence of the bantustans was encouraged. Gradually the services of South African Government departments were withdrawn to be replaced by a homeland administration. Development capital was made available to the Bantustan governments, with which they were to initiate development projects.

Ciskei government commissioned independent consultancy firms to conduct natural resource surveys of the three major basins in the territory, namely the Buffalo river basin, the Kat and Fish river basin, and the Keiskamma river basin. The object of these surveys was to identify the potential of Ciskei for agricultural development. The consultants identified irrigation developments as one of the most promising development opportunities in the territory. For example, in the Keiskamma basin a total of 18 potential irrigation schemes were identified, involving approximately 8 600ha of which some 7 300 ha were considered to have moderate to high irrigation potential.

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1 "The Trust" refers to the "Native Trust", which in accordance with the Native Trust and Land Act, No 18 of 1936, acquired land from non-Bantu owners within the Scheduled Native Areas and Released Areas for redistribution to black people. All Trust land were ipso facto betterment areas, subject to planning by the Department of Native Affairs with the aim of stabilizing or, where needed reclaiming the land.

In Ciskei (and also Transkei), the main consulting agent active in irrigation scheme planning and implementation was Loxton & Venn. In all their plans these consultants favoured developments that were technologically sophisticated and had a high capital requirement.

The high capital requirements of the proposed schemes were justified by assigning a dual function to them, namely to offer both economic and social benefits to the recipient community-region-nation concerned. The consultants were of the opinion that both objectives could be achieved only when the Scheme was subdivided into two entities, namely a commercially oriented and a food-security oriented entity.

The commercial entity was responsible for generating profits, by using external management and hired labour to conduct agricultural production. In their plans the consultant usually projected that income generated by the commercial entity would enable recovery of investment and pay for all production costs involved. Income from the commercial entity would also be used to assist the recipient community in its farming activities, by providing access to inputs and mechanisation at affordable rates. The need to control production on the commercial entity or estate farm of the Scheme required management to gain control over the land. It was therefore necessary for recipient communities to make their land available to the Scheme for reallocation. In general, about 75% of the irrigated land would be assigned to the commercial entity of the scheme and 25% to the recipient community.

Where possible the Scheme would acquire use of the land for estate farming by means of rentals or leases. They introduced the concepts of "Group Farm", whereby land right holders were made shareholders, receiving annual dividends in return for the use of their land and of "Tribal Farm", which constituted land farmed on behalf of the community.

In return for the use of their land, community members were usually given access to a small plot of 0,1 to 0,3 ha, irrigated by means of a drag line sprinkler. On these plots, people were expected to grow most of their basic food requirements, and, through the sale of surplus, realise a small profit.

Some community members or settler farmers were given access to commercial mini-farms, on which they had to produce approved commodities according to specific instructions. In most cases, the farming system that was introduced was foreign to participants. Control over farming activities was strictly enforced, and in most cases the books were kept by central management and farmers paid a stipend and an "agterskot" payment when profits were realised.

1.3. RECENT DEVELOPMENTS ON IRRIGATION SCHEMES IN THE EASTERN CAPE

Initially, most irrigation schemes developed in the Eastern Cape performed reasonably well in terms of level of production and their need for recurrent support from the State. However, structurally the Loxton and Venn model for irrigation scheme development proved to be unsustainable. During the late 1980s there was a general decline of most schemes, mainly as a result of two factors. Firstly, there was growing awareness amongst scheme workers of their rights, causing labour unrest, a demand for higher wages and the erosion of the authority of mainly white management in charge of production activities. This caused a decline in productivity of the estate component of the schemes and consequently in a increasing need for annual State subsidy. Secondly, there was a reduction in the benefits derived by land right holders over time, caused mainly by the "commercialisation" of farmer support services introduced by Scheme management in an attempt to address worsening financial constraints. In several instances this resulted in farmers or land right holders demanding their land back. Where such transfers occurred (e.g. Ncora Irrigation Scheme) this rarely resulted in an increase in production, because most of the released land was left idle. It appeared that farmers had become so used to the Scheme supporting their activities, that they lacked the will or ability to farm the land for themselves. The financial and structural problems experienced by the schemes resulted in the exit of independent management consulting agencies from the schemes during the late 1980s and early 1990s and the transfer of the responsibility over the schemes to the State and its parastatals Tracor (Transkei) and Ulimocor (Ciskei).

Transfer of land from the centrally managed estate to farmers did not always result in a reduction in the labour force employed by the Scheme. In view of the interim constitutional guarantee of job security for state employees until 1999, the State and its parastatals avoided retrenchment of staff, and schemes have had to accommodate large numbers of often redundant or under-employed workers, the cost of which was largely or entirely borne by the State. This situation put tremendous pressure on the budget of the Provincial Department of Agriculture. Most of the funds assigned to the schemes during the mid 1990s went to salaries and wages and little was available to cover running expenditure, maintenance of infrastructure and new developments. This situation led to a further decline in the services provided to farmers on the schemes.

In 1996, the Provincial Government of the Eastern Cape, assisted by the National Department of Agriculture and Land Affairs, started to develop a new policy for the irrigation schemes. At policy making level there is general agreement that the schemes need to be transferred to land right holders and farmers, and that the State or its agents should withdraw from active farming, and that the State should limit its responsibilities to well-defined functions, mainly related to information supply through research and extension and to capital developments. In July 1997 the Provincial Government of the Eastern Cape made a number of decisions aimed at implementing these policies, including the closure of the Eastern Cape parastatals Ulimocor and Tracor.

1.4. INTERNATIONAL TRENDS IN DEVELOPMENT THEORY AND THEIR RELATIONSHIP TO IRRIGATION SCHEME DEVELOPMENT IN CENTRAL EASTERN CAPE

1.4.1 International trends in development theory

After World War II the industrialised world, concerned with the state of development of newly independent countries in Africa, Asia and Latin America, initiated organised development assistance. The main objective was to modernise Third World countries and bring them to a level of development similar to that of Western countries. The early approach towards modernisation of the Third World came to be known as the "*Dominant Paradigm*". Essentially, the Dominant Paradigm, which guided development activities until the end of the 1960s, was based on the assumption that Third World countries were at a stage of development similar to that of Western nations before the industrial revolution. By retracing the development path of the Western nations Third World countries were expected to also achieve the stage of modernisation enjoyed by industrial society. By assisting developing countries, the development process could be speeded through the different stages at a much faster rate than occurred in western countries, because, after all, the path was known and the means to reach the intended goal already available (Melkote, 1991).

The Dominant paradigm was mainly concerned with economic growth, as measured by the rate of growth of output (GNP). Economic growth was considered to be dependent on two factors, namely the availability of productive resources (labour, capital, land, technology and entrepreneurship) and the economic institutions to utilise and guide the use of these resources (Weaver and Jameson, 1978).

In terms of labour, interventions were aimed at increasing specialisation and division through investment in skills training and attitude changes. Capital formation was considered important and societies were required to save capital to invest in physical infrastructure such as factories and dams. Industrialisation was considered dependent on efficient use of land, which would result in surplus food and labour, resources to be used in industrial development. The key to greater productivity in the agricultural sector was to shift from human and animal labour intensive technologies to a labour-saving machine-intensive approach. The use of modern technology was also viewed as central to growth in the industrial sector, and the transfer of technology and technical know-how from Western nations to the Third World was considered crucial to the development of the Third World.

Entrepreneurship was considered to be the catalyst in the process of development. Being a risk-taker, entrepreneurs were expected to easily discard the traditional way of working and imitate new techniques, especially those proven successful in the West. Institutionally, the Dominant Paradigm favoured a "*laissez faire*" approach, involving private ownership of all factors of production (including land), an interrelated market system for the means of production and for output and free trade at all levels (Melkote, 1991).

Rogers (1976) identified four essential elements in the concept of development according to the Dominant Paradigm, namely:

- The need for economic growth through industrialisation and urbanisation;
- The need for use of imported capital intensive technology;
- The need for centralised planning controlled by economists and bankers to guide and speed up development processes; and
- the need to remove factors resulting in underdevelopment which were considered to be an internal problem of Third World countries, caused by primitive organisational structures of society, the absence of social differentiation, and a population which was traditional, uneducated, self-centred and un-scientific in thinking and attitudes.

According to Melkote (1991), the validity of the Dominant Paradigm as a model for development became increasingly subject to criticism during the 1970s. The main reasons for doubting the validity of the Dominant Paradigm were that:

a) it defined development only in selected, quantifiable indicators of economic growth, such as GNP, ignoring other important measures including unemployment rate, poverty and income distribution;

b) it encouraged capital-intensive techniques in capital-poor nations, ignoring labour intensive technologies;

c) it focused only on those constraints inherent to Third World countries, ignoring those limitations imposed by outside factors; and

d) it supported a top-down approach to planning and development and failed to recognise the need for self-reliance and popular participation.

The shortcomings of the Dominant Paradigm resulted in the formulation of new ideas and approaches towards development during the 1970s. New concepts that were introduced were equity in distribution and other benefits of development, active participation of people at grass roots, independence of local communities and nations to tailor development projects to their own objectives, and the integration of traditional and modern systems into a unique blend suited to the needs and culture of a particular community. New approaches towards development included "The Basic Needs Approach", "Integrated Rural Development", "Intermediate Technology" and "Local Organisation For Development". Generally, these new approaches were aimed at the elimination of poverty by addressing people's basic, fundamental needs and involved local people in the process of development. They also accepted the value of local culture and the need for appropriate technological solutions (Melkote, 1991).

During the 1980s two new or revised concepts entered development theory, namely, sustainability and participation. The concept of sustainability emerged as a results of concerns about the environment. There was a growing awareness that industrialised countries exploited the global resources and contaminated the planet, and that developing countries were destroying its natural resources. The concept of (community) participation in development arose from evidence that project efficiency could be increased by allowing target groups to actively participate by giving them greater control over resources and decision making. This resulted in the development of new communication systems between development agents and target communities, referred to as participatory approaches. It involved the co-equal sharing of knowledge between benefactor and beneficiary, often resulting in solutions which combine indigenous and modern scientific knowledge (Melkote, 1991).

During the 1990s, the participatory approach has been applied world-wide, gaining acceptance as a suitable model for community development.

1.4.2 Development theory and its applications in Eastern Cape Province

Irrigation development in the former Ciskei and Transkei initiated between 1955 and 1970 was essentially aimed at providing participating farmers with an acceptable income from full-time farming, using relatively simple and inexpensive technology. These developments were in line with the recommendation by the Tomlinson Commission of 1955. They shared a top-down planning process with the Dominant Paradigm approach, but avoided the use of labour-saving technology.

Full application of the "Dominant Paradigm" in irrigation development in the former homelands only occurred from 1976 onwards, when elsewhere in the world this approach was already subject to severe criticism. It would continue to dominate irrigation scheme planning and development in the black-owned parts of the Eastern Cape until 1985. During this 10-

year period six major irrigation schemes were developed, namely Tyefu and Keiskammahoek (1976), Ncora and Shiloh (1979) and Zanyokwe and Xonxa-Bilatye (1985).

All schemes developed during the period 1976-1985 resulted from an assessment of the natural resource (irrigable soils + dam site = irrigation scheme). All were aimed at increasing the GGP (gross geographical product) of the region in which they were to be developed.

The concept around which the schemes were designed was the same, namely an enterprise that consisted of at least two components, each of which would pursue a particular objective. The two main objectives of the schemes were economic and social. The economic objective was to increase GGP of the region through one or more market oriented irrigated farming enterprises that would be financially and economically viable. Planners identified estate farming as the component responsible for realising the economic objective. The need for an estate component was based on planners' conviction that it was not possible to warrant the investment needed for infrastructural development of an irrigation scheme by relying on local people's agricultural activities only, basically because it was perceived that local people lacked the skills and ability necessary to manage profitable market oriented production of high value cash crops successfully. The estate component of the scheme usually controlled the major part of the land.

The social objective was to provide local people, a group consisting essentially of the original land right holders on whose land the scheme was developed, with an opportunity to grow food for their families and to produce crops that could be sold for cash to cover production costs and perhaps make a small profit.

At many of the schemes there was a third component, directed at providing selected local households (Ncora, Tyefu and Shiloh Irrigation Schemes) or settler farmers (Keiskammahoek Irrigation Scheme) with an opportunity to become involved in small scale market oriented production. Here the main objective was to create a class of black commercially oriented farmers.

All schemes were designed around a central unit. The functions of the central unit were to manage estate farming in pursuit of the economic objective, and to provide farmer support services to food plotters and small scale commercial farmers in line with the social objective. Infrastructurally, planners selected expensive, sophisticated labour-saving technology, which, under local conditions, required an external team of managers and technical experts to supervise an un-skilled labour force. Small scale commercial farmers were introduced to farming systems that were foreign to them, and, as a result, many of the functions usually managed by farmers such as financial management, performance monitoring, input levels, etc. were handled by central unit. Even on the food plots central unit would handle many of the farming activities. The overall result was that participating farmers, who in most cases had granted the right of use to most of their land to the estate-component of the Scheme, became at best glorified farm labourers, carrying out the decisions taken by central unit, instead of becoming independent producers targeting production at maximising food security or dynamic entrepreneurs responding to market demands.

At present all six medium scale irrigation schemes that were developed between 1976 and 1985 are considered to be technically insolvent or defunct, and the opportunities for their restructuring by transferring control over the schemes to farmers severely limited by the inflexibility of the scheme lay-out, making redistribution of land extremely difficult (Catling, 1996).

The question arises why the same model of irrigation development was allowed to be repeated over such a long period of time, using an approach which had long been shown to be ineffective in other parts of the world. Two reasons come to mind.

Firstly, five of the six irrigation schemes were planned by the same consultancy firm. It may have suited the consultancy firm to employ expensive technology, because it appears that their fee was a function of the total capital requirement for the establishment of the schemes. Furthermore, the use of sophisticated technology created the need for an external management agent, often provided for by a subsidiary of the same consultancy firm (e.g. Inter-Science at Ncora Irrigation Scheme). Given the authoritarian political regime that governed the homelands during the 1970s and 1980s, this model of irrigation development did achieve reasonable economic results for a short period of time, because protest by workers and farmers was subject to reprisal by government.

Secondly, top-down planning suited the government of South Africa of that time, and, because of the pariah status of South Africa in the family of nations, resulting from its Apartheid policies, the country was starved of international influences in the field of development. By the mid-1980's local research demonstrated the need for a change in planning and development of irrigation schemes in South Africa, recommending participation of farmers in planning and decision making processes (Van Rooyen, 1985; Bembridge, 1986).

South Africa has a long way to go in removing the damage that has been inflicted as a result of development policies and programmes which did not recognise the need for consultation and community participation. Irrigation schemes developed during the 1970s and 1980s were examples of ill-guided development projects, which will require major restructuring to get them revived in a sustainable way.

1.5 BACKGROUND TO THE CURRENT STUDY

Land reform involving the provision of access to land to large numbers of landless South African households is a policy actively pursued by the present Government. Providing rural households with access to agricultural land is one of the land reform strategies which may also lead to the alleviation of rural poverty. According to Lipton (1996), small scale farming may be one of the only options available to South Africa to absorb the expected increase in the numbers of local work seekers, whereby small scale irrigated production systems are considered best suited to the dry conditions prevailing in most of the country.

Irrigation schemes are seen as potentially suitable for the purpose of providing a large number of households with access to productive agricultural land. This is especially the case in the Eastern Cape, where most of the land is too dry for rainfed cropping and at least half of the land potentially suitable for rainfed cropping is already under the control of black communities. On the other hand, many of the irrigation schemes developed in the former Ciskei and Transkei are experiencing both structural and financial problems and the sustainability of these projects in their current state is being questioned (Catling, 1996).

According to Kassier, Harrison, Tarr and Rhodes (1988) Region D, which covers most of the Eastern Cape Province, had 144 500 ha under irrigation in the late 1980s (see Table 1.5.1.1), which represents about 8% of the total area under irrigation in South Africa. Potentially the province could expand the area under irrigation to 208 100 ha. Most of the area identified for expansion is located in the East Cape part of the province. However, already a considerable portion of the irrigated land in the East Cape (more than 40 000 ha) is not served by a reliable source of water. As a result, the annually available amount of irrigation water is usually inadequate to practice full irrigation (Regional Development Advisory Committee: East Cape region, 1985). In most cases such land is used for the production of fodder crops in support of the main enterprise, namely livestock production. Such land is generally not suited for small scale farmer development projects.

Table 1.5.1.1 Existing irrigated land and potentially irrigable land in Region D (from Kassier et al., 1988).

Region	Existing (ha)	Unused (ha)	Potential (ha)	Total (ha)
Ciskei	6 800	2 500	2 500	11 800
Transkei	6 300	4 600	-	10 900
East Cape	131 400	4 100	42 600	178 100
Total	144 500	11 200	45 100	208 100

On schemes in former Ciskei the supply of irrigation water is generally reliable and adequate to meet crop water demand, conditions which favour small scale irrigation enterprises. Table 1.5.1.1 suggests that only 58% of the potentially irrigable land in former Ciskei has been taken into production. Of the remaining 42%, half consists of unused land in existing projects, whilst the other half constitutes land that requires development from the start. In projects such as Tyefu (Lower Fish), Tyume (Ciskei citrus) and Keiskammahoek/Zanyokwe the infrastructure to store water for irrigation is already in place and expansion into unused land may be relatively inexpensive. It follows that, locally, there is potential and existing infrastructure to expand the area under irrigation and to broaden access to such land, thereby contributing towards alleviating rural poverty, one of the major problems in the area.

At present there are six medium sized irrigation projects in former Ciskei. Details regarding the six projects are presented in Table 1.5.1.2. Together they involve 2768 ha of land and 2306 rural households. Of these 2306 households 2092 (91% of the total number) are involved in food plot production (Farrow, 1994 and Sonandi and Van Averbeke, 1995a and 1995b). Irrigated food plot production is conducted on small plots, which range in size from 0,16 to 0,25 ha.

In Eastern Cape irrigation development planning, **the basic concept of an irrigated food plot is a small area of irrigated land that provides the holder with an opportunity to grow food for subsistence and a small cash profit** (Loxton, Venn and Associates, 1983). The concept of an irrigated food plot implies that the holder will be involved in the production of crops that will feed his household at least in part and of crops that will generate cash in sufficient amounts to pay for all production costs and, in addition, generate a small profit.

Over the years, there has been a trend in local irrigation scheme policy to increase the proportional area allocated to food plots in favour of other enterprises such as small scale commercial farming and estate farming (e.g. Tyefu Irrigation Scheme - De Lange, Van Averbeke, Sonandi, Lesoetsa, Witbooi and Mei, 1994). This resulted from a change in the policy of Ulimocor, which demanded the parastatal to withdraw from active farming and direct its activities to farmer support services. Table 5.1.1.2 shows the potential for the expansion of the six existing medium-sized irrigation projects into unused land. At present the unused area exceeds the existing irrigated area of 2768 ha by 651 ha. Using a average of 0,2 ha per household - the current standard size for local food plot allocations - an additional 17 095 households could potentially be able to benefit from being allocated a food plot on unused irrigable land in these six schemes.

Ulimocor (Ciskei Agricultural Corporation) is responsible for five of the six Ciskeian irrigation projects. Keiskammhoek irrigation scheme, the only exception, was also under the control of Ulimocor, but was handed over to the Department of Agriculture and Land Affairs of the Eastern Cape. In an overview of these six projects, Farrow (1994) of Ulimocor indicated that all of these projects are subject to problems, which adversely affect economic viability at farm and scheme level. However, the extent of the problems differs between schemes and between the types of enterprises within schemes. Some projects and some enterprises could be described as extremely inefficient, production being a fraction of what is potentially possible, e.g. Keiskammahoek Irrigation Scheme in general, and the commercial dairy enterprises in particular (Sonandi and Van Averbeke, 1995a and 1995b). In other schemes production levels appeared satisfactory, but participants were found to be disgruntled by the lack of financial benefits derived from their labour, e.g. food plot growers at Tyefu Irrigation Scheme (De Lange, Van Averbeke, Sonandi, Lesoetsa, Witbooi and Mei 1994). Land tenure problems appear to be one of the factors affecting the attitudes of farmers and food plot growers at the reasonably productive Shiloh Irrigation Scheme, preventing further progress (Farrow, 1994).

It is important that provision of access to irrigated land to rural households is planned and facilitated appropriately, in order to ensure economic and social viability at both household and project level. The investment required to bring irrigated land into production is considerable and usually funded by the state. By removing the constraint of water deficiency, irrigation can add considerably to the productivity of the land, making it possible to grow crops normally not suited to local conditions of water supply. It is important that, over time, irrigation projects should develop into regional assets, providing participants with real and economically sustainable benefits. This can be achieved only by creating conditions under which participants do not rely on government support outside the areas of extension, research, access to information and community support. When the present study was initiated it appeared that few, if any of the schemes in former Ciskei had reached that stage of development, but some had made more progress than others. It also appeared that irrigated food plot production was a reasonably successful model of local irrigation scheme development. Relative to most other models of irrigation scheme development it has the advantage of being of potential benefit to a very large number of poverty-stricken rural households, which is important considering that addressing the needs of this grouping within our society is one of the main objectives of the Reconstruction and Development Programme.

Experience gained on existing irrigation schemes should not be ignored in planning for future expansion of existing schemes or the development of new schemes. In the past, general evaluations have been made of irrigation schemes in former Ciskei (Bembridge, 1987; De Lange, Van Averbeke, Sonandi, Lesoetsa, Witbooi and Mei 1994; Sonandi and Van Averbeke, 1995a and 1995b), but there has not been a comprehensive analysis and assessment of the irrigated food plot production model. The current study is aimed at addressing this gap in existing knowledge. Its aims are:

- to document prevailing food plot production systems, and
- to provide information about the benefits participants derive from these systems, both qualitatively and quantitatively, and
- to identify factors which contribute to success in the food plot model of irrigation scheme development.

Table 1.5.1.2. Existing irrigation Projects in former Ciskei

Project name	Area under production including land farmed by management agent (ha)	Potential for expansion (ha)	Main enterprise	Number of farming households	Type of holdings (excluding land farmed by managing agent)
Tyefu Irrigation Scheme	644	994	vegetables and maize	32	commercial farmers of 4 ha units
				1 487	0,16 ha allotments and 0,2 ha food plots
Keiskamma-hoek Irrigation Scheme	805	1195	dairy and vegetables	33	commercial farmers on 12 ha
				84	0,25 ha food plots and a co-operatively managed dairy scheme
				34 workers	state owned enterprise
Ciskei Citrus Projects	624	700	citrus	22	private farmers
Shiloh Irrigation Scheme	455	400	dairy and vegetables	15	commercial on 4 ha units
				558	0,25 ha food plots
Zanyokwe Irrigation Scheme	412	130	vegetables and maize	64	private farmers (on 6 ha units)
				180	food plots
Horseshoe Irrigation Scheme	36	18	vegetables	1	private farmer on 40 ha
				14	private farmers on 2 ha units
				112	food plots
Total	2768	3419		2 306	

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CHAPTER TWO

FACTORS INFLUENCING SMALL SCALE IRRIGATED CROP PRODUCTION: A BRIEF OVERVIEW OF LITERATURE

2.1 PHYSICAL FACTORS

2.1.1 Introduction

In irrigated agriculture, the physical factors are those that relate to the natural resources land, water and climate. Local physical factors are of major importance in the planning process of an irrigation development, because they determine to a large degree which irrigation systems can be used, the range of crops that can be grown and the farming systems that can be employed.

In modern irrigation development, physical resources are assessed by means of a comprehensive resource survey before decisions on the implementation of the proposed development are taken. Assessment of the physical resources involves detailed studies of topography and soils (land), hydrology (water) and climatic variables (climate), and the results of these different studies are usually integrated by means of a land evaluation procedure. Land evaluation assists planners in deciding what uses of the land are physically possible, economically viable and socially relevant, and which changes to the land are desirable and feasible. They also enable assessment of the comparative advantages of present and potential land uses (Nortcliff, 1988).

2.1.2 Climate

Climate is the long-term characteristic regime of weather resulting from the energy balance, atmospheric circulation, character of the active surface, and, in some cases, anthropogenic influence (Petr,1991). According to Petr (1991), solar radiation is the first factor to act on the production of plants, whereby the radiation flux respresent a source of energy for photosynthesis, whilst also influencing temperature. Temperature is the second factor that affects plant growth, influencing directly the rate of biochemical reactions, and therefore, also the rate of plant growth. Temperature patterns (diurnal and seasonal) also determine the species of field crops that can be grown in a specific region. Rainfall is the third factor influencing plant growth, because it determines the soil water regime and plant water availability. The influence of rainfall on plant production is reduced when irrigation water is available. The fourth factor is the composition and movement of air. The chemical composition of the air is fairly constant, but the concentration or pressure of water vapour in the air varies considerably. Water vapour pressure deficit has an important effect on water and energy balances in plants. The humidity of the air, being a function of temperature and vapour pressure, has many secondary effects, such as the rate of drying of crops and the incidence of fungal infections. Movement of air or wind can cause mechanical damage to plants, especially important in fruit crops (blemishes) and cereals (lodging), and also affects the evapotranspiration process.

The study area is situatated between 33° and 34°S, ensuring high levels of irradiation during most parts of the year. Relatively low levels of cloud cover result in a high mean number of daily sunshine hours. In Alice, situated centrally within the study area, the mean number of sunshine hours is about 7, with little variation between months. The mean annual temperature in the study area ranges between 16 and 20°C. The temperature regime enables the growing of sub-tropical crops along the coast, but more in-land frost is experienced during the winter months. Class A-pan evaporation in the study area is expected to range between 1600 and 2000 mm per annum and three rainfall zones can be distinguished, namely a southern coastal zone, where about 40% of the rainfall falls in winter, a central zone where the distribution pattern is bimodal, with rainfall peaks in spring and autumn, and a northern summer rainfall zone. Mean annual rainfall in the target zone ranges from just under 400 mm in the Fish river valley (Tyefu) to more than 1000mm in parts of the Amatola mountains. Wind occurs most frequently at the coast. The hinterland is subject to the effect of hot berg-winds, which are most common during August and September. Generally, the climate of the study area enables the production of a wide range of food and industrial crops.

2.1.3 Land

The factor "land" usually refers to topography and soil. The topography of an area is determined by altitude, terrain morphology, slope and the presence or absence of micro-relief. In irrigation, slope is probably the most important factor, because it determines in a major way which system of irrigation can be used safely. Almost any type of irrigation system can be used on level land, because the erosion hazard is very low. On level or nearly level land surface irrigation is often recommended, because it is cheap. As the slope gets steeper surface methods of applying water become hazardous and planners have to resort to overhead or micro irrigation systems.

Terrain morphology is also important, because it allows assessment of flooding hazard (alluvial bottom lands) and run-on hazard (lower middle slopes and toe slopes). Where such hazards occur, the erection of special structures, such as dykes, contour banks and water ways) may be necessary. The need for such structures adds to the initial capital outlay and to recurrent maintenance costs of a scheme, thus affecting the economics of irrigation.

Generally, the topography of the Eastern Cape is steep. About a third of the province (31,3%) consists of mountain ranges with large differences in local relief. Plateaus with medium to large differences in local relief cover just over half of the province (53,3%). A small part consists of relatively level plains (11,0%) and river valleys (4,6%). The valleys are usually deeply incised and the occurrence of level land of alluvial origin is generally limited and localised (Van Averbeke, 1995).

Soil refers to the mantle of usually unconsolidated material that covers the earth's crust. This material has been subjected to physical, chemical and pedological processes of weathering, usually resulting in the formation of different layers called horizons. Soil is the natural growing medium for plants, providing foothold, nutrients and water. A good soil allows plant roots to penetrate deep into the profile and water to penetrate readily through its surface and move through its profile percolating beyond the rooting zone when in excess. It has the ability to store a large quantity of plant nutrients and is free of any toxic elements or substances that may harm plants and their roots.

Soils in the former Ciskei are subject to some major limitations, which influence their irrigation potential. Each of these limitations is discussed in some detail.

Effective rooting depth In the major portion of the former Ciskei soils are shallow. The water storage capacity of a soil is determined mainly by the depth to which plant roots can extend into the soil (effective rooting depth) and to a lesser degree by soil texture. Shallow soils have low water storage capacities and require an irrigation regime that consists of frequent but shallow applications.

In many instances soil depth also influences soil drainage, i.e. the rate at which excess water is removed from the soil profile. Because of their limited storage capacity, shallow soils are filled rapidly with water. The underlying rocky or clayey layers prevent excess water from draining away and the soil becomes saturated. Plants growing in a saturated soil experience difficulties with the uptake of nitrogen and may also be subjected to the effect of toxic substances, which develop as a result of the waterlogged conditions. Once the soil is saturated with water, additional rain can no longer infiltrate the soil and runoff will occur. Runoff is responsible for most of the erosion occurring in former Ciskei.

Infiltration rate and soil compaction Many of the soils occurring in former Ciskei have physical (and chemical) properties, which make them susceptible to compaction. Soil compaction causes a reduction in the porosity of the soil and a concomitant increase in bulk density. Two types of compaction are identified, namely subsoil compaction and surface compaction. Subsoil compaction refers to the creation of a dense layer in horizons situated below the cultivated layer. Subsoil compaction is usually caused by traffic (e.g. tractor wheels). It affects root proliferation adversely limiting most of the root activity to the surface layer. This, in turn, increases the susceptibility of the crop to water stress. Subsoil compaction is a major problem in intensively cultivated land and is of special concern in irrigated lands which are planted to perennial crops such as fruit trees. In lands already subject to subsoil compaction, the problem is addressed by means of deep cultivation. Deep cultivation is an expensive mechanical operation, which is often warranted only in land planted to high value crops.

Surface compaction refers to the creation of a dense layer at the surface of the soil. Surface compaction is also known as crusting or capping. It has an adverse effect on the rate at which water infiltrates the soil and it may prevent seedlings from emerging (e.g. corkscrew in maize). The crust is usually caused by the action of water, be it in the form of water drops hitting the soil surface or a sheet of water running over the surface. Surface crusting is often associated with low structural stability. Structural stability refers to the resistance of soil aggregates against destruction by external agents such as water. Some important factors which reduce structural stability and enhance crusting are low soil organic matter content, high exchangeable sodium content, low clay content, and a particle size distribution characterized by a high silt and fine sand content. In irrigated lands crusting and associated low infiltration rates affect the rate by which water can be applied safely to the soil. Low infiltration rates demand longer or more frequent irrigation cycles, if water is to be applied in adequate amounts. Practically this may not be possible and surface crusting may be one of the major factors causing "under-irrigation" of crops on local irrigation schemes.

Soil alkalinity In the drier areas of the Eastern Cape, where the rainfall is less than 500 mm, surface soils are often calcareous and in some instances alkaline. Especially irrigated soils are subject to alkalinization. In the Fish river valley, alkalinization was identified as one of the major threats to the productivity of irrigated land (De Lange, Van Averbeke, Sonandi, Lesoetsa, Witbooi and Mei, 1994). The main cause of alkalinization of irrigated soils is the application of poor quality irrigation water.

Phosphorus deficiency Most of the soils in the Eastern Cape are extremely deficient in phosphorus. Phosphorus is a major plant nutrient and deficiencies have a marked, adverse effect on crop yield. Many small scale farmers fail to replace the phosphorus withdrawn from the soil by the previous crop. Since major parts of the crop are used for home consumption, little monetary returns are derived from small scale cropping. Several investigations have demonstrated that black small scale farmers are reluctant to spend money on fertilizers. Instead, they mainly rely on manure to maintain the fertility of their lands. Manure is usually not supplied at a rate adequate to compensate for uninhibited removal of phosphorus by crops (Yoganathan and van Averbeke, 1996).

2.1.4 Water

The supply of water for irrigation is a function of accessible water sources, the quantity of water that is available from these sources and the quality of that water (Thompson, Spiess and Krider, 1980).

Water may be obtained from surface or sub-surface sources. Large irrigation schemes usually make use of surface sources, whereby water in rivers or streams is diverted directly onto fields or delivered to fields through the distribution facilities of the irrigation project, after having been captured in a storage facility such as a dam. The use of sub-surface sources most often involves pumping of ground water which finds it application mainly on individual farms.

The quantity and timing of potential water deliveries affect planning and selection of farm irrigation systems and cropping systems, because the available flow from the source may be inadequate to enable full irrigation of all crops throughout the year. When the quantity of water is limited, appropriate cropping cycles may be needed in order to optimise economic returns. Limitations in the quantity of water available for irrigation affect nearly one third of the area under irrigation in the Eastern Cape (Kassier, Harrison, Tarr and Rhodes, 1988), restricting local farmers to the practice of applying supplementary irrigation to relatively drought resistant fodder crops, instead of year-round cash cropping under fully irrigated conditions. The quality of irrigation water is essentially determined by its chemical composition. Water usually contains a range of soluble salts occurring in varying concentrations. Soluble salts can have two effects on growing plants, namely, specific and general effects. Specific effects are caused by particular ions which are harmful to plants. Examples are borates and sodium carbonates, the latter being harmful mainly because it increases soil pH, thus rendering many plant nutients unavailable. The main general effect of soluble salts is the raising of the osmotic pressure of the soil solution, resulting in stunted growth of plants (Rowell, 1988). Irrigation waters are usually classified on the basis of their salinity and sodicity hazard. Salinity hazard is assessed by measuring the electrical conductivity of water and sodicity hazard by means of the sodium absorption ratio (SAR), which is the ratio of the sodium ion concentration to the square root of the calcium plus magnesium concentrations, all expressed in millimoles per litre.

In the former Ciskei, surface waters are generally of a reasonably good quality. Exceptions are the Fish river, lower Kat river, lower Buffalo river and the Keiskamma river below Dimbaza, which are all subject to high salinities (Hill, Kaplan & Scott, 1991).

2.2 INFRASTRUCTURAL FACTORS

Irrigation development is usually carried out in the form of irrigation projects with specific development objectives to achieve. Depending on the level (eg. national, regional, project, farm, etc) at which irrigation development planning is taking place, the objectives of irrigation can be very diversified. The objectives for irrigation development are usually multiple and should fit within the framework of the National Water Master Plan. These objectives could be: to increase local food production, to increase national agricultural production, to reduce rural-urban migration, to alleviate poverty redistribute income and improve rural welfare, to increase employment opportunities in the rural areas etc. In order to achieve the specific project objectives, an efficient and appropriate infrastructure is indispensable.

The term *infrastructure* has been defined in various ways by different authors, Wharton, (1967); Willard (1974) etc. Infrastructure is complex and involves facilities and services related to agricultural production and marketing. According to Ilaco (1985), infrastructure can be divided into two categories:

- physical infrastructure and
- social infrastructure.

2.2.1 Physical Infrastructure

Physical infrastructure covers a wide range of physical facilities so far as they are related to the supply of farm inputs and marketing of produce from the project area (McDonald, 1985). The main facilities are discussed below, somewhat in line with the classification of Wharton (1967).

2.2.1.1 Irrigation and Public Water Facilities These are facilities for storage and delivery of water for irrigation and public use. They include irrigation and drainage infrastructure like dams, canals (conveyance and distribution networks), drainage systems etc.

The means of abstraction and delivery of irrigation water from a source is determined by several factors which may include the type of source, topography (especially the slope between the point of abstraction and the point of use and the terrain along the transmission line), method of irrigation, the soils, climatic conditions, the discharge, economic factors etc. In the study area, the common source of water for irrigation and public use is reservoirs and the method of water abstration is mainly by pumping. Water application in all the schemes is by movable sprinkler systems.

With an exception of SIS where water is delivered from Waterdown Dam (on Klipplaat River) to the project area by an open channel, in all the other schemes, water is delivered by pipeline. KIS (Upper Gxulu) obtains its water from Cata Dam on the Gxulu River. In HAIS and HOIS, water is pumped directly from the rivers without storage to the fields where it is applied to the food plots. Water for irrigation in HAIS is abstracted Kat River using two pumps (one in each section of the scheme) while in HOIS water is abstracted from Buffalo River using two electrical pumps. With ZIS, water is abstracted from Sandile Dam via a pipeline.

Since the method of water appliction in all the schemes is sprinkler system, the required hydraulic head to operate the sprinklers is created either pumping water by gravity due to the difference in height between the source of water and the point of use. The required hydraulic head in TIS and KIS is created through gravity flow. In some sections of TIS water is pumped from the Great Fish River and stored in earth dams from where it is delivered to the fields by gravity. However, since the Fish River is saline, TIS is now getting good quality water from the Glen Melville Dam, which is supplied from the Orange River via Orange/Fish and Fish/Ecca Tunnels. Glen Melville Dam is located on the Brak River. Water is conveyed to the scheme through a pipeline with a connection at Committees Drift. This source of water has now reached Ndwayana.

Most projects are designed with good irrigation infrastructure. Problems arise when the infrastructure is poorly maintained. In all the irrigation projects where this study was conducted, the various Scheme Managements maintain irrigation infrastructure up to the farmers plots. However, the farmers feel it is not their obligation to maintain the on-farm structures. As a result, there is a lot of wastage of irrigation water due to leaking pipes, fittings etc.

2.2.1.2 Transport Facilities There are different means of transporting goods but not all may be relevant to the region where this study was conducted. However, transport facilities embrace facilities such as roads, railways; airports; seaports etc. Besides these, animal and/or even human transport is still in use in many areas of the world. To achieve the multiple objectives of most projects is impossible without a good transport network. Arnon, (1981) stated that an efficient marketing system for commercial farming is not possible without a good transport system.

Lack of a proper transportation network has a number of drawbacks when it comes to marketing of produce or delivering inputs to the project areas. Bad roads for instance make it impossible for produce to get to the market or cause damage especially to perishable products while they are on the way. Arnon (1981) observes that in many developing countries railways do not penetrate far into the project areas and most roads are dry-weather tracks, which are unusable for varying periods of time during rainy seasons. Consequently, the expense of delivering produce to the market can even exceed the cost of production making the produce very expensive to the consumer. Inputs too become expensive due to the high cost of transportation.

Most of the schemes in the study area are characterised by reasonably well maintained secondary roads and poor tertiary or feeder roads. In some cases like Tyefu Irrigation Scheme, getting the produce to the market centres is fairly expensive due to long distances to the markets and poor feeder roads.

2.2.1.3 Agricultural Research and Experiment Facilities Since training and extension very often are an integral part of irrigation schemes, demonstration farms may be essential, field experimental stations for applied research may be planned for, and field laboratories may be required. These facilities are important as they help in identifying the appropriate technology and the transfer of the same to the farmers. In the projects where this study was carried out, some of the above facilities like experimental stations or training centres are either not available or non-functional.

2.2.1.4 Storage and Processing Facilities Storage facilities can be in the form of silos, or warehouses. Storage facilities are important especially where roads are impassable for some time in a year. In such cases, the produce can be stored in the project area and when the roads are in a usable condition, the produce can be taken to the markets or the processing centres. In the study areas, there are no significant storage facilities. The farmers are forced to deliver their produce to market soon after harvesting to avoid post-harvest losses due to poor storage.

Processing facilities comprise of machinery equipment and buildings. Losses can be reduced by processing the produce in the project areas. However, it may not always be economically viable to have the processing facilities in the schemes. With an exception of the dairy produce, most of the other products from the study area are processed outside the schemes. The major processing centres are Port Elizabeth and East London.

2.2.1.5 Input and product markets Irrigated crop production usually makes use of high levels of inputs. These inputs include planting materials (hybrid seed, vegetable transplants), chemical fertilizers, chemicals for plant pest and weed control and the use of mechanised implements in land preparation, cultivation and harvesting. In order to maintain high levels of production and quality it is important that farmers have ready access to all the necessary inputs. In the case of small scale irrigated farmers on schemes situated in rural areas, it may be necessary to arrange access to inputs through a central service managed by the Scheme, as was the case at most of the schemes in Former Ciskei and Transkei or through private entrepreneurs (e.g Tyefu Irrigation Scheme). Privatisation of input supply can endanger production at rurally based schemes, for example when the provision of certain input supply services is not an economically viable proposition because the market provided by scheme farmers is too small. This may result in certain input supply services being discontinued.

Product markets are also essential to the economic viability of irrigated crop production. When situated in deep rural areas, the opportunities for local marketing may be limited and transportation of produce over medium to long distance becomes necessary. Often this requires the collection of marketable produce at a central place, enabling bulk transport. At schemes in the Eastern Cape central marketing services were part of the range of services offered by Scheme management. Viability of a central marketing service tends to be closely linked to the amount of produce that is being delivered for marketing by the service. When production declines below a threshold level, the economical sustainability of central marketing services is under threat, which in the case of Eastern Cape schemes forced their discontinuation (FOA and ARDRI, 1996).

2.2.1.6 Utilities These include power supply, communication facilities, domestic water supply etc. These facilities are essential for rural development. John Howel (1985) states that lack of rural infrastructure is proving to be extremely expensive in terms of production. Most unemployed young people in the prime of their youth do not wish to stay in the rural areas where these utilities are lacking. Hence, they migrate to towns to seek for employment leaving old people in the villages who are usually too weak to cultivate the land effectively due to lack of labour.

In order to market ones produce, one might have to make several phone calls or send a number of facsimiles to various outlets. As such, there are transaction costs involved befored the produce gets to the markets. These transaction costs can at times can be so high as to render an enterprise uneconomical. Thus, cheap and efficient communication services are essential even in agricultural enterprises. In the area of study, communication services are of very poor quality when they are available but in most schemes, they are either non-funtional or do not exist at all.

In most schemes where this study was conducted, rural electrification has not began yet. However, power supply is available for pumping of water in the schemes. Few of the projects have clean domestic water supplied to the farmers.

2.2.2 Social Infrastructure

According to Ilaco (1985), social infrastructure covers religions, educational institutions and organizations, tribal and communal laws, extension, credit and financial institutions and marketing services. However, to this list one can add housing, health services, and administrative and/or political institutions related to or involved in agricultural production.

These factors will not be discussed in detail here as they are covered elsewhere in this report (see Sections 2.3 and 2.4). Suffice it to say that:

- as Ilaco (1985) puts it, social considerations may exert greater influence on humans behaviour than financial ones and as such, a basic knowledge of the main social factors prevailing within a community and their influence on farmers' behaviour is indispensable. The social factors were seemingly not considered during the establishment of all the schemes that were involved in this study.

- irrigation development increases production and an efficient marketing system has to be in place to cope with increased production. According to Mollett (1984) and Nurul (1974), efficient market systems must provide for movement, storage, collection and distribution of goods at minimum costs. In developing countries, marketing systems are inefficient. With a poor marketing system, the farmer will not be able to sell his surplus produce. As a result, the farmer tends to produce only for his own consumption.

- produce markets and input markets do have a great influence on the agricultural enterprises. If these markets are situated far away from the projects areas, (especially the small irrigation projects), then the cost of transportation can significantly reduce the profitability of the projects. In many of the schemes where this study was carried out, the scheme managements buy the inputs in bulk and then sell to the farmers in small quantities that the farmers can afford. In some cases (e.g. Upper Gxulu - Keiskammahoek), the scheme management does not provide inputs to the farmers but there are shopes near the project that supply the inputs to the farmers. For most of the projects in the study area, produce markets are situated far away from the projects. The adjucent communities to the various schemes do not usually consititute sufficient produce markets for the schemes.

2.3 PLANNING, DESIGN, INSTITUTIONAL, ORGANISATIONAL, SOCIAL AND ECONOMIC FACTORS

2.3.1 *Planning and design of irrigation schemes*

There is substantial evidence world wide especially in Asia, that farmer involvement in planning, design and construction occurs in the development of an irrigation scheme. Two studies, Bruns and Atmanto in Indonesia and Vermillion in India, both cited in Turral (1995) emphasised the sense of ownership generated by farmer input in design and construction on small irrigation projects in India and also, documented the differences in engineering solutions preferred by farmers compared with standard designs.

Farmers also need to learn about how irrigation systems operate in order to be able to evaluate their problems and consequently make useful contribution to irrigation development. In a workshop on institutional framework for irrigation carried out in Thailand, Abernethy (1993), presented some guidelines for farmers involvement at different phases of irrigation development. These guidelines relate to planning, where much consultation and dialogue is solicited as much as possible. According to the group, consultation should include not only beneficiaries of proposed projects, but also negatively affected groups such as farmers who would be displaced by (for example) such projects. With respect to design, farmers should be given the opportunity to comment on layout plans for canals and drains and location of structures. Here, the use of traditional types of structures should be encouraged.

In another study in the Madura groundwater irrigation project in India farmers were found to be involved in the design and layout of canalisation from the time of the survey onwards (Turral, 1989). In South Africa, small scale farmer involvement in the planning and design of irrigation projects appears to be minimal. Farmer involvement in the planning and design of some Eastern Cape schemes in former Ciskei and Transkei was very limited. Once government acknowledged the need for an irrigation scheme in the area, they tendered it and turned it over to the winning consultant group who immediately got into action. This was the case for Keiskammahoek and Ncora as they were grand designs of homeland administrations with help from the South African government. Several of these schemes suffer today because of lack of consultation and involvement of the communities whose lives were going to be changed as a result of the various constructions.

Clearly farmer knowledge of topography, drainage and other layout plans are extremely important for adequate design and layout of irrigation systems. Even in areas where there is no real expertise in irrigation, effort must be made to confirm farmers indigenous knowledge in those areas and consult them for participation.

2.3.2 Institutional factors

2.3.2.1. Government The act of governance is the ability to direct, control or rule with authority. Government is involved in managing resources entrusted to it by people and its powers are often backed up by laws. The followership within the system usually select people who become responsible for managing and administering such laws for the benefit of all. The local government form of administration is the newest of the forms of rural administration in South Africa today. Although, the structures are still very new, they will in the future be a key to decentralized rural development.

Government policies provide direction to the many aspects of the rural sector economy. Its intervention to develop irrigation schemes in many parts of the developing countries has historically not been successful. Evidence from the literature suggest that most government led irrigation schemes in Africa failed dismally and came far short of the original expectations of the planners (Bembridge, 1985). Bembridge's conclusion in his study agrees with Prof Ian Curruthers who in a decade ago said: "In Africa, irrigation as a means for food production is either largely unimportant or unsuccessful". However, it should be recognised that new institutions in certain African countries have already begun to combine the limited water resources and appropriate technology for productive and profitable agriculture.

In Australia, responsibility for land and water with respect to irrigated farming, remains with the state government and this helps the overall farmer development (Constable in Abernethy 1993).

In several of the Latin America countries, such as Mexico, Brazil, Argentina, Chile and Peru, Government departments or Ministries of Agriculture are very participative in irrigation led food crop production projects allowing for a high level of success in crop farming. The case of Peru is evident, where Government policy favoring rice farmers counteracted the intervention of a Technical Bureau, granting a fixed price for rice and for its marketing (Urban, 1990).

2.3.2.2. *Management of irrigation schemes* The leadership provided through effective and efficient management holds a key to proper delivery of services to clientele. In extension related institutions such as those working for the development of small scale farmers in food crop production, there is general paucity of management, organisational, and administrative skills at all levels. According to Bembridge (1985), this handicap in management can be found in the entire system, from specific project management to farmers, and among financing organisations as well.

The services provided by management usually will depend on the mo8del of management used in the organisation. Coward (1980) outlines three types of management systems that conforms to the way organisations or institutions serve their clientele. The first is the bureaucratically managed systems, fully administered by government or its agencies; the jointly managed systems in which some functions are performed by the development agency while others are taken over by the project participants. The third scenario is the community based system, mainly small projects, operated by users themselves and their representatives.

The South Africa experience especially with the former "Homelands" administration clearly reveals the inefficiency of the bureaucratically managed system as government took over all services and a dependency syndrome was created which may take some time to erase.

2.3.2.3. Land Tenure and Use System Land is a major factor in irrigation farming and thousands of people depend upon it for survival. Because of its institutional importance, it is often recognised as one that has to be utilised and managed in a sustainable way such that it will support the inhabitants of that area.

The different forms of tenure system, namely; tribal ownership, state ownership, trust land, quitrent and freehold all do occur at schemes under investigation in this study. The land tenure system in the former Ciskei area of South Africa where the irrigation schemes for this study are located is principally dominated by communal land. Most of the lands in the tribal areas are held in trust by the state for tribal communities and are used by members of this community in accordance with the recognised traditional communal system of land tenure.

More often, than not; the local tribe identifies strongly with its available land and we find therefore that communal system of land tenure is necessary for the continued existence of tribal community life (Romuld and Sandham, 1995).

Studies in the literature have shown that secure land tenure is a necessary pre-condition for the adoption of long term sustainability of farming practices. In many parts of the World, this assumption may not be true. For example, in Thailand, research showed that farmers thought that land tenure made no difference to farming practices(Anon, undated).

Land tenure in Black African tradition within South Africa is a very complex issue involving a variety of attitudes, behaviours and long established code of conduct. No particular member of the community has individual right especially as no registered title was given at any point in time.

In South Africa, the historical and political complexity of the land issue, rights and entitlement makes the question of tenure also very relevant. Most land right holders, including farmers maintain that without secure tenure through title or certificate of occupancy, evidence of ownership or rights over property on that land is not guaranteed (FOA/ARDRI, 1996).

The peculiar political arrangements during the years of apartheid meant that distribution and securing title was unequal as a great part of the land was reserved or owned by whites. Lundgreen (1983) points out that the trend in this sort of arrangement was consistent in areas of European encounters with Natives as was found in Kenya and Tanzania.

For irrigated food crops, tenure is a major consideration. For example, in the Eastern Cape midlands, citrus farmers who became non title land owners through the transfer of white farms to black smallholders by the Ciskei government have pointed to the lack of title as the fundamental problem facing them in their future as citrus farmers (Hawes pers. comm).

In dry South Africa irrigated land is amongst the most productive land available. It is therefore, important that this land is used intensively. When irrigated land is held under a form of communal tenure, the number of households holding land is usually large, because equity was and still is an important consideration in tribal land allocation. However, over time, as a result of historical changes in the socio-economic conditions of households, not all land holding households maintain an interest in farming. In the interest of intensive use of irrigated land, it is important that land holding households no longer interested in or no longer capable of producing on their land allocation feel secure to make their land available to other households seeking access to more land. If equity is a concern, land transfers would be by means of land leases or rentals. If not land sales could form part of the transfer mechanisms. The willingness of households to enter into land transactions will depend on the prevailing security of tenure. According to Place, Roth and Hazel (1994) cited by Thomson and Lyne (1995), tenure security comprises three elements, namely breadth, duration and assurance. The breadth of rights refers to the bundle of rights assigned to the land right holder and includes rights to use, transfer and exclude others. Duration refers to the length of time a given land right is legally valid, and is very important when land use demands substantial investment, as is often the case in irrigated land. Assurance refers to the present and future degree of certainty by which the given land right is held and is dependent on the effectiveness of the legal system in settling land disputes (Thomson and Lyne, 1995).

In communal areas of Upper Tugela in KwaZulu-Natal, Thomson and Lyne (1995) found that all three elements determining tenure security were inadequate to enable optimum use of arable land (limited breadth of rights) and exchanges of land (limited duration and assurance of rights). Under irrigated conditions, the absence of adequate duration and assurance of rights is bound to limit land exchanges, and, therefore, allocative efficiency. Allocative efficiency is a measure of the ease by which land is re-allocated from households with a land surplus to land-seeking households. Low allocative efficiency will impact negatively on land use intensity, because surplus land will not readily be allocated to land-seekers.

In the case of land held under communal tenure, Thomson and Lyne (1995) recommended an incremental approach to increasing tenure security. The recommended approach consists of the enforcement of property rights that customary law afford to crop farmers, followed by making the right to a particular arable allocation permanent, without displacing customary safeguards against land sale. Thomson and Lyne (1995) suggested that this approach would promote allocative efficiency, whilst maintaining equity.

2.3.3 Organisational factors and extension services

2.3.3.1 Farmer Organisations Farmer organisations usually constitute farmers that have come together as a group to carry out objectives, formulated by them, to solve problems which cannot otherwise, be easily solved by the individual farmer. The implication here is that the organisations mandate must be clearly defined (Legoupil, 1990). For small scale farmers with or without access to irrigation, belonging to farmers organisation often brings positive impacts on its participants (Wijayaratna in Abernethy (ed) 1993). However, the productivity and sustainability of farmer organisations will depend on the creativity, resourcefulness, honesty and hardwork of its participants as shown by the results of a study in Bangladesh where with little or no co-operation from outside, small farmers were able to organise themselves into groups for service functions (Wijayaratna in Abernethy (ed), 1993.

In South Africa, where local communities insist on active participation in service delivery, farmer organisations play a major role in ensuring that people work together, formulate a common agenda and have a sole voice in political representation to administrative governance. There is a wide range of farmer organisations servicing agricultural related institutions at local grassroots level in the Eastern Cape province. At present, there appears to be broad consensus that since majority of farmers are small and also, disadvantaged, they require better representation for the submission of their viewpoints to local leadership. Only good farmer organisation can help in achieving this role.

Relations between the different farmer organisations and government or its parastatal institutions are not always cordial (LAPC, 1996). Concerns, according to the LAPC study was usually to questions of representation, support of one group over another by the controlling department or ministry, the role of "outsiders", and the social and progressive status of membership as it influenced financial well being of the organisation.

Overall, new evidence from state-owned irrigation schemes, with mandate for food crop production and other aspects of farming, show that farmer organisations are more visible than before, articulate clearly for emerging farmers and consolidate their positions forcing government to respond or act on their demands. The success of farmer owned co-operatives in this area has been marginal, if any at all. Such failures destroy the confidence of these organisations and structurally weaken their institutional base.

2.3.3.2 Extension services Universally, extension's role in small farmer development is educational. They are expected to provide or disseminate information to farmers. Other services expected of extension in their role and responsibilities include, providing institutional support and facilitating farmers needs to support centres. Several models of extension presently exist in getting extension services more clientele-oriented. In all of these models, government policy is considered important. However, recent evidence from field investigations of three irrigation schemes in the Eastern Cape province revealed that farmers expected extension workers to farm for them. This altered the scheme extension workers conception of their role not originally defined in their educational functions (FOA/ARDRI, 1996).

According to Igodan (1996), extension must be involved in monitoring and evaluation of the performance of farmers in development projects. The feedback from the monitoring process allows extension personnel to detect areas of defects and provide corrective measures through proper education. The failure of the "former homelands" irrigation schemes in the Ciskei and Transkei, resulted amongst others; to the lack of clear understanding of extension services, and the proper utilisation of the extension workers skills and competence (FOA/ARDRI, 1996).

2.3.4 Social services and amenities

Social services and amenities relate to social infrastructure often viewed by people in the community as an extension of social welfare such as in the case of monthly pension scheme. The components of social services and amenities in rural areas have been defined, for example, see section 2.2 in this document.

The range of social services and amenities can be categorised into Educational (schools), Religious (churches, mosques), Entertainment (sports field) and Health (clinics, hospitals). The body of irrigation research literature is relatively silent on the provision of social infrastructure by government or its parastatal institutions prior to the development of irrigation facilities in the area. What is evident from studies investigated is that many services, especially the educationally and health related ones spring up in these communities after migration into the area have necessitated it. Some services are provided free while others are perceived to be free. In the old days of the Homeland administration, many communities in the Ciskei and Transkei enjoyed free services ranging from taxation to water use and healthcare. This free delivery has allowed service to be analysed from the point of the providers (Government) than the beneficiaries (local communities). This has in some ways perpetuated the continuation of a dependency syndrome and unnecessarily attracted blame from the beneficiaries to the providers for a slow process of service delivery.

In the Eastern Cape irrigation schemes, especially the ones under investigation, social services and amenities are very limited and the state and quality of service to rural communities is poor. This can be found from the physical neglect of these areas. However, there are a few government built schools and clinics and hospitals are close to nearby towns. Most of the rural areas within the radius of these schemes do not enjoy electricity and proper housing. However, the Reconstruction and Development programme intends to assist in bringing these amenities soon.

2.3.5 Economic factors

2.3.5.1 Introduction Water is an essential factor in crop production. In areas where natural rainfall is not plentiful, irrigation water is often the base of production. As a matter of fact, irrigated agriculture is considered to be the best way out to alleviate food shortages in Sub-

Saharan Africa in particular and in the whole of Africa in general. Thus, the availability and cost of obtaining water for irrigation is of major economic concern.

Irrigation agriculture in South Africa uses approximately 51 % of the total water resources (Backeberg and Oosthuizen, 1995). According to the Department of Water Affairs and Forrestry (1986), 25 to 30 % of the gross agricultural production in South Africa is originated from irrigated agriculture. In South Africa, irrigation water is a scarce resource and hence its efficient and optimal application is of paramount importance.

2.3.5.2. Economic factors in South African irrigation scheme development Past irrigation water use in South Africa was one sided in the sense that most of the water for irrigation was for white commercial agriculture (DWAF, 1994). Water for irrigation was generally diverted from rivers and all the vast investments on irrigation schemes served the white farm sector of South Africa.

On schemes constructed due to political pressure, it was realised that soils were not suitable for permanent irrigation agriculture (Backeberg and Groenewald, 1995). Irrigation schemes were hurriedly constructed before an in-depth study was conducted regarding type of irrigation system, crop-water response function, dam capacity and stability of water supply. Economic circumstances such as marketing, farming size, management and capital in areas where irrigation schemes are located in South Africa were ignored or neglected.

Before 1950's, water resources in South Africa had been developed largely on an ad hoc basis and this often failed to consider cost-benefit analysis (Department of Water Affairs, 1986). It appears that prior to 1950, irrigation development in South Africa has been undertaken in terms of physical measures and economic considerations were of secondary importance.

Starting from late 1950s, some researchers have emphasised the application of economic principles to solve problems of water utilisation in South Africa (Van Wyk, 1964, Olivier and Behrmann, 1969; Siertsema, 1968).

Important economic features and relationships in irrigation farming were identified as the application of the principles of production economic theory with respect to irrigation practices, and the focus on economic considerations with planning of government water schemes and irrigation board schemes.

In the 1960s, there had been debate in favour of more efficient use of water on existing irrigation schemes and elimination of uneconomic small farming units rather than horizontal expansion of irrigated land. Siertsema (1968), strongly argued in favour of vertical expansion of irrigated farming together with planned farming systems and farming techniques.

The transformation of water resource inputs to crop outputs is the basic relationship in the research of irrigation economics. According to Bosch, Eidman and Oosthuizen (1987), two major problems are experienced by farmers who attempt to increase irrigation efficiency. These are:

a) returns from irrigation are uncertain because of the uncertainties about weather, soil water levels & crop water requirements; and

b) the timing of water applications largely determines crop response and increased yield through irrigation.

These problems prevail in any country regardless of the level of development of the country. In search of solutions to the above problems, researchers in South Africa recently have put economic principles into practice particularly in the developed commercial agriculture. According to the Department of Agriculture and Water Supply (1989), researchers in South Africa have used cost-benefit analysis to investigate the viability of irrigation projects. This, however, may not be the case for irrigation schemes which mainly deal with small scale agriculture.

Currently, researchers have recognised a number of deficiencies of research on irrigation schemes that primarily deal with small scale agriculture. According to Backeberg and Groenewald (1995), the following research priorities must be given the maximum attention:

a) exploitation of unused potential on existing irrigation schemes

b) performance feasability studies on new irriation schemes

c) quantification of the social, fiscal and economic impact of irrigation development on the various irrigation schemes in South Africa

d) retrospective evaluation of the success or failure of the existing irrigation schemes

e) social benefit-cost analysis for rehabilitation of existing or development of new schemes, and

f) capacity building on human resources who consume and allocate water resources optimally.

This study generally touches research priorities identified in (c) and in (d).

2.3.5.3 Credit and Finance Providing credit and finance to small scale farmers is a major issue in most developing countries of the world. There is evidence, according to Bembridge (1985) that lack of credit and available finance provided to the farmer at the right time may constitute a constraint to development.

Small farmers with little or no resources often need credit and loans to purchase inputs, prepare the land, hire some labour etc. Because of their relatively poor resource background, they are discriminated against by lending agencies (Igodan, 1991).

In South Africa and prior to 1994, small scale farmers especially in the former Ciskei and Transkei had access to credit/loans and government approved institutions, such as the Development Bank of Southern Africa (DBSA) and were able to finance groups of farmers with full government/department participation in the project. The experience of lending agencies with respect to loan repayment on farming activities especially for resource poor farmers has brought about changes in lending policies (Thomas & Stilwell, 1994). The default rate at the Transkei Agricultural bank during the Homeland administration was 75 %.

In the Eastern Cape, many farmers complain about having to complete forms of many pages in non-useable language and demand for impossible collaterals from the lending banks (Hawes[2], Pers. Comm). This attitude of banks and lending agencies with respect to credit and finances is consistent with World Bank study in Rwanda with small scale food crop farmers. Commercial banks wish to lend to creditworthy projects and individuals, but will be reluctant to lend money if the farmer is not certain on reaping the returns from the project. Increased tenure security in form of land title, long term lease may facilitate farmers access to credit which could be used to purchase inputs or to invest in the development of the crop. However, no bank will accept title as collateral unless the land is saleable.

2.3.5.4. Marketing Services Agricultural marketing is an important aspect of rural enterprise. It's intervention is crucial to the overall production system as an efficient marketing system usually affects consumers and producers alike. In developing agriculture as we often see in the rural areas of South Africa, traditional marketing systems often prevail. They are in their own way sophisticated performing activities such as storage, handling, transportation and processing activities. The catalyst to efficient marketing service is the extension officer working with the producers in the farming households. They are usually responsible for providing market information, facilitating the development and maintenance of infrastructure and transportation. This is what happens with small scale farmers world-wide (Igodan, 1991).

In the rural areas of the Eastern Cape province, many of the rural household farming community indicate that marketing of their farm produce is a major problem for them (FOA/ARDRI, 1996). According to several sources during field investigations in irrigation scheme evaluations, many farmers were unaware of simple marketing channels after successful harvest of their crops (FOA/ARDRI, 1996). The lack or comprehension of the details of markets, formation of co-operatives and setting of competitive prices, credit selling/buying and profit margins means that extension marketing specialists have not been successful in the education of farmers about rural market systems.

2.4 HUMAN FACTORS IN IRRIGATION SCHEMES IN THE EASTERN CAPE

2.4.1 General issues

The use of irrigation schemes in rural areas of southern Africa is a relatively new phenomenon. This type of agriculture requires much more work throughout the year. It requires greater use of purchased inputs and, in many cases, modern technology with the required educational background. To the less experienced farmer it is a risky operation. Steinburg (1983) reported that whenever irrigation is practised it has extensive economic and social influences, pervasive managerial implications and remains a singularly critical element in local, regional, national and indeed international food calculations.

In the northern part of the Eastern Cape, formerly Transkei, Bembridge (1984) reported that agriculture was mainly of a subsistence nature with food being produced for household use.

[2] Max Hawes, Regional manager of Alice Kat region of Ulimocor, Bisho, Eastern Cape.

Income was not generally derived from agricultural pursuits. Flood irrigation was practised in a few places in the former Transkei several decades ago. Further, farmer organisations were, for the most part, non existence. Thus, with little experience in irrigation agriculture and virtually no social organisation for agriculture it is expected that the introduction of irrigation with modern technology such as sprinklers would lead to problems of its own (Rossouw, 1989).

In a summary report by Bembridge (1984) it was found that constraints of irrigation development should be dealt with under the headings of institutional and socio-economic factors. Steinburg (1983) came to the following conclusions based on reports of irrigation schemes throughout the world:

1. The creation of new institutions seldom enhances participation because the aspirations and priorities of the farmers differ considerably from those of the officials;

2. The problems of women on irrigation schemes were not dealt with in depth, but it seemed that they were seldom better off with the creation of irrigation schemes as they usually had to work harder and received less benefits than might have been assumed.

3. Health, sanitation, nutrition and environmental impacts seemed to vary considerably from project to project.

4. Increased income usually resulted in greater emphasis on education which, in turn, had social implications affecting labour patterns and physical mobility.

5. Irrigation has political symbolism as well as having economic implications which can be detected on a national, regional and local level and is likely to increase social tensions (Steinburg, 1983, pp. 22-35).

In an evaluation of an irrigation scheme conducted by Rossouw (1989) it was found that human factors were seldom considered by management and extension services. Personal factors that negatively affected the impact of irrigation farming were poor health, old age, widowed heads of household, low educational levels and male absenteeism. These were barriers to the adoption of irrigation farming practices. Socio economic factors in the irrigation scheme area that negatively affected the adoption of irrigation farming was the need to search elsewhere for income generation. In addition, it was believed that the children were better off going for post-matriculation education and there were very few who saw career opportunities for their children in the rural areas. It was concluded "unless conditions can be created where farming income and the general work situation compares favourably with work situations elsewhere, the scheme will remain a haven for people who are unable to make full use of the technology offered" (Rossouw, 1989, p. 497).

2.4.2 Women and agriculture in Eastern Cape

It is generally accepted that in the former homelands of Ciskei and Transkei, women are more active in crop production than men, (Bembridge, 1984 & Steyn, 1988). This situation is not different from that in many other parts of the world, such as Asia, Sub-Saharan Africa and North Africa (Saito and Spurling, 1992). In traditional African society the role of men was to clear land, herd cattle, hunt and take part in political and military affairs, whereas the role of women was to plant crops, control weeds, harvest and prepare and store food crops, (Bembridge, 1984). This general description of gender roles in traditional African society by and large also applied to traditional Xhosa society in the Eastern Cape, as is evident from Barrow (1801), as quoted by Steyn (1988), who described gender roles in Xhosa society as follows: "*...while men are employed in rearing and attending to cattle, women are engaged in the affairs of the house and in cultivating the ground,..*" Bembridge (1984) reported that 85% of the labour in small scale agriculture in Transkei was provided by women. The dominant role of women in agriculture in Transkei was partly due to the absence of able-bodied men in this region, because most men were working far away from home as part of the migrant labour system. A study of the role of women involving the wives of farmers in Keiskammahoek Irrigation Scheme, revealed that nearly three quarters of the women were actively farming, and that women play an important role on the farm, especially when men are away on other business. The women indicated that men usually still did all the hard work. Yet, tending to the vegetable gardem, hoeing and harvesting of the fields, and herding of cows were functions mostly carried out by women (Wiliams,1994).

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CHAPTER THREE

RESEARCH METHODS AND AREA OF STUDY

3.1 OBJECTIVE OF THE STUDY

The objectives of the study were as follows:

To determine the physical, infrastructural, economic, institutional and social factors of food plot production on irrigation schemes in the Central Eastern Cape (former Ciskei).

To analyse and assess the above factors, including economic feasibility, in order to identify potential practical applications of these to irrigation scheme planning.

To formulate guidelines for irrigated food plot policy.

3.2 RESEARCH APPROACH

The study consisted of two phases. During the first phase an analysis was made of secondary sources of information relating to food plot production on irrigation schemes in central Eastern Cape. This analysis was followed by field visits to the schemes during which the validity of the secondary information obtained was tested by interviewing key-informants and by means of field observations. The second phase consisted of a formal questionnaire survey administered to food plot holders on the six irrigation schemes under investigation. The design and content of the instrument used for primary data collection (questionnaire) is discussed in the ensuing sections. A copy of the survey document appears in Appendix A.

3.2.1 Design of the instrument for primary data collection

The instrument for primary data collection was designed through the collective effort of the research team. The actual questionnaire has the following parts:

Demographic Factors

- This section attempted to seek out household personalogical variables such as age, sex, marital status, farmers' educational level, size of farm holding, experience as a food plot holder, etc. The section was also included to access the general socio-demographic factors of the food plot holders on each of the irrigation schemes.

Physical Factors

- In this section, an attempt was made to design questions that would assess food plot holders' perception regarding climate, soil water quality and use, soil fertility, pests and diseases.

Institutional and infrastructural factors

- In this section, questions were formulated to collect primary data on land use and tenure, land availability, water supplies and use in the respective irrigation schemes.

Socio-economic Factors

Questions formulated in this section related to the first hand information on farm operation, labour, marketing, support services, credit and extension and income & expenditure.

3.2.2 Population and sample

3.2.2.1 Population: The target population for the study were food plot holders of these irrigation schemes. These households vary in terms of numbers and the type of crops they grow. The actual number of farming households was determined from a frame obtained from the Ciskei Agricultural Co-operation, i.e. ULIMOCOR. Tyefu had 1487 farming households, KIS (84), Shiloh (453), Zanyokwe (180), Hertzog (81) and Horseshoe (15). A total of 2300 farming households constituted the overall population of the study (see Table 3.2.1.1).

Table 3.2.1.1. Irrigation schemes, number of food plot holders and main enterprise

Scheme	Location /district	No of food-plot holders	Main enterprise of scheme
Tyefu	Lower Fish river basin	1 487	Vegetables, maize, etc.
Shiloh	Hewu	455	Dairy, vegetables, etc.
Keiskammahoek (Upper Gxulu)	Gxulu river valley	88	Dairy, vegetables, etc
Zanyokwe	Along Keiskamma river North of Middledrift town	174	Vegetables, maize, etc.
Hertzog	Northern part of Kat river basin	81	Vegetables
Horseshoe	East of King William's Town	18	Vegetables
TOTAL		2 303	

3.2.2.2 Sample: The two most important factors that affect sample size are time and costs (Batlese, 1986). It was not possible to utilise all 2300 farming households in the questionnaire survey because of costs, time and other considerations. Taking these considerations of limitations into account, a decision was made to limit the sample size to 10% of the identified farm house-holds on each of the six described irrigation schemes (Dilman, 1976) (See Table 3.2.1.2). Since the number of food plot holders vary from scheme to scheme, disproportionate stratified random sampling procedures were applied to select samples and eventually the participants in the field research survey. The actual samples considered from each irrigation scheme is shown on Table 3.2.1.3.

Table 3.2.1.2 Selection of sample size based on disproportionate stratified random sampling

Irrigation Scheme	Sample Size
Tyefu	160
Keiskammahoek	30
Shiloh	30
Zanyokwe	30
Hertzog	30
Horseshoe	15
TOTAL	315

Table 3.2.1.3 Actual sample taken from the irrigation schemes

Units	Sample size					
	0,16 ha	0,20 ha	0,25 ha	1 ha	2 ha	Total
Tyefu - Kalikeni	2	13	6	-	-	21
Tyefu - Pikoli	-	13	6	-	-	19
Tyefu - Ndlambe	13	4	10	-	-	27
Tyefu - Ndwayana	-	29	-	-	-	29
Tyefu - Glenmore	60	-	-	-	-	60
Keiskammahoek			30			30
Shiloh			33			33
Zanyokwe (Lenye)		13				13
Hertzog (HACOP)				30		30
Horseshoe					7	7
Grand Total						269

3.2.3 Survey procedure

Primary information was mainly collected by means of a questionnaire with the assistance of a team of five field enumerators. The questionnaire, developed by the investigators was pre-tested after face and content validity was assured by a group of experts in the Faculty of Agriculture at the University of Fort Hare. On the basis of feedback from the pre-testing, the questionnaire was re-formulated and prepared in its final form. The final version of the questionnaire was administered to food plot holders in the six irrigation schemes from March to June 1996, constituting a period of 4 months of field research work. After the initial cleaning up of the data to ensure useable data, the total response rate was calculated and recorded at 86%.

3.3 SECONDARY INFORMATION

In addition to the primary information, secondary information was collected from various sources. The research team collected information from the visits to the schemes and held discussions with project managers of the irrigation schemes; information was also extracted from cost and income records of each irrigation scheme. In addition, information on financial matters of the irrigation scheme was collected from ULIMOCOR's Head Office located in Bisho. Other necessary data was collected from published research reports, publications from various organisations, journals, social surveys, family expenditure surveys and other useful sources.

3.4 AREA OF STUDY

The six irrigation schemes are distributed all over the former Ciskei Homeland, now central region of the Eastern Cape Province (see Fig.1).

3.4.1 *Description of the schemes*

3.4.1.1 Tyefu Irrigation Scheme (TIS):

3.4.1.2 Keiskammahoek Irrigation Scheme (KIS): The Keiskammahoek Irrigation Scheme is situated in the Keiskammahoek district of the Eastern Cape Province. The scheme is located 30 km west of Dimbaza off the KWT/Alice main road. At the time of its height of development, it was generally regarded as the "Gold Mine" of the area by the community. There are 8 units on the KIS covering a total area of about 800 ha. The main concern of the study is unit 11 with an area of 24 ha under food plots. This irrigation scheme is located in the lower Fish river of the Eastern Cape province. It has a river basin topography with a climate that can be generally described as warm and dry. The summers in the area are usually very hot while winter temperatures are mild. The mean annual rainfall in the area is less than 400 mm.

The scheme comprises of five sections. Of interest and concern to this study were 223 small plot holders occupying 0,25 ha each; 547 small plot holders with 0,20 ha each and 717 allotment holders occupying 0,16 ha each.

Unit 11 is also known as Upper Gxulu. Upper Gxulu is situated in the valley of Gxulu river, which is tributary of the Keiskamma river. The village is situated approximately 5 km west of the town of Keiskammahoek. The climate at Upper Gxulu is dry and sub-humid. The mean annual rainfall is 700 mm. It has a climate generally believed to be suitable for irrigated crop production.

3.4.1.3 Shiloh Irrigation Scheme (SIS): Shiloh irrigation scheme is situated in the Hewu district of the North Eastern region. It is located 35 km south of Queenstown. The scheme was established along the banks of the Klipplaat river on the outskirts of Whittlesea and adjacent to Sada Township.

The climate at Shiloh irrigation scheme is semi-arid and can be considered harsh, with long cold winters and short but hot summers. The mean annual rainfall at the scheme site is 485 mm. There are three sections on the scheme. This study, however is concerned with 455 food plot holders on land size of 0,25 ha each.

3.4.1.4 Hertzog Agricultural Co-operative Irrigation Scheme (HAIS): This irrigation co-operative is located in the northern part of the Kat river basin along the Readsdale river and forms part of Mpofu district. A total of 81 farmers have joined hands and formed the Hertzog Agricultural Co-operative (HACOP). Each member of the Co-operative has access to 1 ha of irrigated land. Co-operative members grow a range of vegetables and some crops. The land is divided into three sections, namely Hertzog, Fairbairn and Phillipton. The climate at HACOP is semi-arid while the mean annual rainfall recorded at 600 mm.

3.4.1.5 Horseshoe Irrigation Scheme (HOIS): Horseshoe Irrigation Scheme is located about 10 km west of King William's Town. The scheme is established on a 50 ha land. Fifteen farmers at the scheme each hold 2 ha of irrigated land. Farmers produce a variety of vegetables for markets in King William's Town and East London. The climate on the scheme site is semi-arid and mild. The mean annual rainfall is 535 mm.

3.4.1.6 Zanyokwe Irrigation Scheme (ZIS): This scheme is situated more or less east of Middledrift town at an altitude ranging between 440 m and 640 m above sea level. The climate at Zanyokwe irrigation scheme is semi-arid and relatively mild. Mean annual rainfall is 600 mm. Zanyokwe irrigation scheme forms part of Keiskammahoek district and occupies 471 ha. Our concern to this study is the section called Lenye North consisting of 10.2 ha of 0.2 ha food plots.

3.5 DATA ANALYSIS

After coding and re-organisation of the data on computer, the data was analysed with a statistical package for social sciences (Statistica). The analysis sought to provide answers to the questions raised in the objectives of the study.

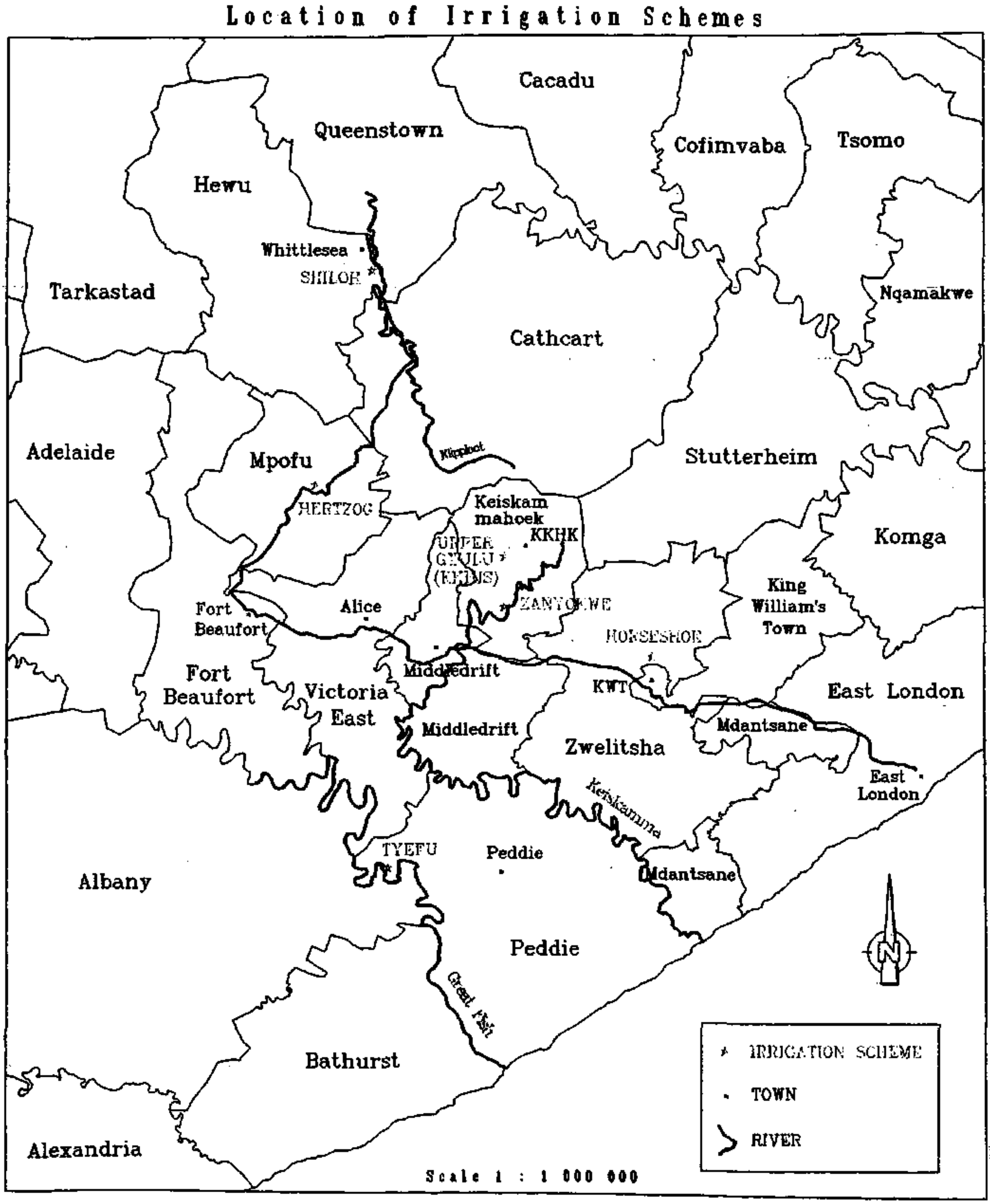

Figure 1. Location of the six irrigation schemes included in the study.

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CHAPTER FOUR

DESCRIPTION OF FOOD PLOT PRODUCTION ON IRRIGATION SCHEMES IN CENTRAL EASTERN CAPE

4.1. TYEFU IRRIGATION SCHEME

4.1.1 General description and historical background

The development of an irrigation scheme at Tyefu was the subject of investigations by the South African Government in the mid-1930s. However, at that time the high salinity of the Fish river water was considered prohibitive for such a development. In 1975 the Ciskei Department of Agriculture and Forestry initiated feasibility studies with the object of developing an irrigation scheme on the eastern side of the river. The Tyefu Irrigation Scheme (TIS) started as a pilot project in 1977. The objectives of the pilot project were to investigate the suitability of the area for irrigated crop production and to get the local communities involved in irrigated cropping. The design of the pilot project addressed the salinity problem by pumping water from the Fish river during periods of high flow and low salinity into storage dams, which were constructed on some of the local tributaries of the Fish river. The runoff water from these tributaries further diluted the Fish river water stored in the dams. From the storage dams the water is then gravitated to the irrigated fields. Yet, despite the dilution of Fish river water with runoff water, the general quality of irrigation water was still considered to be poor. A possible solution to the problem of water quality was the transfer of water from the Orange river. In 1981 the Department of Water Affairs (RSA) proposed a bulk water supply scheme to deliver water from the Orange river to the Fish river. In 1985 it was decided that water from the Orange river would be supplied to farmers on the west bank of the Fish river only. Ciskei was made responsible for developments on the east bank of the Fish river. At present the necessary infrastructure for the supply of bulk water from the Glen Melville water transfer scheme to Tyefu has reached Ndwayana.

The Tyefu pilot project started with the development of 121 hectare at Ndlambe in 1977, followed by 109 hectare at Pikoli in 1978, and was completed by adding 106 hectare at Kalikeni in 1981. The land was subdivided as follows:

- 22 "commercial" farms of 4 ha each
- 223 "compensation" plots of 0,25 ha for subsistence food production allocated to persons who held dryland arable allocations before the scheme
- 3 tribal farms totalling 183 ha operated by Ciskei Agricultural Corporation (CAC) on behalf of the tribal authorities
- 66 "allotments" of 0,16 ha each leased to persons who had no land rights but who wished to augment their domestic food supply.

The "tribal farms" were managed and farmed as commercial estates by CAC on behalf of the tribal authorities. Profits from these estates were channelled to the tribal authority for the

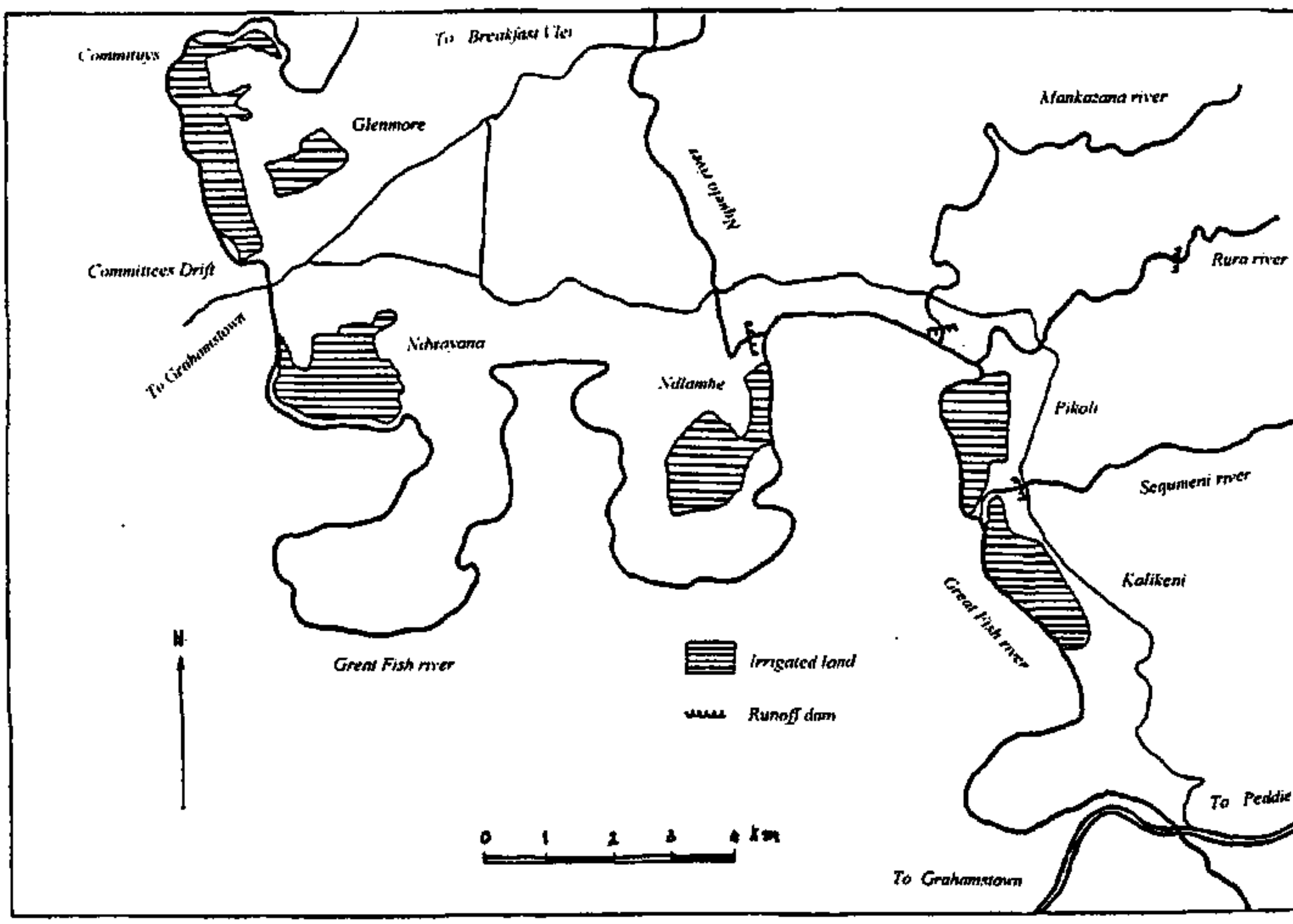

Figure 2. Map of Tyefu Irrigation Scheme.

upliftment of the living standard of the community. CAC provided a comprehensive range of services to these farms, including the supply of irrigation water, transport, production requisites, marketing and training.

Since its inception the scheme has been expanded gradually from 336 ha in 1981, 473 ha in 1984 to 644 ha in 1996, and its structure has also been changed to a degree. Farming by the scheme of the Tribal farms has been discontinued and some of the land that became available has been subdivided into 0,2 ha food plots (now called small plots) and 0,16 ha allotments. An overview of the present status of the different holdings is presented in Table 4.1.1.1. Approximately 228 ha of estate land remains under the control of the management organisation, but production on these lands has been discontinued, and a total area of approximately 1000 ha of potentially irrigable land remains un-developed.

Table 4.1.1.1. Types of holdings at each of the sections of Tyefu Irrigation Scheme.[1]

Section	Mini farm of 4 ha		Small plot of 0,25 ha		Small plot of 0,20 ha		Allotment of 0.16 ha		Estate land[2]
	No	ha	No	ha	No	ha	No	ha	ha
Kalikeni	7	28	92	23	138	27.6	22	3.5	26
Pikoli	11	44	54	13.5	90	18.0	0	0	27
Ndlambe	14	64	77	19.3	44	8.8	142	22.7	71
Ndwayana	0	0	0	0	275	55.0	0	0	0
Glenmore	0	0	0	0	0	0	553	88.5	104
TOTAL	32	136	223	55.8	547	109.4	717	114.7	228

Relocation of land right holders is always a sensitive issue. Following the publication of the Tomlinson Commission Report in 1955, attempts were made to relocate people at Tyefu by introducing betterment planning. This decision was strongly opposed by the residents. Meetings were held with tribal authorities and with the community in order to inform the residents of Tyefu of the potential benefits of an irrigation scheme to the community.

Initially, residents from Ndwayana were opposed to the implementation of the irrigation scheme. The response by the Pikoli and Ndlambe communities was more positive. In a combined meeting with all the residents of the area an agreement was reached on the voluntary transfer of the land rights of residents to the CAC in exchange for farming support services and the allocation of irrigated land to residents and on the relocation of residents residing on land targeted for irrigation development.

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[1] The exact area or irrigated land at each of the five sites and the exact number of farming units differs according to the source consulted.

[2] Land remaining under the control of Scheme management.

Over the years, a number of controlling bodies (Residents Associations, Residents Consultative Committee, Agricultural Steering Committee, LFRDP Co-ordinating Committee) have been established to co-ordinate the scheme and facilitate communication between all interested parties. Re-organisation of control over the scheme continues. In 1994 a facilitator was appointed to enhance real farmer participation in the management of the scheme. In July 1997 the Eastern Cape Provincial Government made the decision to close Ulimocor. At this stage it is not clear what the future holds for farming at the Scheme.

4.1.2. Physical factors

4.1.2.1 Climate The climate of the Tyefu Irrigation Scheme can be described as warm temperate, dry semiarid. The climate in the valley, where the irrigated lands are situated, is one of the driest in the region. Without irrigation the growing of crops such as maize is an extremely marginal and risky activity.

Temperature: Temperatures at Tyefu Irrigation Scheme were recorded for a period of eight years only (1977-1984) by Loxton, Venn & Associates (1987). Mean monthly temperatures for Tyefu are presented in Table 4.1.2.1. The summers in the Fish River Valley are hot, the mean monthly maximum temperature for the period December to February ranging between 29 and 30°C. During this period, extreme temperatures of 40°C and more may be recorded (see Table 4.1.2.2). These extremely high temperatures may cause heat stress in crops. Winter temperatures are generally mild. The mean monthly minimum temperature for the period June to August ranges between 7 and 9°C. The valley slopes are thought to be virtually frost free, but the lower lying areas are subject to ground frost, which can be expected for some 15 to 30 days each winter during the period July to August. Diurnal temperature fluctuations are larger in the valley than on the plateau, the valley being subjected to lower night temperatures and higher day temperatures. Sudden fluctuations in temperature may occur throughout the year. Two weather effects are responsible for these abrupt changes in temperature. Sudden cooling is caused by the on-shore flow of very cold air of Antarctic origin, brought in by the passage of cold fronts and the ridging-in of the South Atlantic high pressure system. Rapid warming is caused by off-shore berg winds. During the eight year period of temperature monitoring, the maximum daily fluctuation was 32°C, when temperature dropped from 42 to 10°C within a 24 hour period.

Table 4.1.2.1. Temperature data for Tyefu weather station (1977-1984) from Loxton, Venn & Associates, (1987).

Month	Monthly mean maximum temperature (C°)	Monthly mean minimum temperature (C°)	Monthly mean temperature (C°)
January	29,3	18,0	23,7
February	30,1	18,5	24,3
March	28,9	17,5	23,2
April	27,0	14,0	20,5
May	24,6	10,9	17,7
June	21,8	7,9	14,9
July	22,5	7,3	14,7
August	22,7	8,7	15,7
September	24,0	10,9	17,5
October	25,1	13,0	19,0
November	26,8	15,2	21,0
December	29,2	17,1	23,2
MEAN	26,0	13,3	19,6

Table 4.1.2.2. Temperature extremes recorded at Tyefu weather station (1977-1984) from Weather Bureau (1986).

Month	Mean of highest monthly temp. (°C)	Highest ever temp. (°C)	Mean of lowest monthly temp. (°C)	Lowest ever temp. (°C)
January	39.2	42.0	12.9	9.5
February	38.6	41.0	13.8	11.5
March	38.7	42.5	12.7	10.5
April	36.0	38.5	8.1	6.3
May	34.0	37.0	4.8	3.0
June	29.5	31.2	2.5	0.0
July	31.6	37.0	1.8	0.4
August	32.5	35.5	3.6	2.0
September	35.8	43.0	5.6	3.6
October	37.6	42.0	7.4	3.5
November	37.9	41.0	10.5	9.0
December	40.2	41.8	12.6	10.0
MEAN	36.0		8.0	

Rainfall: Generally, the mean annual rainfall in the area is low, especially in the valley where the mean annual rainfall is less than 450 mm and in places less than 400 mm. The plateau is slightly wetter. The distribution of rainfall is positively skewed, the proportion of years with an annual rainfall less than the mean being higher than that of years with an annual rainfall exceeding the mean. As a result, the median or middle value is lower than the mean. The rainfall is erratic in quantity and distribution. The coefficient of variation of the mean annual rainfall is approximately 40%. The seasonal distribution of the rainfall shows a maximum during the summer months (October through to April) (see Table 4.1.2.3). However, the proportion of the rain falling outside the summer season, ranges between 25 and 30%, which is 10 to 15% higher than is the case in other parts of central Eastern Cape with true summer rain. Although the climate in the area is considered to be dry, the possibility of a very wet season occurring are real. Such wet seasons are often followed by floods and severe soil erosion. The mean monthly and mean annual rainfall recorded at five stations located in or near the study area are presented in Table 4.1.2.3.

Table 4.1.2.3. Mean Annual Rainfall (mm) at five location in and around the Tyefu area.

Station	Tyefu	Committee's Drift	Line Drift	Peddie	Frasers Camp
Longit.	26°55'	26°50'	27°12'	27°07'	26°55'
Lattit.	33°11'	33°11'	33°04'	33°12'	33°17'
Alt. (m)	119	150	150	305	575
Years	7	12	39	98	59
Jan.	32,4	21,8	35,1	42,5	45,1
Feb.	20,6	47,4	42,6	55,2	53,8
Mar.	45,5	62,5	65,1	64,5	71,7
Apr.	41,3	41,3	37,3	40,9	42,0
May	23,1	15,8	29,0	39,9	34,9
Jun.	27,2	19,9	14,1	23,3	20,4
Jul.	41,7	13,4	19,3	25,0	22,5
Aug.	25,0	37,4	18,6	31,2	28,2
Sep.	25,0	20,1	32,8	41,0	43,7
Oct.	58,0	38,5	41,1	58,4	56,5
Nov.	34,2	35,5	43,1	53,3	58,8
Dec.	31,4	44,6	26,0	46,4	46,8
Mean annual	405	399	404	524	525

Evaporation and radiation: The mean monthly Class A pan evaporation at Tyefu is presented in Table 4.1.2.4. The data are based on a short term record of four years only. When compared with two long term records, namely, those of Alice and Ecca, the values recorded at Tyefu appear to be somewhat high. The difference in evaporation between Tyefu and the other two stations may be due to the location of the evaporation pan. According to Doorenbos and Pruitt (1977) pan location may account for errors as high as 15%. As is the case in most dry parts of the Eastern Cape, Tyefu enjoys high levels of radiation and light is probably the least limiting factor of all the climatic variables influencing the agricultural potential of the area.

Table 4.1.2.4. Class A Pan Evaporation (mm) at Tyefu, Ecca and Alice.

Month	Tyefu (n=4)	Ecca	Alice (n=9)
Jan	257	224	215
Feb	240	183	178
Mar	186	165	152
Apr	177	129	120
May	136	103	113
Jun	120	90	93
Jul	120	100	111
Aug	114	121	131
Sep	131	124	142
Oct	168	173	161
Nov	201	202	172
Dec	244	229	210
Total	2094	1843	1797

Source: Loxton, Venn & Associates (1987) & Van Averbeke (1991).

Wind: There are no stations in the area that record wind direction and velocity. Brutsch (1993) indicated that between Port Elizabeth and East London the wind blows mainly from a WSW and a ENE direction during summer and from a WSW to NW direction during winter.

4.1.2.2 Geology and soils: The geological substrate at Tyefu consists mainly of a variety of sedimentary rocks. Deposition of these rocks dates back to the Karoo sequence. At Tyefu Irrigation Scheme the oldest deposits of this sequence, namely, those belonging to the Ecca Group, are found. Locally they consist mainly of "blue or black shales". Soils derived from these shales appear to be highly erodible and in many places the soil cover has been removed, leaving behind a blue-black moonscape void of any form of vegetation, except for the occasional clump of bush. Terraced alluvial deposits of various ages are found in the valley of the Fish River. It is on these terraces that the irrigated lands are situated. Irrigable soils are moderately deep to deep and eutrophic, meaning that little leaching of bases is taking place. In fact many of the soils are alkaline (soil pH test exceeds 7 and in some cases approaches 9), due to the presence of free lime and/or alkaline salts such as sodium carbonate. The use of saline irrigation water is thought to have contributed to the alkalinization and sodification of these soils. Most virgin soils are deficient in phosphorus.

General information on the Tyefu soils was compiled by Loxton, Hunting & associates (1979) as part of a comprehensive study of the Fish and Kat river basins. Subsequently, a detailed study of the irrigable soils at Tyefu was conducted by Loxton, Venn & associates (1987). Loxton, Venn & associates (1987) identified two main terrace positions, namely, the high (old) terraces and the low (young) terraces. The high terraces or their remnants occupy positions between 20 and 120 m above the bed of the Fish river. On these remnants soil development has proceeded for a considerably long time and this has resulted in the reddening of the soil material. In some places the remnants of the old terrace have been well preserved, but in others the terraces have been degraded and are now appearing in the landscape as colluvial slopes. Often the contact between soil and underlying rock substrate is marked by a non-massive, permeable calcrete layer. Most of the red soils show only weak structural development in the subsoil and generally the soils are classified as being of the Hutton type. Most of the soils tend to be calcareous. Permeability of the soils is generally good, but in some areas the permeability of the soils is adversely affected by the presence of a dense subsoil layer. On the low terraces brown and grey soils are found. Generally, these soils show little evidence of profile development. Very recent sediments are also found dating back to the 1974 floods. These soils are extremely sandy, making them susceptible to wind erosion. They are classified as Dundee soils. Oakleaf type soils are found in slightly higher positions. Here, evidence of profile development comes in the form of thin discontinuous cutans of clay and organic matter. The presence of these cutans indicates the downwards migration of these two substances in the soils. Maximum profile development occurs in the Valsrivier type soils, where the migration of clay has resulted in a significant increase in the clay content of the subsoil. Valsrivier type soils appear to occur only along the western banks of the Fish river.

4.1.2.3. Water quality: The quality of an irrigation water is determined by total salt concentration and by the chemical composition of the salts. Loxton, Venn & Associates (1987) presented the results of an analysis of the Fish river water conducted over a period of 60 months, (1977 to 1983 with missing data for some months). These data are summarised in Table 4.1.2.5.

Table 4.1.2.5. Analysis of Fish river water sampled at Tyefu irrigation scheme during the period 1877-1983 by Loxton, Venn & Associates (1987) (The data presented are the means of 60 entries).

SAR	7,9
pH	7,8
EC (mSm^{-1})	200
TDS (mgl^{-1})	1320
Na^{+} (mel^{-1})	13,87
K^{+} (mel^{-1})	0,15
Ca^{2+} (mel^{-1})	1,91
Mg^{2+} (mel^{-1})	4,25
Cl^{-1} (mel^{-1})	11,63
CO_3^{2-} (mel^{-1})	0,25
HCO_3^{-} (mel^{-1})	5,20
SO_4^{2-} (mel^{-1})	3,71

Using the USDA classification of irrigation water (Richards, 1954) the Fish river water is classified as a high-salinity medium sodium water. The average salt concentration of the water is so high, that full irrigation of a perennial crop such as lucerne with undiluted Fish river water would introduce to the soil nearly 19,8 tons of salts every year. (calculation is based on the application of 1500 mm irrigation water per annum). According to Richards (1954), high salinity water cannot be used on soils with restricted drainage and even when soils are adequately drained special management for salinity control (leaching of salts) may be required and crops with good salt tolerance should be selected. Medium-sodium water presents an appreciable sodium hazard in fine textured soils with a high cation exchange capacity, especially under low leaching conditions, unless gypsum is present in the soil (or is applied to the soil as a soil ameliorant). The sodium hazard of such water is low when the water is used in the irrigation of coarse textured soils (Richards, 1954). All available evidence (Nell, 1989; Modi, 1991; Loxton, Venn & Associates, 1987 and Dempsey, 1994[3] pers. com.) suggest that the problem of salinization at Tyefu has not yet resulted in a significant degradation of the resource. Farmers at Tyefu do experience occasional problems with the high salinity of the water, especially during the early stages of crop development. In the past irrigation of newly established stands of vegetables and maize with saline water has caused burning of seedlings. However, it appears that the leaching action of rain water brought about by the occasional wet year has been sufficient to leach most of the salts introduced with the irrigation water to lower layers of the soil profile.

The degradation of the soils as a result of sodification and alkalinization on the other hand is apparent. On the western side of the river, Nell (1989) found that during the period 1950 to 1989, the soil pH had increased by approximately 0,7 of a unit (median soil pH increased from 8,1 to 8,9) and most soils are now considered to be strongly alkaline. He also found that irrigation had increased the exchangeable sodium percentage (ESP) of the soil by about 70% in the surface horizon (from 7,2 to 12,4) and by about 40% in the subsoil (from 14,8 to 20,7). At present, the ESP values of the irrigated soils on the western side of the river is now so high that soils can be classified as sodic (lower ESP-limit for sodicity is 15%) and strongly alkaline.

Loxton, Venn and Associates (1987) found all irrigated soils at Tyefu to have a pH in excess of 7,3 (most being higher than 8) and an ESP in excess of 10. However, problems with respect to sodicity and alkalinity are less severe on the Tyefu side of the river. This is most probably due to the dilution of Fish river water with runoff water in the storage dams.

4.1.3 Infrastructural factors

4.1.3.1. Water supply: Water for irrigation is obtained from the Great Fish River where it is pumped during periods of high flow into storage dams constructed in some local tributaries of the Great Fish River. From the storage dams water is gravitated to the irrigated fields. Water supply to Tyefu was provided from five independent schemes as follows:

(a) Part of Glenmore Scheme (located upstream of Committees Drift, with an approximate area of 117 ha) receives irrigation water directly pumped from the Great Fish River. No significant storage facilities are provided and besides this, during winter, the water is usually too saline to support any irrigation.

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[3] Mr R Dempsey was the extension officer responsible for Albany district.

(b) For the rest of the Glenmore Scheme (with about 55 ha of land located at Committees Drift), water is pumped through a 2.5 km rising main to an 8 Ml raw water dam. Next to the dam is a water purification plant with a capacity of 500 kl/day. Water is pumped to a 1 Ml reservoir 2 km up the hill and then supplied to the villages through a communal standpipe system.

(c) Water to irrigate 151 ha around the scheme headquarters at Ndlambe comes from two earth dams constructed on the Nqwelo tributary. However, this water is usually not enough to meet the demand and, therefore, water is pumped from the Great Fish River to top up the lower dam. From the latter, the local village is supplied with water via a treatment plant with a capacity of 280 kl/day.

(d) The Pikoli section with an area of 113 ha is fed with water from two dams on the Mankazana and Rura tributaries. Mankazana Dam receives additional water pumped from the Great Fish River.

(e) The Kalekeni section is supplied with water harnessed by Sinqumeni Dam but also receives water pumped from the Fish River.

In 1994 a food plot scheme was developed at Ndwayana, using a pump on the Fish river. River water is pumped into a concrete reservoir located above the food plot scheme, from where it is gravitated to the fields. Table 4.1.3.1 gives the capacities of the various dams in the project area.

Table 4.1.3.1. Major Dams at Tyefu Irrigation Scheme

Name of Dam	Capacity of Dam (10^3 m^3)	Remarks
1. Ndlambe	1000	Water is pumped from the Great Fish River and is used for irrigation and domestic purposes
2. Nqwelo	415	located on Nqwelo runoff stream, when the dam is full it feeds Ndlambe Dam
3. Mankazana	1850	impounds runoff water
4. Sinqumeni	620	Water is pumped from the Great Fish River and is used for irrigation purposes
5. Rura	226	impounds catchment water[4]

Source: Adapted from Loxton, Venn and Associates (1987)

From the foregoing, it is clear that the yield of the various dams falls short of the demand and the scheme heavily relies on poor quality water from the Fish River. However, a proposal to provide the scheme with good quality water from the Glen Melville Dam, which is supplied from the Orange River via Orange/Fish and Fish/Ecca Tunnels has been implemented partially. Glen Melville Dam is located on the Brak River. Water is conveyed to the scheme through a pipeline with a connection at Committees Drift. This source of water has reached Ndwayana but funds to extend the pipe line to Ndlambe, Kalekeni and Pikoli have not been secured.

[4] The dam at Rura is not used because it leaks water.

4.1.3.2. Communication services: Within Tyefu Irrigation Scheme there are tertiary (farm roads). A well maintained secondary gravel road links up the project area with the King Williams Town - Grahamstown road (N2). The northern part is served by a gravel road, the Breakfastvlei - Grahamstown road. The absence of tarred roads within the scheme means that the vehicle owners who operate within the scheme and the adjoining areas are likely to charge a lot of money for transportation of goods. Therefore, the high transportation costs (De Lange, van Averbeke, Sonandi, Witbooi and Mei, 1994) may partly be attributed to poor roads within the scheme.

The scheme is not served by railway. The nearest railway line runs from East London through King Williams Town (KWT) and Middledrift. It is about 50 km to the north. The absence of a rail network may have no effect at all on food plot irrigation. Railway is one of the cheapest means of transport especially for bulk goods. However, for a small producer (the plot holder), it is difficult to say how the presence or absence of this means of transport affects transportation costs.

There are many taxis in operation in the project area. R.S.A Railways Road Motor Transport runs a bus service on daily basis from Grahamstown to Peddie (Loxton, Venn and Associates, 1987). This means that farmers should be able to take their produce to some of the market centres. However, the cost of transportation prohibits selling of produce to large markets such as KWT, East London, Grahamstown, etc, unless produce is pooled and transported in bulk.

Until 1996, Tyefu Irrigation Scheme was served by telephone telex facilities which were linked to the Peddie exchange, and these facilities were usually out of order (de Lange et al, 1994). Recently, a direct line has been installed. The nearest postal services are at Peddie. In the absence of good telecommunication services scheme management has found it difficult to exploit favourable market opportunities.

4.1.3.3. Power supply: The scheme is supplied with electricity which is used for pumping water. There is a 66 kV Escom power line which follows the Breakfastvlei - Grahamstown gravel road .(Loxton, Venn and Associates, 1987).

4.1.4. Organisational services

4.1.4.1 Banking services Although the Ciskei Agricultural Bank provides loans to farmers, they are required to deposit 10% of their loan requirement before loan applications are processed. Many farmers do not have this deposit and therefore cannot buy inputs or have their land prepared. On the other hand, in the past the rate of default amongst farmers has been high.

4.1.4.2 Scheme management services: Management of Tyefu Irrigation Scheme is in the hands of Ulimocor, a parastatal organisation established during the mid-1980s to handle agricultural production projects in the former Ciskei. Initially Ulimocor was involved in estate production at Tyefu, but gradually this land was alienated in favour of small scale farmers. At present Ulimocor no longer farms, being involved in farmer support only. Scheme management supplies mechanical operations on request and offers these on credit. Inputs are also available from the Scheme. Scheme management consists of a project manager, an operation manager, an extension supervisor, two secretaries/bookkeepers, workshop personnel and tractor drivers. The total number of staff at the Scheme amounts to 60 people.

4.1.4.3. Land Preparation and Maintenance Services: Although in the past scheme management used to carry out land preparation for farmers, they changed this and now land preparation can be carried out either by the Scheme or by the farmers themselves (donkey drawn implements). Since basically it is the old people who work on the food plots, large portions of the plots are not under a crop especially during winter.

Farmers are expected to maintain the irrigation equipment (dragline and sprinklers) in their plots. As farmers complain that they do not get enough money from the food plots, irrigation equipment is often not well maintained. This leads to poor water use efficiency as water leaks from hydrants and draglines.

4.1.4.4. Training and Extension Services/Facilities: Training and extension very often are an integral part of irrigation schemes. The Department of Agriculture and Forestry has offices at Ndlambe and Pikoli which fall within the boundaries of the scheme. Other offices are situated at Enxuba. Ulimocor also offers extension services. A part time facilitator was appointed in 1994 to assist farmers with solving institutional problems.

4.1.4.5. Retail outlets and marketing services: Although there are several small local retail outlets in and around the scheme, the main market of the fresh produce is East London. However, KWT and Grahamstown are the nearest towns with comprehensive retail services. Tyefu Irrigation Scheme is situated far away from the main markets and hence selling of their produce faces several problems. As mentioned above, transportation costs make it difficult for the farmers to deliver their produce to places like East London which is 150 km away from the scheme.

4.1.4.6 Input markets Until 1991 Scheme management services included the supply of a full range of inputs, including planting material, fertilisers and chemicals and land preparation. The supply of seed, chemicals and fertilisers was handed over to a former scheme employee, for him to run as a private enterprise. This enterprise has since been discontinued because of financial problems. The Scheme also discontinued the production of seedlings, but maintained the supply of land preparation services. Farmers now source their other inputs from enterprises in nearby urban centres.

4.1.5. Social services & amenities

Without proper services and amenities, there is always a tendency for people, especially young ones, to migrate from rural areas to major cities and towns. This trend has a negative influence on the development of rural areas creating scarcity of labour as only old people, who are not very productive, are left behind.

4.1.5.1 Health and Education Services The nearest hospital is located at Peddie but there are two health clinics established and run by the Department of Health at Enxuba for the Glenmore residents and at Ndlambe. A mobile clinic also operates in the project area.

A variety of education facilities are available at KWT and Grahamstown. The project area is served by seven schools, two of them are located at Pikoli, two at Ndlambe and one each at Enxuba, Ndwayana and Qamnyana.

4.1.5.2. Welfare and Entertainment/Recreation Services Lack of proper facilities in the project area has contributed to the migration of youth to urban areas. The observation during a tour of the project was that only old people and children were left in the villages. Perhaps future planning should incorporate creating civic and youth centres in the project areas. All the selected schemes for study had this problem.

4.1.6. Economic factors

4.1.6.1. Introduction: The main objective of the economic analysis of the schemes was to determine cost/benefit at scheme level, at food plot sub-section level and at farm or plot level. At scheme and food plot sub-section level the source of data are the financial records kept at the schemes or at the offices of the management organisation Ulimocor. In this analysis the use of actual expenditure and income data are preferred. A researcher spent two months at Ulimocor, but was unable to extract an accurate records of actuals. As a result, we had to rely on budgeted amounts only. It was also impossible to separate the financial data applying to food plot sub-sections from those of other scheme components. Financial analysis at sub-scheme level was, therefore, impossible. Analysis of food plot or farm level in Chapter 5 and forms part of the empirical data.

4.1.6.2. Financial analysis at scheme level: In Table 4.1.6.1, the anticipated financial position of Tyefu Irrigation Scheme for the period 1984/85 to 1990/91 is shown on the basis of budgeted expenses and income. The data suggest that at Scheme level Tyefu incurred a deficit every year. In Table 4.1.6.2 actual and budgeted data are compared for the 1984/85 financial years. Actual and budget figures are similar, but the net cost to the State was less than anticipated.

Table 4.1.6.1 Tyefu Irrigation Scheme: Financial Analysis on the Basis of Budgeted Expenses and Income (Rand).

Category	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
Gross income generated	1 298 906	1 551 180	1 284 206	968 344	1 010 268	1 113 652	1 319 268
Operating costs:							
Direct costs	917 914	1 224 972	1 197 213	1 130 821	1 031 786	1 240 168	1 343 100
Indirect costs	871 706	497 811	526 446	314 174	892 866	1 028 838	1 042 190
Total operating costs	1 789 620	1 722 783	1 723 659	1 444 995	1 924 652	2 269 006	2 385 290
Net operating Profit/loss[1]	- 490 714	- 171 603	- 439 453	- 476 151	- 914 384	-1 155 354	-1 066 022
Capital expenditure	280 000	189 500	234 750	93 300	95 000	403 000	244 500

Source: Loxton, Venn & Associates (Various years)

1) Figures are obtained by subtracting total operating costs from income.

Note

- Income includes livestock sales, produce sales and other income from the capital unit.
- Direct costs include production costs, livestock costs, etc
- Indirect costs include salaries and wages to Ulimocor staff, vehicle expenses, payment to produces, depreciation, etc.

Table 4.1.6.2. Financial Analysis of Tyefu Irrigation Scheme on the Basis of Actual Expenses incurred and Actual Income Generated.

		1984/85
	Actual	Budgeted
Income	1 419 428	1 298 906
Direct costs	762 808	917 914
Indirect costs	989 340	871 706
Total	1 752 148	1 789 620
Net operating profit/loss	- 332 720	- 490 714
Capital Expenditure	283 584	280 000

4.2 KEISKAMMAHOEK IRRIGATION SCHEME

4.2.1. General description and historical background

During the 1970s agricultural consultants planned what was to become the Keiskammahoek Irrigation Scheme (KIS). Planning of the scheme took place under the direction of the Department of Agriculture and Rural Development of Ciskei and implementation commenced in 1976. It was decided that the main enterprise at the Keiskammahoek Irrigation Scheme was to be dairy production. At present the scheme has been operating for 20 years, but, so far, the search for suitable and sustainable ways of utilising the available resources at the scheme continues. This search has caused the scheme and its members to be subjected to frequent change. Over the years, the scheme has moved away from a central management approach, where farmers were by and large treated as labourers, towards privatisation, where decision making is in the hands of the farmers. Privatisation of most of the Scheme by transferring land, infrastructure, marketing and decision making to farmers resulted in a reduction in the recurrent cost of the Scheme to the State or its agent. However, total output by the Scheme declined to about 25% of capacity and the majority of private farmers are in serious debt. Several factors have contributed to the demise of private farmers, including ill-guided farmer training, the writing-off of farmers debts by the former Ciskei Government contributing to a dependency syndrome amongst farmers (FOA & ARDRI, 1996) and social factors causing a degree of opposition between the economic and social objectives of farmers (Holbrook,1996). At present, production per unit of land is extremely low and there is great unhappiness amongst farmers at the scheme. In addition there is controversy about land ownership and militant action in favour and against privatisation of the remaining state-owned infrastructure at Unit 3, also called Central Unit. Attempts at solving land conflicts in the past seem to have increased tension, because action favoured one group of people at the expense of others.

Planners envisaged the scheme to cover an area of approximately 1 730 ha, but only a fraction of that area was effectively developed. The size of the different units (as envisaged by the planning process) is shown in Table 4.2.1.1.

Table 4.2.1.1. Size of the units of the Keiskammahoek Irrigation Scheme as per master plan.

UNIT	SIZE (ha)
1*#	111
2*#	76
3*#	142
4*#	85
5*#	63
6*#	109
7	46
8*	75
9	105
10	54
11*#	357
12	86
13	429
Total	1 738

* unit where irrigation infrastructure has been installed

unit where dairy infrastructure has been installed

Of interest to the current study is Unit 11 of KIS, also called Upper Gxulu, which incorporates an irrigated food plot scheme. Upper Gxulu is situated in the valley of the Gxulu river, which is a tributary of the Keiskamma river. The village is situated approximately 5 km west of the town of Keiskammahoek. In 1947 Upper Gxulu was identified as a suitable site for the relocation of people living in the Mdledle and Ntontela areas. Prior to that Upper Gxulu was a settlement of white farmers, who were predominantly of German extraction. They used the land for the production of vegetables and beef. Because of the government policy to consolidate the native areas, in this case Ciskei, the white farmers had to make way. They left the area during the late 1950s and early 1960s. By the mid-1960s, 84 families, most of them coming from the Mdledle and Ntontela areas, had moved to Upper Gxulu. Only families owning land in their areas of origin and being in possession of a certificate proving such ownership, were eligible to move to Upper Gxulu. The main advantage of resettling at Upper Gxulu was the availability of good quality land and irrigation water. It is generally accepted that the move from Mdledle and Ntontela to Upper Gxulu was voluntary and was supported

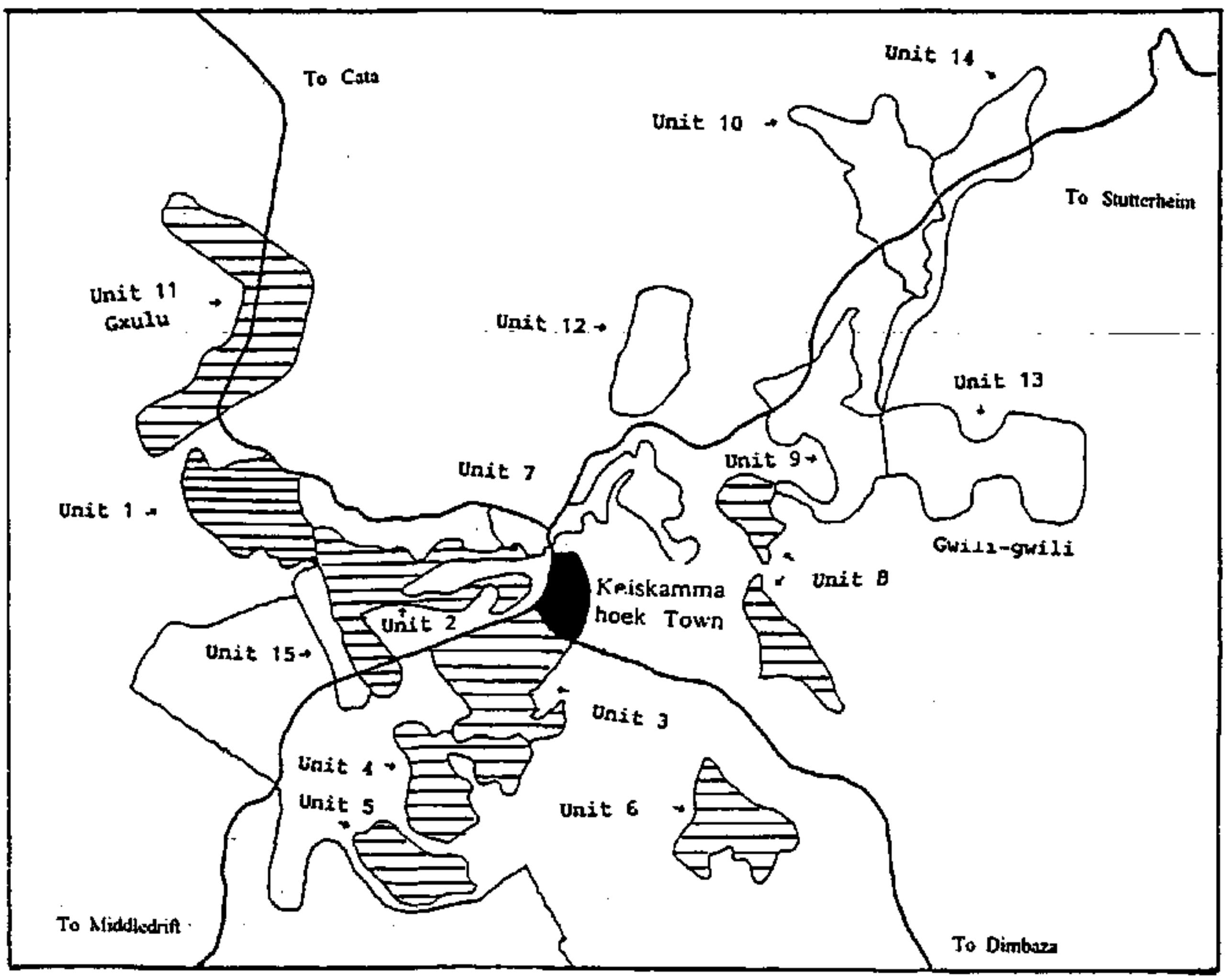

Figure 3. Map of Keiskammahoek Irrigation Scheme.

by the people who moved. However, a minority of Upper Gxulu residents recall the move as being enforced (Sonandi and Van Averbeke, 1995).

Each of the 84 families was allocated 1.5 morgen (1,28 ha) of irrigated arable land on which lucerne, maize and vegetables were grown and surface irrigation was practised. Farmers describe their production systems as follows: "Lucerne was either sold or fed to cows in milk. Maize was grown mainly for home consumption and vegetables were marketed in Keiskammahoek. At that time, there appeared to be easy access to markets. Agricultural implements and machinery, such as ploughs, tractors, balers, rakes, irrigation pipes, were hired from the government. These were stored in sheds that were built in the village. Paying for the hired machinery was done on the spot. Seeds, pesticides, fertilisers and expert advice were also readily available. Individual farmers were able to hire lorries or tractors, to transport produce to the market place and this at affordable prices. Produce was easily sold and money to pay for hired transport would be available after marketing" (Sonandi and Van Averbeke, 1995).

When Ciskei became independent in 1981 many things changed. Negotiations with KIS planning officials resulted in the Upper Gxulu residents being persuaded to become part of the KIS, joining the main enterprise, namely dairy production. The size of the arable plots was reduced from 1.28 ha to 0.25 ha for each of the 84 families. Four extra food plots became available, increasing the total number of plots to 88. The rest of the land - approximately 120 ha - which was once irrigated arable land - was converted to irrigated pastures. Some land was used as a site for the erection of a dairy parlour. The planners of the dairy scheme convinced the food plot owners that by sacrificing some of the area used for growing crops, they would earn extra income from the sale of milk (Sonandi and Van Averbeke, 1995).

According to the residents, the first few years following the independence of Ciskei farming went well. Marketing was extended to places such as King William's Town. Sometimes trucks from nearby towns would come to buy vegetables at the food plot scheme. Towards the beginning of the 1990's there was increased competition at their chief market place, Keiskammahoek Town. A white commercial farmer running a nursery started selling seedlings and better quality vegetables at a lower price. Trucks coming from King William's Town shifted their business away from Upper Gxulu, trading mainly with this commercial farmer. Conditions worsened when the government transferred its tractors, trucks and many of its implements from Upper Gxulu to Unit 3 (the Central Unit of KIS).

In order to make use of government equipment, Upper Gxulu farmers had to file an application with the administrative personnel of Unit 3. This system made it difficult to time ploughing and planting optimally. In vegetable production planting at the right time is essential, if marketing opportunities are to be exploited fully. The new tractor hire scheme made such kind of planning difficult. Furthermore, seeds, fertilisers and pesticides, which used to be offered for sale at Upper Gxulu, were now available at the Ulimocor depot in Keiskammahoek town only, adding to the deterioration in the quality of the farming support services. All these factors have contributed to the Upper Gxulu vegetable enterprise losing its competitive edge. At present most of the vegetables being produced are for home consumption. Cabbage is said to be the most popular vegetable crop. Others crops being planted are maize, oats, peas, beans, potatoes, spinach, carrots and beetroot (Sonandi and Van Averbeke, 1995).

4.2.2 Physical factors

4.2.2.1 Climate The climate at Upper Gxulu is dry sub-humid and, being situated between Dohne and Keiskammahoek, the mean annual rainfall is estimated at being approximately 700 mm (see Table 4.2.2.1). Temperatures are mild relative to those recorded at the other schemes (see Table 4.2.2.2). Mild frost may be experienced during the period May to October (see Table 4.2.2.3). The climate is generally well suited for irrigated crop production. The relatively cool conditions cause the demand for irrigation water per unit area to be less than in most other irrigation schemes in the region (see Table 4.2.2.4).

Table 4.2.2.1. Temperature data recorded at Dohne weather station (1939-1984) from Weather Bureau (1986).

Month	Monthly mean maximum temperature (°C)	Monthly mean minimum temperature (°C)	Monthly mean temperature (°C)
January	25,3	14,2	19,8
February	25,2	14,5	19,8
March	24,4	13,9	19,1
April	22,1	11,6	16,9
May	20,1	9,1	14,6
June	18,4	7,2	12,8
July	18,6	7,0	12,9
August	19,4	7,1	13,2
September	20,8	8,4	14,5
October	21,5	9,8	15,7
November	22,7	11,4	17,0
December	24,6	12,9	18,8
MEAN	21,9	10,6	16,3

Table 4.2.2.2. Temperature extremes recorded at Dohne weather station (1939-1984) from Weather Bureau (1986).

Month	Mean of highest monthly temp. (°C)	Highest ever temp. (°C)	Mean of lowest monthly temp. (°C)	Lowest ever temp. (°C)
January	35.7	40.0	8.8	3.1
February	34.7	40.0	8.9	4.4
March	33.4	38.9	7.5	3.3
April	30.4	35.6	5.6	1.7
May	27.5	32.2	3.1	-1.1
June	24.5	29.6	1.3	-2.8
July	25.0	27.9	1.1	-3.3
August	28.9	32.2	0.9	-1.7
September	31.7	36.0	1.7	-4.5
October	33.3	37.2	3.6	-0.4
November	33.5	38.6	5.6	0.6
December	35.3	40.3	6.8	1.7
MEAN	31.1		4.5	

Table 4.2.2.3. Class A Pan Evaporation (mm) at Alice and Keiskammahoek.

Month	Keiskammahoek*	Alice**
Jan	191	215
Feb	147	178
Mar	143	152
Apr	108	120
May	98	113
Jun	88	93
Jul	98	111
Aug	120	131
Sep	136	142
Oct	162	161
Nov	164	172
Dec	181	210
Total	1636	1797

Source: Hill, Kaplan, Scott & Partners (1977)* and Van Averbeke (1991)**

Table 4.2.2.4. Mean Annual Rainfall (mm) at two stations located in the vicinity of Upper Gxulu.

Station	Dohne	Keiskammahoek
Longit.	27°28'	27°09'
Lattit.	32°31'	32°41'
Alt.(m)	899	671
Years	34	75
Jan.	101	71.2
Feb.	104	76.3
Mar.	112	82.6
Apr.	54	49.1
May	31	34.0
Jun.	16	21.3
Jul.	23	23.2
Aug.	38	25.2
Sep.	50	44.7
Oct.	70	61.0
Nov.	81	70.4
Dec.	79	69.6
Mean annual	759	628.6

4.2.2.2 Geology and soils: The substrate of the area consists mainly of mudstones, sand stones and shales of the Lower Beaufort series. Karoo dolerite in the form of sills and dykes also occurs. Alluvial terraces are found along the Keiskamma river and its tributaries. Upper Gxulu is situated at an altitude of approximately 800 m above sea level. The irrigated food plots are located on a gently sloping foot slope and the adjacent valley bottom of the Gxulu river. According to Hill, Kaplan, Scott & Partners (1977) the irrigation land of Upper Gxulu is characterised by soils of the Avalon type (Soil Classification Working Group, 1991). These soils tend to be well suited for rainfed production, because drainage in the subsoil layers is impeded as evidenced by the Soft-plinthic-B-horizon occurring below the yellow-brown apedal B-horizon. As a result the soil profile is expected to hold water for long periods of time with the impeded drainage conditions in the lower layers preventing subsoil water from percolating below the rooting zone. Under irrigated condition, however, the soils may be prone to water logging, especially when water is applied in excess of field capacity. This may occur during heavy rain storms, when irrigation is followed by rain, or when the application of irrigation water exceeds the quantity required to bring the profile to field capacity.

4.2.2.3 Water quality: Chemically, the quality of the Keiskamma river water above the confluence with the Tyume river is good and the salinity hazard is considered insignificant, as is evident from the data presented in Table 4.2.2.5. Sediment loads of the water are often high, especially in the tributaries of the Keiskamma river (Hill, Kaplan, Scott & Partners, 1977).

Table 4.2.2.5. Analysis of Keiskamma water sampled below Cata dam

(Hill, Kaplan and Scott, 1991).

SAR	0,78
EC (mSm^{-1})	22.8
TDS (mgl^{-1})	137
Na^+ (mel^{-1})	0.83
K^+ (mel^{-1})	0.02
Ca^{2+} (mel^{-1})	0.50
Mg^{2+} (mel^{-1})	0.60
Cl^- (mel^{-1})	0.63
CO_3^{2-} (mel^{-1})	1.16
SO_4^{2-} (mel^{-1})	0.15

4.2.3 Infrastructural factors

4.2.3.1 Water supply: The KIS project is supplied with water from Cata Dam on the Gxulu River and Mnyameni Dam on Mnyameni River. The annual yield from Mnyameni and Cata dams is 2.8 x 10^6 m^3 and 7.9 x 10^6 m^3 respectively, while the irrigated area served by these two dams is 205 ha and 649 ha respectively (Hill Kaplan Scott, 1991). According to Hill Kaplan Scott (1991), the supply from these dams will continue to exceed demand up to at least 2010 and it is expected that until that time availability of water for irrigation will not be subject to limitations. Water for irrigation is supplied through a pipeline by gravity. Mnyameni Dam also supplies domestic water to Mnyameni and Upper Gxulu villages as well as the town of Keiskammahoek.

4.2.3.2. Communication services: Upper Gxulu Village is located approximately 5 km from Keiskammahoek town. The village is served by a gravel road which is in a poor condition. As such, the development of good secondary roads in and around the scheme will have to be given attention in future so as to help farmers transport their produce to the major neighbouring centres with ease. There is a 24 km tarred road connecting Keiskammahoek Town with the rural road R63 (Alice - Middledrift - KWT road). These two tarred roads join near Dimbaza. There is also a fairly good gravel road joining Keiskammahoek with Middledrift. There is no railway network in this area. The nearest railway line is the one that connects Alice, Middledrift, Dimbaza and KWT. Despite the poor condition of the roads in and around the project area, Gxulu Village can be accessed by taxi, cars and animal drawn carts.

The nearest post office is located at Keiskammahoek. According to Sonandi and van Averbeke (1995), schools and two trading stores act as collecting points for mail. Besides the schools, clinic, shops and the dairy parlour, a few farmers have telephones.

4.2.4. Institutional factors

4.2.4.1 Banking services As in all former Ciskeian Irrigation Schemes, when the government withdrew its support to the schemes, financial assistance to the farmers was through Ciskei Agricultural Bank (CAB). However, in most cases it appeared that farmers did not meet the conditions for loans, which might inhibit them from buying commercially available seed and inputs or cultivating all of their plots.

4.2.4.2 Farmer support services The main focus of the Keiskammahoek Irrigation Scheme is the dairy enterprise and support for irrigated food plots has been withdrawn. Farmers experience problems with land preparation as there is only one co-operatively owned tractor at Upper Gxulu. In the past, government used to assist in land preparation but it has since withdrawn this help. Farmers are expected to look after their own irrigation equipment, but are assisted in maintaining the main supply system.

Extension services are offered by employees of the Eastern Cape Department of Agriculture situated at Keiskammahoek town.

4.2.4.3 Retail outlets and marketing services: The village has two grocery stores although only one is well stocked. Farmers mainly produce food for home consumption and only when there is surplus do they take it to the market. Farmers mainly take their produce to Keiskammahoek town. Scheme management does not assist in marketing.

4.2.5. Social services & amenities

4.2.5.1 Health and education services: Upper Gxulu village has a clinic which offers very basic services. More involved medical attention requires a visit to the nearest hospital, which is at Keiskammahoek.

There is a pre-school, primary school and a secondary school in the village. The secondary school serves not only the Upper Gxulu residents but also those of the surrounding villages and the town of Keiskammahoek.

4.2.5.2 Welfare and entertainment/recreation services: As reported by Sonandi and van Averbeke (1995), lack of level land has made it difficult for the village to develop a sports ground and sports meetings are held on the ground adjacent to the high school.

4.2.6. Economic factors

4.2.6.1. Introduction: Ulimocor was responsible for managing Keiskammahoek Irrigation Scheme until 1991. Most of KIS expenditure relates to the dairy operation and farmer support services at Unit 3. Most of farmer support services provided by Unit 3 goes to the private dairy farmers. Food-plotters at Unit 11 receive very little assistance.

4.2.6.2 Financial analysis at scheme level: The financial analysis of KIS on the basis of budgeted expenses and income is presented in Table 4.2.6.1. There was a net-funding requirement throughout the period under review. Analysis of the actuals, presented in Table 4.2.6.2. confirm the budget trends and losses were generally larger than anticipated for the period under review. The net funding requirement for the 1994/95 financial year was estimated at about R1,4 million, 1995/96 R1 million and 1996/97 at R0,8 million.

Table 4.2.6.1. Keiskammahoek Irrigation Scheme: Financial Analysis on the Basis of Budgeted Expenses and Income.

Year	Total Operating[1] Costs	Income Generated	Net operating Profit/loss[2]	Capital Expense
1976/77	115804	1000	-114804	NA
1977/78	302589	104962	-197627	NA
1978/79	439743	291393	-148350	NA
1979/80	676686	571508	-105178	NA
1980/81	742073	765437	-23364	NA
1981/82	997667	959972	-37695	NA
1982/83	1752661	1495043	-257618	NA
1983/84	2327140	1521945	-805195	NA
1984/85	2703866	2205423	-498443	788100
1985/86	2417676	1800326	-617350	1044025
1986/87	1800947	1378861	-422086	104650
1987/88	1869333	1206930	-662403	114400
1988/89	3788543	2755455	-1033088	161000
1989/90	4471307	3569284	-902023	970630

Source: Loxton, Venn & Associates (Various years)

1) Due to lack of clear and precise records on indirect costs, we were forced to show the total operating costs.

2) Figures are obtained by subtracting total operating costs from total income.

3) NA - Not Available

Table 4.2.6.2. Financial Analysis of Keiskammahoek Irrigation Scheme on the Basis of Actual Expense Incurred and Actual Income Generated.

	1984/85	1985/86	1986/87	1987/88	1988/89
Income[1)]	1648811	1054000	648000	767000	2897000
Direct costs[2)]	1480643	781000	674000	655000	811000
Indirect costs[3)]	1412230	859000	342000	268000	2865000
Total	2892873	1640000	1016000	923000	3676000
Net Operating Profit/loss	-1244062	-586000	-368000	-156000	-779000
Capital Expenditure	577348	190,000	13000	118000	132000

Source: Loxton, Venn and Associates (Various years)

1) Income includes livestock sales, produce sales, other income sources

2) Direct costs include production costs, dairy factors, livestock costs

3) Indirect costs include salaries and wages to ULIMOCOR staff, vehicle expenses, payment to produces, depreciation.

4.3. SHILOH IRRIGATION SCHEME

4.3.1. General description and historical background

Shiloh Irrigation Scheme (SIS) is situated in the Hewu District of the Eastern Cape Province. It is located 35 km south of Queenstown. Shiloh was founded in 1818 as a station of the Moravian Missionary Society which was to serve the Thembu people. The mission station was granted some 30 000 ha of land. Baines, who visited Shiloh in 1848, describes it as *"a neat little settlement, the enterprise of the missionaries and their charges there being demonstrated by an irrigation scheme, a riem-making industry and well tended fields and livestock"*. Whittlesea, located a few kilometres north of Shiloh, was developed during the late 1840s, when white traders were granted 2000 ha of land to develop a town. In the mid-1960s the South African government developed an irrigation scheme of 334 ha at Shiloh and provided 278 farmers with 1,2 ha of irrigated land. The scheme obtained its water from the Waterdown dam and irrigation was by means of surface application, with land laid out in border strips. The development of this scheme and the allocation of irrigated land coincided with the excising of Shiloh grazing land by Government. This land was used to develop Sada township and industrial complex (Anonymous, undated). According to the Department of Agriculture and Forestry of Ciskei (1984), the Shiloh irrigation scheme was virtually moribund by 1978. In 1979 the Ciskei Marketing and Development Board commissioned consultants to prepare a plan for the revitalisation and expansion of Shiloh Irrigation Scheme (SIS). The report, prepared by Loxton, Hunting and Associates, was presented in November 1979 (Department of Agriculture and Forestry, 1984). The proposed Scheme incorporated the 334 ha owned by 278 landowners and some additional land acquired by the State as part of a land consolidation exercise. According to the Department of Agriculture and Forestry (1984) protracted negotiations took place between the Government of Ciskei and the Mziwoxolo Tribal Authority with a view of matching the wishes of existing land owners and those of the homeland government. The same source reports that:

"... the majority of the existing land right holders agreed to pool their resources of land and form a Group Farm to be operated and managed on their behalf by a Central Unit, and as shareholders they would participate in the profits of the venture. Each land right holder was also granted a 0,25 ha food plot on which he could satisfy his subsistence requirements and produce a small surplus for sale. Provision was made for land right holders who did not wish to participate in the Group Farm to receive an annual rental for their plots and relinquish their rights to participate in the Group Farm and the food plots."

The plan also envisaged development of 4 ha commercial farms, directed mainly at dairy production on irrigated pasture (lucerne and maize). By 1982 Shiloh Irrigation Scheme involved 394,75 ha of irrigated land, consisting of 113,75 ha food plots, 68 ha commercial farms, 120 ha Group Farm and 93 ha being occupied by the Central Unit. An additional 60 ha of commercial farms was being developed, bringing the total area occupied by the Scheme to 454,75 ha. The 113,75 ha of food plots consisted of 280 plots (70 ha) allocated to land right holders and 175 plots (43,75 ha) part of which were allocated to people who lost arable land when Sada Township was developed and the rest was offered for rent to households who did not have land rights.

The area occupied by the Scheme has not changed since 1982. However more food plots are being developed in the Whittlesea region, namely along the Oxkraal river, which runs west of the town. SIS is divided into nine units, four of which are farming units used as follows:

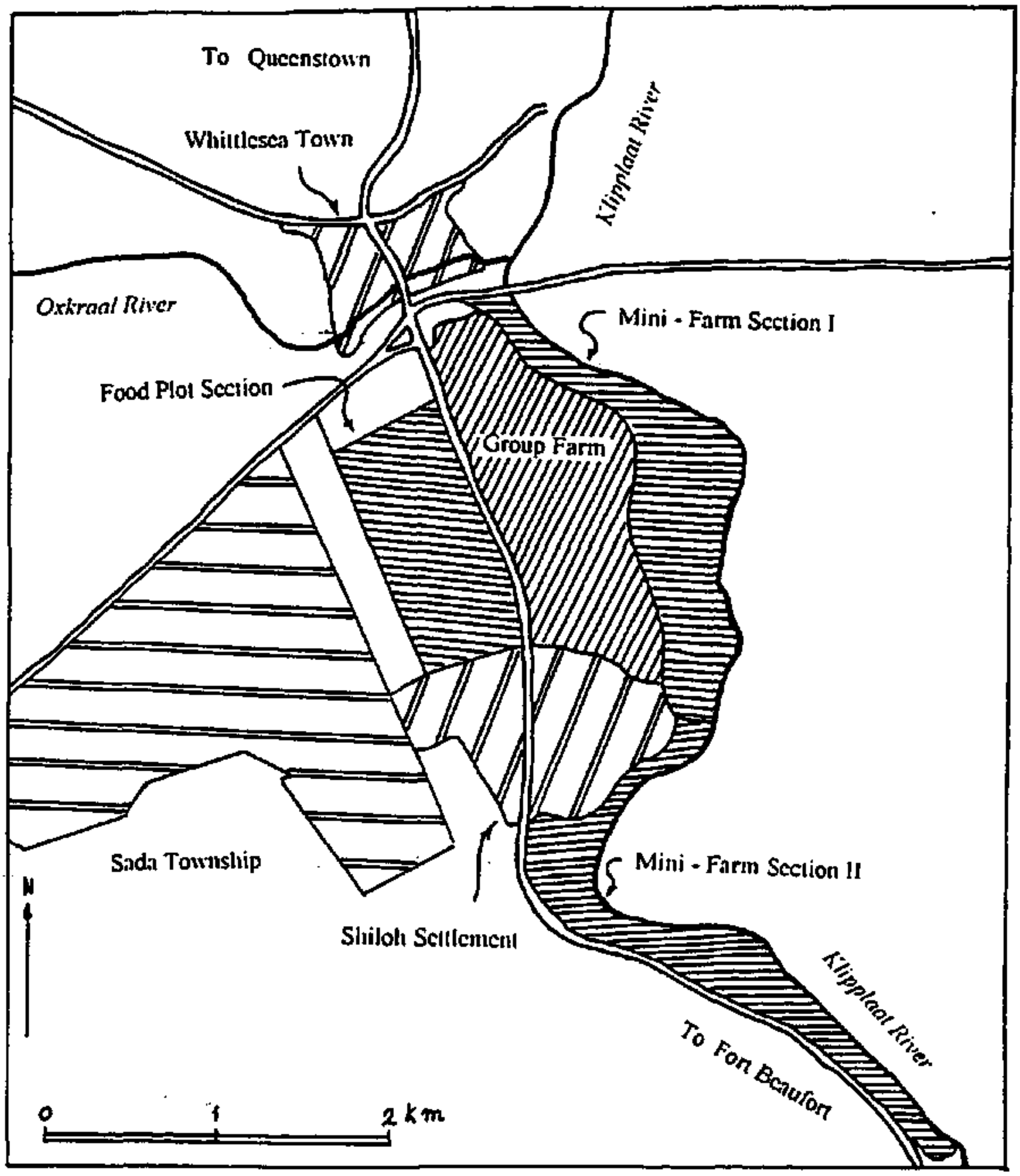

Figure 4. Map of Shiloh Irrigation Scheme.

Unit 1 - 455 irrigated food plots of 0.25 ha each;

Unit 2 - 15 commercial farmers with 4 ha each;

Unit 3 - 132 ha referred to as the Old Group Farm - commercial farming is carried out on behalf of 272 members who have land occupational rights.

Unit 4 - 68 ha on which commercial breeding of dairy cows used to be practised.

The other units include administration, workshop, store, dairy factory, training & extension. SIS is adjacent to two urban developments, namely Whittlesea and Sada Township. The other nearest large centres are Queenstown, Carthcart and Seymour.

The population of the Sada/Whittlesea area is estimated at 100,000 by the Department of Health, but other Government Departments put it at 50,000 people. However, the population is believed to be much higher than 100,000 people by the SIS management. According to Shiloh Irrigation Scheme management about 60% of the population of Sada/Whittlesea area is below 20 years of age with low income levels and either unschooled or considered functionally illiterate. Unemployment in the area is approximated at 90%.

4.3.2. Physical factors

4.3.2.1 Climate: The climate at Shiloh is semi-arid and can be considered as harsh, with long cold winters and short but very hot summers. The area is characterised by summer rainfall and differs in that respect from the other schemes under consideration, where the probability of receiving rain during winter is much higher and where peaks are recorded in spring (October) and autumn (March). The mean annual rainfall at Shiloh is estimated at 485 mm (see Table 4.3.2.1) and 63% of the rain falls during the period December to March. Frost may occur as early as April and may last until October (see Table 4.3.2.2), limiting the summer growing season involving frost-sensitive crops to approximately five months. During winter, frost is known to affect crops with moderate tolerance such as cabbage, which is a very popular vegetable amongst food plot growers in the region. The annual Class A pan evaporation of 1708 mm is slightly lower than at Alice (see Table 4.3.2.3), mainly as a result of cold temperatures during the winter months. During summer Class A pan evaporation exceeds that recorded at most other local schemes with the exception of Tyefu, which also suffers from hot summer temperatures.

Table 4.3.2.1. Mean Annual Rainfall (mm) at four stations located in the vicinity of Shiloh Irrigation Scheme.

Station	Queenstown	Whittlesea	Rocklands	Poplar Grove
Longit.	26°52'	26°49'	26°28'	26°44'
Lattit.	31°54'	32°10'	32°01'	32°08'
Alt. (m)	1094	1052	1220	1143
Years	112	22	67	29
Jan.	77	79.0	59.3	68.8
Feb.	88	86.6	67.9	84.1
Mar.	83	74.2	74.7	73.2
Apr.	40	34.0	32.8	37.6
May	24	17.5	20.7	17.3
Jun.	14	13.0	9.7	13.5
Jul.	13	7.9	9.9	6.9
Aug.	16	8.6	10.0	12.7
Sep.	26	32.0	24.0	29.0
Oct.	40	34.3	30.5	38.6
Nov.	58	34.0	42.0	47.0
Dec.	72	64.2	57.0	63.0
Mean annual	551	485.9	439.1	491.5

Table 4.3.2.2. Temperature means recorded at Queenstown weather station (1873-1984) from Weather Bureau (1986).

Month	Monthly mean maximum temperature (°C)	Monthly mean minimum temperature (°C)	Monthly mean temperature (°C)
January	29.3	14.5	21.9
February	28.7	14.7	21.7
March	27.0	13.3	20.1
April	23.9	9.4	16.6
May	20.6	6.0	13.3
June	18.3	3.0	10.6
July	18.2	2.9	10.6
August	20.2	4.6	12.4
September	22.9	7.3	15.1
October	24.7	9.5	17.1
November	26.4	11.6	19.0
December	28.6	13.5	21.1
MEAN	24.2	9.2	16.7

Table 4.3.2.3. Temperature extremes recorded at Queenstown weather station (1873 - 1984) from Weather Bureau (1986).

	Mean of highest monthly temp. (°C)	Highest ever temp. (°C)	Mean of lowest monthly temp. (°C)	Lowest ever temp. (°C)
January	37.3	40.6	9.2	3.9
February	35.7	40.0	9.1	3.9
March	34.1	37.2	6.7	1.5
April	30.2	34.0	2.5	-1.1
May	26.9	31.1	-1.2	-5.5
June	23.4	26.1	-3.6	-6.7
July	23.6	26.4	-3.9	-7.5
August	27.6	31.1	-3.1	-6.7
September	31.5	35.0	0.2	-3.8
October	34.1	37.8	2.1	-1.7
November	35.2	38.1	5.3	0.1
December	36.7	40.0	7.4	3.0
MEAN	31.1		2.4	

Table 4.3.2.4. Class A Pan Evaporation (mm) at Queenstown and Alice.

Month	Queenstown*	Alice**
Jan	206	215
Feb	165	178
Mar	135	152
Apr	102	120
May	92	113
Jun	80	93
Jul	96	111
Aug	128	131
Sep	143	142
Oct	167	161
Nov	178	172
Dec	216	210
Total	1708	1797

Source: Anonymous (undated)* and Van Averbeke (1991)**

4.3.2.2 Geology and soils: The substrate at Shiloh consists of sandstones, mudstones and shales of the Upper Beaufort series. South of Shiloh a large outcrop of dolerite occurs, which, over a considerable distance, lines the Klipplaat river. The irrigation scheme is located on alluvial terraces along this river.

Shiloh is located in the Bulhoek pedosystem, which is characterised by soils of the Swartland, Valsrivier, Mispah, Hutton and Shortlands forms (Laker, 1978). A soil survey of the scheme was conducted by Loxton, Hunting and Partners in 1979, but a copy of the survey report could not be sourced. Field observation suggested that the soils of the food plot section are either of the Shortlands or Hutton form, which are known to allow for free drainage of water and, therefore, tend to be well suited for irrigation. The land surrounding the scheme is severely eroded (O'Connell, Manthe & Partners, 1985), and this is considered one of the causes for the decline in rainfed crop production in the region.

4.3.2.3 Water quality: Chemically the quality of the Klipplaat river is excellent and its use does not present any salinity or sodicity hazard (see Table 3.5).

Table 4.3.2.5. Analysis of Klipplaat river water (Hill, Kaplan Scott, 1991).

SAR	0.5
EC (mSm^{-1})	10.5
TDS (mgl^{-1})	63
Na^{+} (mel^{-1})	0,39
K^{+} (mel^{-1})	0,08
Ca^{2+} (mel^{-1})	0,40
Mg^{2+} (mel^{-1})	0,25
Cl^{-1} (mel^{-1})	0,26
CO_3^{2-} (mel^{-1})	0,72
SO_4^{2-} (mel^{-1})	0.04

4.3.3. Infrastructural factors

4.3.3.1. Water supply: The water supply to SIS is from the Waterdown Dam on the Klipplaat River. The capacity of the dam is reported to be 27.54 million m^3 per annum (Hill Kaplan Scott, 1991). The dam supplies Shiloh, Dyamala, Emtabazo, Emtha, Mabaleni, Whittlesea, Sada area and Queenstown with domestic water. From the dam, Whittlesea and Sada are allocated 4.20 million m^3 while SIS is allocated 2.47 million m^3 annually. The projected water requirements for irrigation and domestic purposes according to Hill Kaplan Scott (1991) for the year 2010 are 4.48 and 2.14 million m^3 per annum respectively. This leaves a combined surplus of 0.05 million m^3 per annum from the total allocation of 6.62 million m^3 but a deficit of 2.01 million m^3 on irrigation water. Although during drought periods irrigation water from the Waterdown Dam is restricted, SIS has an alternative source water from the Oxkraal Dam. The commercial farmers at Shiloh pay for water at a rate of R112/ha/year for 6000 m^3. Food plot farmers do not pay for water. Although the scheme is allocated water at a rate of 6000 m^3/ha/year, practically, water is used at rate of 10000 m^3/ha/year. The cost of the extra 4000 m^3 is borne by the scheme.

4.3.3.2. Communication services: The primary roads serving the region are the tarred rural road R67 joining the towns of Seymour and Whittlesea with Queenstown and R351 to Sada. Queenstown is 35 km away from Whittlesea. There are taxi services between Whittlesea and the nearby towns like Seymour, Carthcart, and Queenstown.

The nearest railway to area is the Tarkastad/Queenstown line. There is no economic development that warrants the construction of railway network joining the above line. The presence or absence of a rail network may have little or no effect at all on food plot irrigation. Railway is one of the cheapest means of transport especially for bulk goods. However, for a small producer (the plot holder), it is difficult to say how the presence or absence of this means of transport may affect transportation costs.

The Hewu region does not have much in terms of post and telecommunication services and will need to be developed. There is one post office at Sada/Whittlesea and about 5 postal agencies. Lack of good telecommunication services makes it difficult for the management in the scheme to take advantage of good markets. However, the scheme has telephone services.

4.3.3.3. Power supply: Power supply to the region (Sada and Whittlesea) is through a 400 KV Escom line from Queenstown. The scheme is supplied with electricity, which is used for pumping water. Water delivered to the farmers' offtake does not have enough pressure for the system to operate and therefore they are forced to pump the water again in order to maintain the required pressure. Unlike the food plot farmers, the commercial farmers at the scheme contribute towards payment of electricity at a rate of R8-10 per month or R100 p.a.

4.3.4 Institutional factors

4.3.4.1 Banking Services: Although the Ciskeian Agricultural Bank provides loans to farmers, they are required to deposit 10% of their requirement before their loans can be processed. Many farmers do not have the deposit and therefore they may not be able to afford to buy inputs or pay for land preparation. On the other hand, farmer usually default in their loan repayment making it difficult for the Bank to continue extending the credit facility to them. Unlike at many other irrigation schemes in former Ciskei, at Shiloh, commercial farmers operate on a cash basis and pay for all the services offered to them. As such the scheme does not offer any farmers credit facilities. Farmers pay the actual cost of inputs but electricity and water are subsidised.

The Scheme does extend credit to the 272 food plot farmers who have occupational rights to the land. The maximum credit that can be granted to a farmer is about R183 per year. No such credit facility is extended to holders of compensation plots or rented plots.

4.3.4.2 Scheme Management Services: Both irrigated food plot holders and commercial farmers are able to buy their inputs from the scheme in quantities that are convenient to them. The scheme buys inputs in bulk from the suppliers. Scheme management provides basic land preparation services. Commercial farmers, holders of compensation plots or rented plots pay for land preparation services but land right holding food plot farmers do not. The supply of primary tillage by the Scheme was one of the conditions Ciskei Government agreed to during the negotiations on the planning of SIS with land right holders. Maintenance of the main infrastructure is also carried out free of charge by scheme management.

The Department of Agriculture and Forestry has offices at Whittlesea and SIS has one extension officer. However, the importance of extension and training seems to have been underestimated. Until two-three years ago, the scheme used to organise training sessions for staff and farmers at the scheme's training facilities. However, the latter has since been turned into offices for the Department of Health and Welfare. Therefore, no more training sessions are carried out. According to SIS management, training was given when demanded, but participants used to read newspapers. This was attributed to giving the wrong training to the right people. Besides, almost all farmers in the area are illiterate and wanted to be paid when they attended training sessions.

4.3.4.3 Retail outlets and marketing services: The urban centres of Sada and Whittlesea are the major outlets for Scheme produce. The other markets centres situated near the scheme are Queenstown, Seymour and Cathcart. Generally there is a market for the vegetables that are produced, but one of the greatest problems facing the scheme is theft of produce, which relates to the presence of dense settlements around the Scheme. When requested, scheme management renders marketing services to the irrigated food plot farmers, selling and transporting produce to local shops. Otherwise the food plot farmers market their produce themselves. Commercial farmers sell their milk to the scheme which operates a dairy factory and when there is surplus milk, the scheme sells it to *Bonita* in Queenstown.

4.3.4.4 Input market: The Scheme has a retail outlet from which farmers can purchase seed, chemicals and fertilisers in quantities appropriate for small scale farming. This outlet is very useful and is used by farmers outside the Scheme also.

4.3.5. Social services and amenities

4.3.5.1 Health and education services: The region has relatively good health facilities. There is a general hospital located at Whittlesea and there are clinics and 2 mobile units which provide basic primary health care.

There appears to be adequate distribution of education facilities in the region. However it was noted that there was lack of classrooms and teachers. The education level of teachers too requires to be improved. This is a problem in many regions of Eastern Cape. A recent article in the Financial Mail showed that there are 53000 teachers in the Eastern Cape who are not qualified. Of those, 12000 don't have even matric level of education and 8000 are below standard six. As a result, those households who have the financial means tend to move to areas where their children can obtain sound education especially in the former whites-only schools.

4.3.5.2 Welfare and entertainment/recreation services: Entertainment, recreation and welfare facilities are lacking in the region. Sports and recreation facilities are concentrated around the Sada/Whittlesea urban centres. Lack of proper facilities in the rural areas has contributed to the migration of the youth to Sada and Whittlesea. The influx of people to the urban centres adjacent to TIS coupled with a high rate of unemployment has contributed to a serious problem of theft of farmers' produce.

4.3.6. Economic analysis

Shiloh irrigation scheme comprises of Central Unit Farm, Commercial Farmers, Food Plot Holders and Group Farms. As of 1996, there were 15 commercial farms, 455 food plot holders, a Group farm and a Central Unit farm. The budgeted and actual costs incurred and incomes generated at scheme level reflect activities performed in all these sub-sections, but a break-down of the budget per sub-section is not available. Table 4.3.6.1 shows the financial position of the scheme on the basis of budgeted expenses and income generated. There has not been a single year when the anticipated flow of income exceeded the anticipated flow of costs. This simply indicates that the scheme was not economical even at budgeting level. Table 4.3.6.2 shows the actual financial position of the entire irrigation scheme. It is obvious that the scheme was operating at a loss for each of the years that were covered. This indicates that the scheme was also performing poorly in the actual situation.

Table 4.3.6.1. Shiloh Irrigation Scheme: Financial Analysis on the Basis of Budgeted Expenses and Income.

Categories	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1992/93
Capital costs	330,000	80506	31929	99950	45000	193750	NA	121000
Operating costs: Direct costs	814918	842063	1247481	1513697	1948618	2170471	1360700	1856590
Indirect costs	812372	367691	379300	333365	793469	877691	-	817697
Total operating costs	1627290	1209754	1626781	1847062	2742087	3048162	-	2674287
Income generated	827560	756241	729014	708058	1100330	1208135	1277764	1375235
Net operating Profit/loss 1)	-799730	-453513	-897767	-1139004	-1641757	-1840027	-82936	-1299052

Source: Loxton, Venn & Associates (Various years)

1) Figures are obtained by subtracting total operating costs from income

<u>NOTE</u>

Income = livestock sales, produce sales, other income

Direct costs = production costs, livestock costs, etc

Indirect costs = salaries & wages to ULIMOCOR staff, vehicle expenses, payment to producers, depreciation etc.

Subsidy = are not comparable since they are nominal value

Table 4.3.6.2. Financial Analysis of Shiloh Irrigation Scheme on the Basis of Actual Expenses incurred and Actual Income Generated.

	1984/85	1989/90	1990/91[a)]	1991/92[a)]
Income	949153	118915	1353649	1267586
Direct costs	641770	239491	1738990	1666402
Indirect costs	774465	341858	571796	644671
Total	1416235	581349	2310786	2311073
Net operating profit/loss	-467082	-462434	-957137	-1043473
Capital Expenditure	330,000	-	-	-

Source: Loxton, Venn and Associates (Various years)

a) Calculation is for the 9 months ending December of each year.

4.4. HERTZOG AGRICULTURAL CO-OPERATIVE (HACOP) IRRIGATION SCHEME

4.4.1. General description and historical background

In the northern part of the Kat river basin along the Readsdale river, a tributary of the Kat river, an irrigation co-operative has been developed by the local community. A total of 81 farmers have united into the Hertzog Agricultural Co-operative (HACOP). Each member of the coop has access to 1 ha of irrigated land. This land is used to grow a range of vegetables and crops. The land is divided into three sections, namely, Hertzog, Fairbairn and Phillipton.

The history of the co-operative and the scheme was recorded by means of a time line. Time line is a Rapid Rural Appraisal technique. It is used to reconstruct the past by sourcing the collective memory of the community in a community meeting. This activity is usually also very informative for members of the community, as most have never been informed of the history of the area in which they live.

The first Xhosa family (probably from Mfengu origin) to arrive at Hertzog-Fairbairn was the Hans family. In 1836 the Hans family moved from Peddie to Hertzog in search of grazing for livestock. Range conditions in Peddie were deteriorating as a result of overstocking. At that time Hertzog was occupied by coloured people, from whom the Hans family purchased land. This land appears to have been freehold. After the Hans family had settled at Hertzog, white people also entered the area. A lot of land held by coloured people changed hands and became white-owned. The way in which the transfer of land from coloured to white owners occurred is not quite clear. Informants indicated that the coloured people received little in terms of compensation, and, once transfer was executed, they were removed from the area by force. It appears that the coloured people were dispossessed, because they sided with the Xhosas against the British and were punished for that. It was said that a lawyer by the name of "Solomon" played an important role in the execution of the land transfers and the removal of the original owners.

The Aba family was the second group of black settlers at Hertzog. Being acquainted to the Hans family, the Abas were invited to the area in order to address their need for land. Apparently, there was still a lot of vacant land in the area. The Aba family also purchased the land and held it privately. Other black families settled in the area, joining the farm owners as labourers. Three additional Xhosa families became land owners, namely the January, Mgwali and Mbi families.

The names of Fairbairn, Hertzog and Phillipton was derived from the names of English-speaking white farmers settling in the area. Previously the area had other names. Fairbairn was referred to as Vaaldraai by coloured people and Xhosa people called it Katak. The Fairbairn family arrived in the area in 1926 with two heads of cattle only. The Hans family

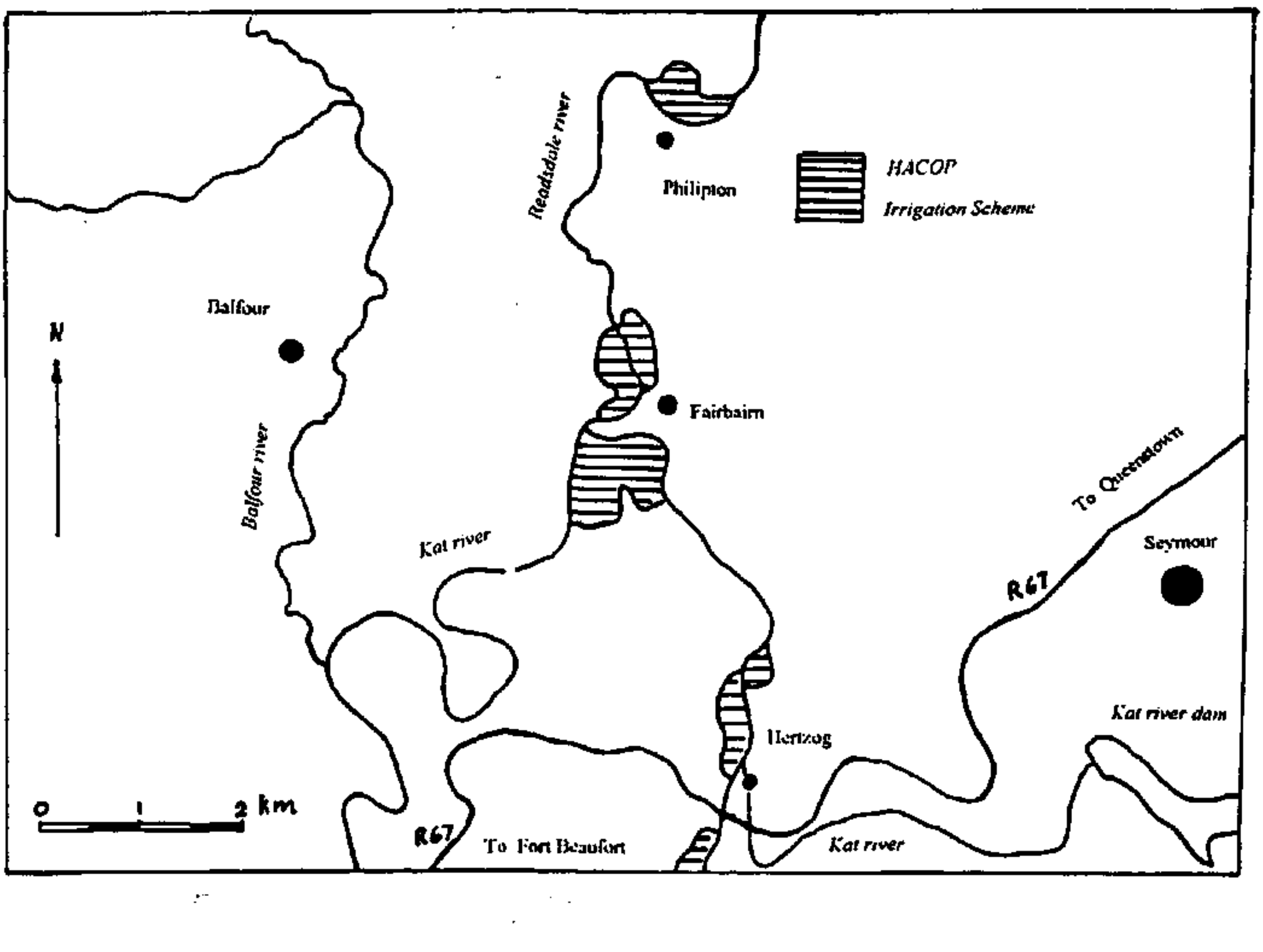

Figure 5. **Map of Hertzog Agriculture Co-operative (HACOP) Irrigation Scheme.**

helped Mr Fairbairn by providing him with more animals. Mr Fairbairn returned this favour by setting up a medical care centre at his home, where members of the community were vaccinated, resulting in a drastic reduction in illnesses amongst the local population. Mr Fairbairn developed irrigation at Fairbairn. He employed furrow irrigation, planting maize, tobacco, wheat, pumpkins and potatoes. Former farm labourers remember furrow irrigation as being very demanding. The irrigation water was very cold, causing arthritis and loss of strength. Mr Fairbairn passed away before the end of WOII and was buried amongst the Xhosa people. At about that time restrictions were imposed on farm worker families in terms of the number of cattle that could be kept. Every family was allowed to keep one cow only and people had to resort to buying milk from white farmers. In 1948 a lot of cattle died as a result of drought. That year there were only two sites at which people were able to obtain water.

In 1949 dams were constructed to store water. A small tobacco plant was erected and white farmers concentrated on tobacco production. "Katriva" tobacco became a household name amongst Xhosa people. The success of tobacco in the area resulted in the processing plant being extended. During the tobacco era (1940-1978), farm labourers were paid partly in kind (maize) and partly in cash. In 1978 white people left the area, probably because it was targeted for incorporation into Ciskei (released land). Farm workers were left empty-handed as restrictions on livestock had decimated their herds. During the late 1980s there was an unsuccessful attempt by the Ciskei Department of Agriculture and Forestry to revive large scale tobacco farming in the area (Nel and Hill, 1996). Thereafter the Ciskei Government attracted a private agricultural concern, based at Patensie and consisting of white farmers, to re-develop the area and revive farming (Nel and Hill, 1996). According to HACOP members, many jobs were created by the project. Monthly wages for workers was about R100 per month and foremen received R300 per month. Production concentrated on maize, tobacco and potatoes mainly. Sprinkler irrigation was introduced for the first time. Very nice vegetables were being produced, but there was a problem with stealing and many Xhosa people were expelled from the area. Workers did not care much about the infrastructure and water pumps were not looked after well. As a result, there was infrastructural deterioration.

In 1993 the Patensie farming concern left the area, stating inadequate financial reward as the main reason for its withdrawal from the project.

National political change, rising unemployment and poverty and the initiative of a local church group aimed at the development of agriculture on the abandoned land in the valley, prompted the Hertzog community to seize the initiative (Nel and Hill, 1996). In a series of community workshops, run by the local civic, development options for the area were identified. It was soon realised that under the given conditions, agriculture was the only viable option, land, infrastructure and skills (many local people were ex-farmworkers) being available on site. A strong local leadership structure developed, which negotiated the use of land and infrastructure with the Department of Agriculture and access to finance with the CAB (Ciskei Agricultural Bank) (Nel and Hill, 1996). A loan of R230 000 to bring the land back into production and meet operating costs in the first year was made available. Timely repayment of this loan ensured continued access to financial support (Nel and Hill, 1996).

The community decided to establish a local farming co-operative, which was registered as a Section 21 company. Members of the community were able to join the co-operative by purchasing 100 shares at a cost of R1 per share. This provided the co-operative with its initial operating capital. In 1994, the first 23 volunteer farmers were each allocated a 1-ha plot and adequate piping to irrigate their land. Co-operative leadership consists of shareholders, who implement decisions based on their shared experience as farmers (Nel and Hill, 1996). Intensive market-oriented farming requires a high level of skills and technology, which individual farmers may not have, but which are available in the co-operative. The four tractors are co-operatively owned and land preparation services are hired out to farmers. The co-operative also takes care of bulk buying (input supply) and storage of inputs on behalf of its members (Nel and Hill, 1996). Individual members manage their own CAB account and make use of this account when procuring services from the co-operative. At present the co-operative has 81 members each having access to a one hectare plot of irrigated land.

Following the 1994/95 summer season spirits were high and production and the project appeared to be a tremendous success. Nel and Nell (1995) wrote: "*A spirit of joint endeavour prevails with community members helping each other in labour intensive activities such as ploughing, seeding, spraying and harvesting. The scheme has had a tremendous impact on the community. In terms of remuneration received, the situation in the valley has altered dramatically. Profits of up to R 3000 ($800) per quarter hectare per growing season have been recorded. To families, which were often dependent on a single state pension, this has increased available income by a factor of up to five and significantly improved the quality of life. The majority of the farmers are women which helps to alleviate their traditionally marginalised position in society.*"

During the 1995/96 summer a number of major problems were encountered. The 1995/96 summer was wet and many of the potato and cabbage plantings ended up rotting in the field. Mechanical problems with tractors prevented farmers from planting a winter crop. Marketing of produce appeared to be more difficult than during 1995. According to the Chairperson of the Co-op the financial position of HACOP is not very good at this stage, with interest on loans increasing the amount outstanding and little money coming in.

4.4.2. Physical factors

4.4.2.1. Climate: The climate at Hacop Irrigation Scheme is semiarid and the area is subject to frost. Estimated mean annual rainfall is about 600mm per annum. Frost occurs from late April until early October. There are no rainfall records available for the area. The nearest rainfall station is Fort Beaufort, which is drier than Balfour. Temperature data for Balfour, located a few kilometres from Hacop, are presented in Table 4.4.2.1. From Table 4.4.2.1 it is evident that the frost-free season at Hacop is short in duration. As a result, the climate is sub-optimal for sub-tropical summer crops such as maize and sorghum.

Table 4.4.2.1. Temperature data for Balfour (1936-1952) from Weather Bureau (1984).

Month	Absolute daily min. temp.(°C)	Monthly mean min. temp (°C)	Absolute daily max. temp. (°C)	Monthly mean max. temp. (°C)	Monthly mean temp. (°C)
January	3,9	14,8	43,4	29,6	22,2
February	5,3	14,8	43,7	29,1	21,9
March	2,8	13,3	40,6	26,7	19,9
April	-0,1	9,1	38,3	25,2	17,2
May	-2,0	5,3	33,1	23,5	14,4
June	-6,7	3,0	31,9	20,6	11,8
July	-5,6	2,1	31,1	20,1	11,1
August	-4,7	3,8	34,4	22,5	13,2
September	-2,2	6,7	39,4	23,3	14,9
October	-0,8	9,0	41,1	25,1	17,1
November	1,7	11,6	41,7	26,7	19,2
December	3,3	13,6	43,3	28,7	21,1
MEAN	-	8,9	-	25,1	17,0

4.4.2.2. Geology and soils: The substrate at Hacop Irrigation Scheme consists of shales, mudstones and fine textured sandstones of the Balfour formation of the Beaufort group sediments. Along the Kat river and its tributary, the Readsdale river, alluvial deposits occur. It is on these deposits that the irrigated lands are situated. Two major soil types have developed from the alluvium deposited along the Kat and Readsdale rivers, namely Valsrivier and Oakleaf type soils. Valsrivier type soils dominate and Lindley and Arniston are the main soil series that occur. These soils are characterised by a clayey subsurface horizon, which is known to affect adversely the movement of water within the profile. This may have a negative effect on irrigation practices, because it may limit the ability of farmers to maintain optimum water supply, especially in deep rooted crops. Oakleaf soils tend to have a relatively uniform texture and movement of water within the profile is usually less of a limitation than in Valsrivier type soils. Locally, Oakleaf type soils are known to be prone to crusting and compaction below the plough layer. Infiltration rates tend to decline as the season progresses. As a result, the soils at Hacop are suboptimal for irrigation. Maintaining an adequate supply of water to crops is expected to present problems. Drainage problems may occur on the Valsrivier soils, especially during periods of heavy rain. During the 1995/96 season a lot of plantings at Hacop rotted in the field, because the lands remained too wet to allow people to harvest.

4.4.2.3. Water quality: Water of the Kat river at Balfour (see Table 4.4.2.2) is rated as low in salinity and low in sodium (Richards, 1954). This water can be used for irrigation without any restrictions.

Table 4.4.2.2. Chemical composition of Kat river water at Balfour, just below the Hacop Irrigation Scheme (after Hill, Kaplan and Scott, 1991).

SAR	1,11
EC (mSm^{-1})	33,2
TDS (mgl^{-1})	250
Na^+ (mel^{-1})	1,09
K^+ (mel^{-1})	0,03
Ca^{2+} (mel^{-1})	1,10
Mg^{2+} (mel^{-1})	0,83
Cl^{-1} (mel^{-1})	0,79
$CaCO_3$ (mel^{-1})	1,96
SO_4^{2-} (mel^{-1})	0,17

4.4.3. Infrastructural factors

4.4.3.1 Water supply: Farmers at Hertzog and Fairbairn pump water from the Kat river. There are two pumps at each of the two sections of the Scheme. At Phillipton farmers pump water from the Readsdale river using a single pump. Pumped water is irrigated directly onto the lands by means of moveable sprinklers. Pipes and sprinklers are shared amongst farmers. Irrigation infrastructure is in a relatively poor state of repair, with pumps and pipes getting of age. The number of pipes available also appear to be too few to enable optimum irrigation practices.

HACOP farmers are not part of the Kat River Irrigation District, but they have applied to become members. It appears that through intervention by Ulimocor they are able to secure releases from Kat river Dam. There is little storage capacity at Hertzog and at present all irrigation is from the river directly onto the lands.

4.4.3.2 Other farming related infrastructure: Being an old private farming area, there is a lot of infrastructure available, including sheds, small farm dams, farm houses and some old implements. At present, most of the infrastructure is in a poor state of repair, but a lot of it can be renovated. The Coop has two working tractors, namely a 4WD MF399 and a 2WD MF290 of which the age is not known, but which appeared to be fairly new, and two tractors in an advanced state of disrepair.

4.4.3.3 Communication services: Gravel roads link Hertzog, Fairbairn and Phillipton to the R67, a rural tarred road connecting Fort Beaufort with Queenstown. Availability and cost of road transport is considered a major constraint. Produce is marketed in Fort Beaufort (35km), East London (185km), Queenstown (100km) and Port Elizabeth (285km). Inputs are purchased from Farmarama (East London), who deliver to the Coop at Hertzog.

Until about 1982, a railway service linked Fairbairn Station to Fort Beaufort, which, in turn is linked to Port Elizabeth and East London, the two major urban centres in the Province. This rail connection is no longer active.

At the Scheme there are a number of taxi-combis and private cars which double-up as taxis. People have also access to the Railway Bus Services via a bus stop located on the junction of the R67 and the gravel road to Hertzog. Local transport of water, produce and other goods is usually conducted by means of donkey carts. People who have fallen ill are also brought to the clinic by cart.

There are no telephones at the Scheme, which is considered a serious constraint with respect to marketing. A post office is available at Balfour.

4.4.3.4. Power supply: There is a power line that leads to Hertzog and Fairbairn. At Fairbairn the electricity was used to drive a water pump. However, this pump is not used at present, because the Coop is of the impression that electric pumps are more expensive to run than diesel pumps. The electricity available at the scheme is, therefore, not exploited. Diesel is used to fuel pumps and tractors. Household energy needs are addressed by the use of gas, paraffin, wood, candles and manure.

4.4.4. Organisational factors

4.4.4.1. Banking services: HACOP does all its banking through CAB (Ciskei Agricultural Bank), which enables the Coop to obtain credit and assistance with the managing of the accounts of individual members. Several commercial banks have branches at Fort Beaufort town.

4.4.4.2. Organisation of the Coop: The Hertzog Agricultural Co-operative (HACOP) has 81 member farmers. These farmers were identified by the community as having the necessary skills and motivation to make a success of irrigated farming. Each member farmer was given a 1ha plot. The Coop is subdivided into three sections, namely Hertzog, Fairbairn and Phillipton. Each section has a committee of five, which represent the section's interests at general meetings. Executive management of the Coop rests with an umbrella body consisting of 5 members elected from the three committees of five. This executive body is responsible for most of the day-to-day decision making, liaison with outside structures and administrative management of the affairs of the Co-op. Executive members do not receive any payment for their work. The lack of administrative skills was identified by the executive body as a major constraint, as was the absence of any form of telecommunication. The co-operative supplies services to its members for which the requesting farmers are charged against their individual CAB accounts. Farmers make individual decisions with respect to farming on their plots.

4.4.4.3. Land preparation services and infrastructural maintenance: The coop provides services to all its members at standard rates. Pumping of water (R142 per crop per 0,25 ha), ploughing at R165 per ha, disking at R105 per ha and ridging/cultivation at R50 per ha. All inputs (seed, fertilisers and crop-protectants) are bought by the coop and sold to member farmers at cost. CAB manages the account of the coop as well as the individual accounts of the member farmers. As a result, member farmers can obtain services and inputs on credit, through the coop, and CAB ensures that member accounts and the Coop accounts are settled, once income from sale of produce is secured.

Maintenance of infrastructure (tractors and pumps) is primarily the task of the individuals handling the equipment. Malfunctioning equipment is repaired by Ulimocor, who has a mechanical workshop situated a few kilometres away from the scheme, along the road to Fort Beaufort.

4.4.4.4. Training and extension services and facilities: There is no resident extension officer at the Scheme. Farmers rely on their own knowledge of crop production, acquired during their service as farm labourers, and on the voluntary services of professional staff attached to Ulimocor.

4.4.4.5. Retail outlets and marketing services: There are five small retail outlets at the Scheme, namely two at Hertzog, two at Fairbairn and one at Phillipton. None of these outlets are involved in the marketing of Scheme produce.

4.4.5. Social services and amenities

The social services available at the Scheme are very limited. Each of the three villages has a crèche and a primary school. To attend highschool, local children have to travel to Balfour or schools further afield. There are no clinics on site and people have to travel to Balfour or Seymour for even the most basic health services. The local youth has access to a rugby field (one in each village), which is also used for soccer. Girls have a netball field. There is also a choir.

4.4.6 Economic factors

Hacop irrigation scheme does not receive any government funding. All costs pertaining to farming are borne by the co-operative with the exception of water. Hacop does not pay for the water it extracts from the Kat river. Other irrigation farmers in the Kat basin pay R120 per ha per year.

Farmers divide their plots into 0,25ha sections, which are usually planted to different crops. A crop rotation programme is followed, whereby cabbage is followed by potatoes, beetroot, pumpkin, carrots and then cabbage again. This crop rotation is not adhered to strictly. Also choice of crops appears wider than is suggested. During late summer of 1996, many farmers had planted their fields to maize.

4.5. HORSESHOE IRRIGATION SCHEME

4.5.1. General description and historical background

Horseshoe Irrigation Scheme is a 50ha scheme settled at present by 18 farmers each with access to 2 ha of irrigated land. The Scheme is situated about 10km away from the centre of King William's Town along the R30 to Stutterheim. Farmers focus entirely on commercial production of vegetables, which are marketed to local buyers, in King William's Town and in East London.

The Scheme was developed on land that was bought by the South African Development Trust (SADT) from white farmers as part of the consolidation of Ciskei (released land). SADT ran the Scheme for a few months and then handed over the land to the Department of Agriculture of Ciskei, who, in turn handed it to Ulimocor. From 1986 onwards Ulimocor farmed the released land, which was known as the Braunsweich Development Area, as an estate. The farm, which was to become Horseshoe Irrigation Scheme, was the Central Unit of the estate. The Braunsweich area was earmarked primarily for the re-settlement of Tyutyu, Shobeni and Belazi locations, which had to make way for the development of the Bisho urban settlement. However, only Tyutyu location agreed to the relocation leaving a major portion of the land available for commercial production by Ulimocor.

In 1991 Ulimocor adopted a new policy. The parastatal decided to withdraw from active farming and focus on farmer support. Most of the smallholdings within the Braunsweich Development area were restored to their original size with respect to the farm boundaries stipulated in the title deeds. They were subsequently sold to private Ciskeian citizens. Ulimocor initiated Horseshoe Irrigation Scheme in May 1993. The parastatal offered retrenched labour, previously active in production on the estate, and members of surrounding communities the opportunity to start farming for their own account. A total of 12 irrigation plots of 2ha each were developed on Central Unit land, which became known as Horseshoe Irrigation Scheme. Forty applications were received from retrenched workers, but only four took up the offer and invested their retrenchment packages in farming at the Scheme. The other members were recruited from surrounding communities. The plots were developed using existing equipment. In 1996 the number of plots was increased to 18.

The land at the Scheme was owned by SADT and is, therefore, in State hands. It was purchased from the Izeli Convent and was probably transferred to Ciskei Government later on.

Over the years, there has been a turn-over of farmers, with some leaving the scheme and others taking their place. All farmers are residents of surrounding settlements, many of which are informal. Few of the farmers had a farming background before joining the Scheme.

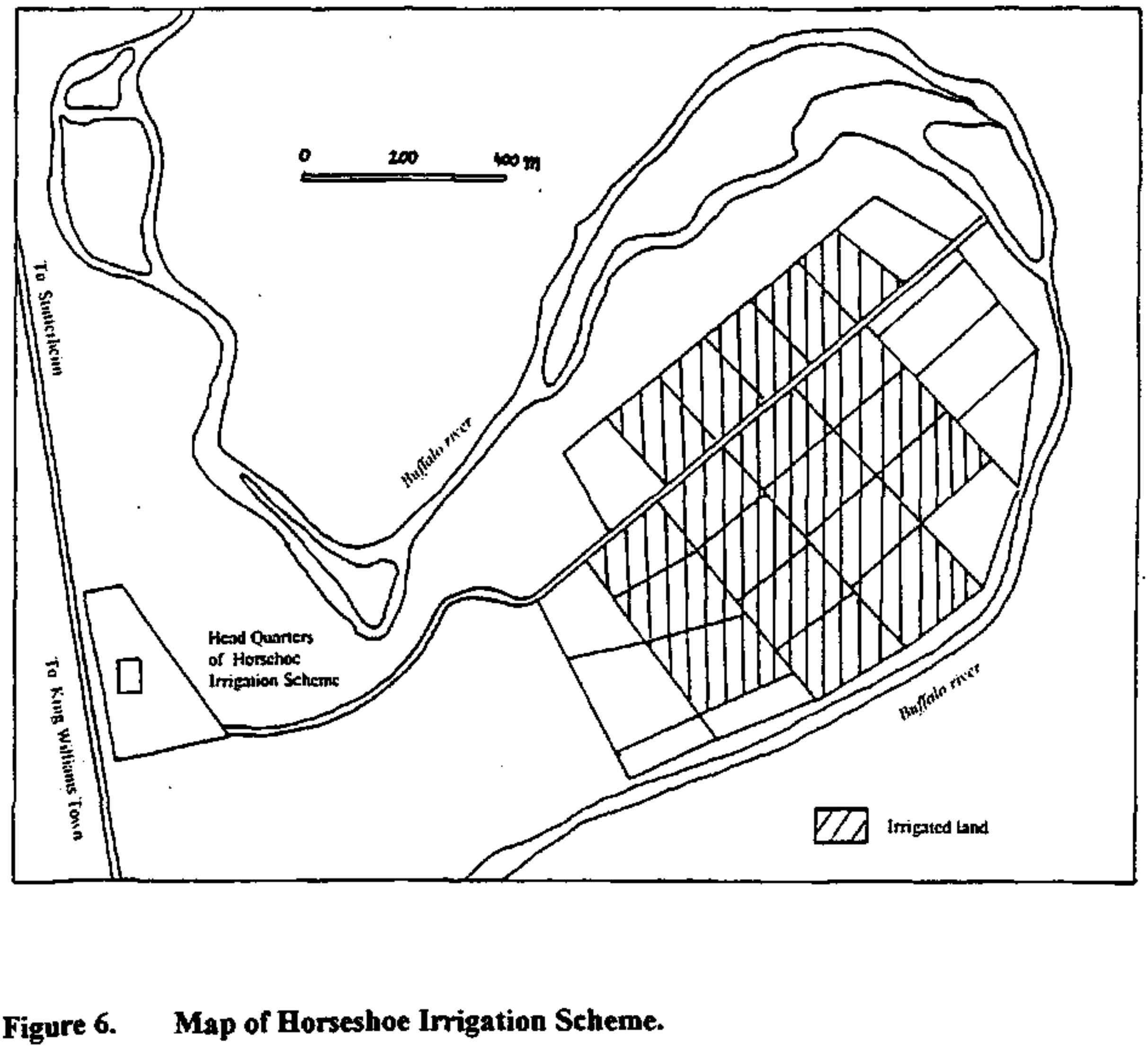

Figure 6. Map of Horseshoe Irrigation Scheme.

4.5.2. Physical factors

4.5.2.1. Climate: The climate at Horseshoe Irrigation Scheme is semi-arid and mild. The area forms part of the transitional rainfall zone where rainfall is characterised by a late spring and autumn peak and where a mid-summer drought often occurs. According to Hill, Kaplan & Scott (1984), the mean annual rainfall is estimated to be 535mm and the annual Class A-pan evaporation 1870mm. Mild frost occurs during the period May until August. Records suggest that temperatures below -2°C are highly unusual. The mean annual relative humidity at 8am is 72% with a low of 68% during the period October to December and a high of 79% in February. Hail is not a serious problem. In Tables 4.5.2.1 and 4.5.2.2 a summary of some important rainfall, evaporation and temperature statistics are presented.

Table 4.5.2.1. Rainfall and evaporation data applying to Horseshoe Irrigation Scheme (after Hill, Kaplan & Scott, 1984).

Month	Mean rainfall (mm)	Mean Class A-pan evaporation (calculated values) (mm)
Jan	55,0	212
Feb	69,0	175
Mar	74,7	170
Apr	41,9	125
May	28,8	117
Jun	15,2	111
Jul	17,4	105
Aug	19,7	131
Sep	41,0	153
Oct	54,9	177
Nov	60,3	188
Dec	57,8	206
Total	535,7	1870

Table 4.5.2.2. Temperature data applying to Horseshoe Irrigation Scheme (after Hill, Kaplan & Scott, 1984).

Month	Absolute daily min. temp. (ºC)	Monthly mean min. temp (ºC)	Absolute daily max. temp. (ºC)	Monthly mean max. temp. (ºC)	Monthly mean temp. (ºC)
January	8,0	17,2	43,4	28,6	22,9
February	8,0	16,8	45,6	28,8	22,8
March	5,6	15,6	41,0	27,6	21,6
April	3,8	12,4	40,4	26,0	19,2
May	-1,0	9,0	36,2	23,6	16,3
June	-1,6	5,8	32,0	22,0	13,9
July	-1,2	5,6	32,4	21,2	13,4
August	-0,5	6,2	36,8	23,2	14,7
September	1,0	9,2	41,6	24,0	16,6
October	3,2	12,0	40,6	25,0	18,5
November	3,2	14,0	42,4	26,2	20,1
December	6,0	15,2	42,8	25,3	20,3
MEAN	-	11,6	-	13,3	18,4

4 5.2.2. Geology and soils: The substrate at Horseshoe Irrigation Scheme consists of fine textured sand stones, mudstones and shales of the Beaufort Group. These sedimentary rocks have been intruded by magma which resulted in the formation of dolerite sheets and dykes. The weathering material of these two rock types form the parent material of local soils. Alluvial deposits occur along the banks of the Buffalo river. The first phase of Horseshoe Irrigation Scheme, consisting of the bottom 20 plots, was developed on land covered mainly by moderately deep Hutton soils (35 ha) (Hill, Kaplan & Scott, 1984) of which the depth ranges between 800 and 1200mm and which are rated as Class 2 soils for irrigation. The extreme bottom part of the Scheme consists of *Katspruit soils (3ha)*. Katspruit soils are rated as class 3 soils for irrigation, with drainage problems being the main limiting factor. The second phase of the Scheme is situated on shallow Hutton soils (8 ha) with a depth ranging between 400 and 600mm and shallow Glenrosa soils (4 ha) with a similar depth range. Shallow Hutton soils are rated class 3 for irrigation and shallow Glenrosa soils class 4. For both these soil types the shallow rooting depth is the main limitation.

4.5.2.3. Water quality: According to Hill, Kaplan & Scott (1991), the quality of the Buffalo river water at the site where Horse Shoe Irrigation Scheme pumps from the river is excellent. The water is classified as a low salinity - low sodium water, which means it can be used for irrigation purposes without any restrictions (Richards, 1954). The chemical composition of the water is presented in Table 4.5.2.3.

Table 4.5.2.3. Chemical composition of Buffalo river water at the site where Horseshoe draws its water (after Hill, Kaplan and Scott, 1991).

SAR	1,5
EC (mSm^{-1})	38
TDS (mgl^{-1})	250
Na^{+} (mel^{-1})	1,74
K^{+} (mel^{-1})	0,05
Ca^{2+} (mel^{-1})	1,08
Mg^{2+} (mel^{-1})	1,67
Cl^{-1} (mel^{-1})	1,86
$CaCO_3$ (mel^{-1})	1,84
SO_4^{2-} (mel^{-1})	0,21

4.5.3. Infrastructural factors

4.5.3.1. Water supply: The Scheme uses two electrical water pumps to extract water from the Buffalo river. Each pump drives water into a under-ground pipeline with hydrants. At the top end each of the under-ground pipelines is connected to an above-ground main line, also equipped with hydrants, which provides water to six plots that were developed during a second phase. Irrigation is by means of a hand-move lateral sprinkler system, which is attached to the hydrants of the main lines. Each farmer has been assigned a lateral, enabling farmers to maintain individual irrigation scheduling.

4.5.3.2. Other farming-related infrastructure: The Scheme has six old tractors (three large and three small), a truck and a range of implements. There is a privately owned workshop at the Scheme, which maintains moveable infrastructure (tractors and implements) and the electrical pumps. Servicing of tractors and implements is by means of a job card system and for the pumps there is a maintenance contract. There are a number of farm sheds and a road stall. The stall is no longer in use.

4.5.3.3. Communication services: The Scheme is situated along the R30, a rural tarred road which connects King William's Town with Stutterheim. The distance to King William's Town is approximately 7km and, from there, the N2 highway gives access to East London, which is 57km from King William's Town. The road network available to producers on the Scheme is excellent.

The nearest station to the Scheme is King William's Town (KWT), but producers do not make use of it. All produce that is marketed in East London is transported by road.

A wide range of transport services is available to Scheme members. Bulk transport by truck can be hired from the Scheme at R2,19 per km. The truck is used mainly for mass transport of people belonging to the local community. Taxi services to and from King William's Town are also frequent and easily accessible, with a taxi-stop at the gate of the Scheme. In 1996, a one way taxi trip to KWT cost R2 per person. Many retailers and hawkers come and buy at the Scheme, and they provide their own transport.

The Scheme has access to a phone (KWT number), but not to a fax. Amongst the local population there is a big demand for a phone, and the Scheme is considering installing a chatter box accessible to the general public. The Scheme operates a postal box in King William's Town which provides access to Scheme employees and farmers.

4.5.3.4. Power supply: Three phase electricity supplies power to the water pumps. The Scheme's offices and workshop are electrified and connected to Eskom. Farmers' homes are not electrified.

4.5.4. *Institutional factors*

4.5.4.1. Banking services: Farmers have access to commercial banks in King William's Town and Ciskei Agricultural Bank (CAB) in Bisho. In the past farmers were not managing their CAB accounts properly. Repayment of loans was not proceeding according to the Bank's regulations, and control by CAB over these loans appeared to be to gentle. This resulted in debts accumulating, causing CAB to suspend the loan facilities to farmers. The Scheme has temporarily taken over the responsibility for financing farmers. Inputs are paid for on a cash basis. Mechanical operations are supplied on credit. On average, farmers are behind on their payments for mechanical operations by about one to three months. Overall the new system has resulted in tighter financial discipline on the part of farmers and in a gradual reduction in farmers' debts to the Scheme. It is envisaged that farmers will soon have repaid their entire debt to the Scheme, where after they may consider repaying their CAB loans. Reduction in the availability of credit has affected production. Farmers now adjust the size of their plantings to the amount of money they have available. This has resulted in a reduction in land use intensity compared to the past and has increased the variability in the size of the plantings.

4.5.4.2. Organisation of the scheme: The Scheme has a staff complement of 20 people, consisting of a manager, an extension officer, three clerical staff, ten security officers, three tractor drivers, one truck driver and one technician. The Scheme assists farmers in all possible ways, but all farming and decision making is done by farmers. The main functions of the Scheme are to make farming possible, by maintaining infrastructure and supplying support services consisting of mechanical operations, purchase of inputs, information and extension, credit (to a limited extent) and security. Inputs such as fertilisers, seedlings and plant pest control agents are sold to the farmers at cost. Scheme management is actively involved in getting the farmers the best possible deal.

4.5.4.3. Mechanical operation services and infrastructural maintenance: The Scheme offers mechanical operations for hire. The cost is based on the amount of fuel used during a particular operation. In 1996, farmers paid R6,50 per litre diesel and this rate covered the cost of fuel, tractor hire, the driver and the use of implements. According to the Scheme's manager, the charges should be about R8,50 per litre including tractor maintenance and repairs, to enable full cost recovery. The Scheme, therefore, subsidises the cost of mechanical operations by about 25%.

The Scheme's workshop has been privatised and it services the Scheme's implements by means of a job-card system (tractors and implements) and a service contract (pumps).

4.5.4.4. Training and extension services and facilities: The Scheme maintains an active training and extension programme. Once a week a formal training session is organised in the Scheme's shed. On average, these sessions are attended by 50% of the farmers. Training sessions deal with various aspects of production of the main crops at the Scheme, such as irrigation scheduling, pest identification (by means of field walks), the use of insect identification booklets, etc. Generally the level of education of farmers is very low and training has to be adapted to suit the farmers. For example, training on irrigation scheduling is based on observations and centres around frequency and duration of water applications. Placement of sprinklers is also dealt with. Runoff is used as an indicator of excessive duration, but leaky pipes interfere with this method of assessing the duration of water applications.

4.5.4.5. Retail outlets and marketing services: Marketing of produce is not a problem at the Scheme. According to the manager, farmers can sell everything they produce. About 60% of the produce is sold at field edge. Hawkers and shop owners come to the Scheme and buy at producer's prices. They provide their own transport. A vegetable wholesale shop in King William's Town is also a major client buying up to 300 bags of cabbages a day. East London market is second choice, because of the distance. It is the major market for specialised produce, such as celery, parsley (used mainly for display purposes in butcheries), broccoli, turnips, tomatoes, peppers, chillies, bringels and spinach. Some produce is also sold to the local community.

4.5.5. Social services and amenities

The social services available around Horseshoe Irrigation Scheme are of a reasonable standard. There are two primary schools, one at Tyutyu (located next to Horseshoe) and one near the Horseshoe Motel in an old farm shed. There is a highschool at Mzontsundu.

People have access to a clinic located in an old farm house at the entrance of Tyutyu. At Mdingi there is another clinic. Specialised services are obtainable in King William's Town and Bisho. One of the Horseshoe fields has been converted into a soccer field.

4.5.6. Economic factors

The annual budget of Horseshoe Irrigation Scheme is about R400 000. Farmers pay for all the services that are provided, with the exception of extension and book keeping. Land preparation and water supply are subsidised. Farmers pay R50 per month for water. This levy contributes about 50% to the cost of pumping. A levy of R50 per month could cover the total cost of water supply, but the pumps are old and require a lot of maintenance, increasing the cost of water supply considerably. The R50 per month levy encourages people, who have lost interest in farming, to exit the Scheme, enabling new members to join. Recently four farmers have left the Scheme. They have been replaced by four new farmers. Generally, the interest in joining the Scheme is high. Most people who joined the Scheme recently are Scheme employees.

4.6. ZANYOKWE IRRIGATION SCHEME

4.6.1. General description and historical background

Zanyokwe Irrigation Scheme (ZIS) comprises of 8 sections on 412,1ha irrigated land and 66,8ha of land with infrastructure, bringing the total to 478,9 ha. The Scheme land consists of relatively small islands of irrigated land, stretching from Lower Ngqumeya in the east to Kamma Furrow in the west. All irrigated land is intended for crop productions. The land is subdivided into 174 Food Plots of 0,20ha each and 64 Commercial Farms of ± 6ha each. The current status of the irrigation development at ZIS is summarised in Table 4.6.1.1. Infrastructure in the form of pumping stations, reservoirs and transmission pipe lines linking pump station with reservoir have been laid out to bring an additional 109,4 ha under irrigation at Lower Ngqumeya (15ha), Wolf River (3ha) and Zanyokwe (91,4ha).

Table 4.6.1.1. Irrigation development at Zanyokwe Irrigation Scheme (November 1996).

Administrative area	Commercial Farms (ha)	Food plots (ha)	Total (ha)
Kamma Furrow	51,0		51,0
Burnshill West	51,0		51,0
Burnshill East	50,7	24,6	75,3
Lenye South	97,4		97,4
Lenye North	82,8	10,2	93,0
Lower Ngqumeya	38,0		38,0
Wolf River	6,4		6,4
Zanyokwe	0,0	0,0	0,0
Total	377,3	34,8	412,1

The regional analysis of the natural resources in the Keiskamma river basin completed by Hill, Kaplan & Scott in 1977, identified irrigable land along the Keiskamma river north-east of Middledrift. On the Water Supply Scheme map of Hill, Kaplan & Scott (1977) it is referred to as Irrigation Scheme No 7 and it was to be supplied with water from a dam to be constructed along the Boma Pass, where Keiskamma river had cut a narrow gorge through dolerite rock. Plans for a dam in the Boma pass were approved and Sandile dam was constructed. The dam was completed in 1983.

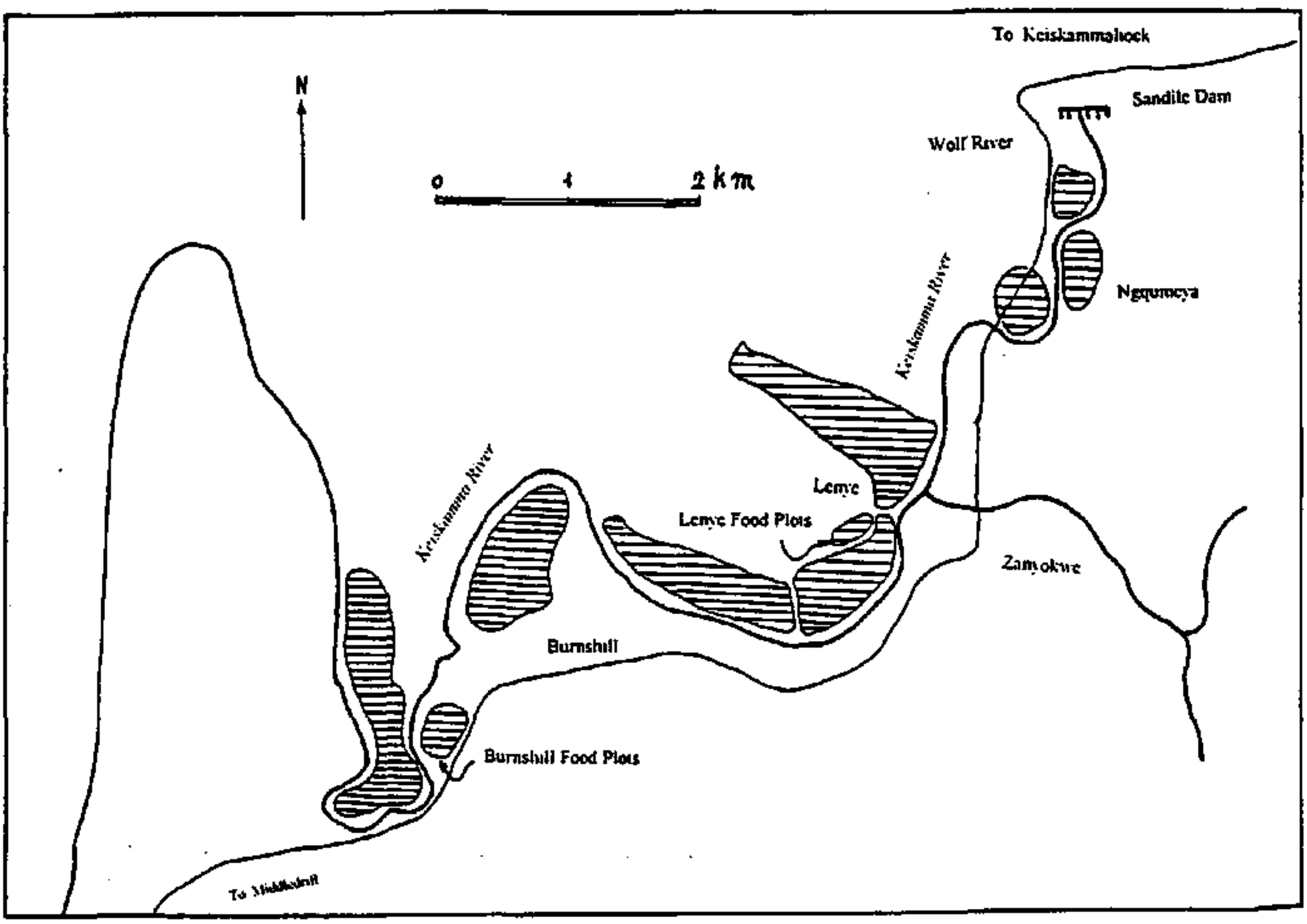

Figure 7. Map of Zanyokwe Irrigation Scheme.

With an estimated long term yield (MAR) of about $20x10^6$ m^3 per annum and a storage capacity of $19x10^6$ m^3 per annum, the dam was to become the main storage facility of water of a multipurpose regional water project. The dam was to supply water to the urban centres of Dimbaza and Middledrift, Fort Cox Agricultural College, Ntaba ka Ndoda, Bulembu airport and numerous rural villages located within the mid-Keiskamma river basin. In the plans, an amount of $9x10^6$ m^3 per annum was also set aside for use in Irrigation Scheme No 7. The availability of a reliable and relatively abundant supply of irrigation water led to the development of Zanyokwe Irrigation Scheme. Plans for the development of ZIS were drawn up by Loxton & Venn in 1983 (preliminary plan) and 1984 (final plan). These plans were reworked in 1985 and implemented from 1985 onwards by the Israeli company Agri-Carmel.

Essentially, the plan for Zanyokwe mirrored those implemented developed and implemented elsewhere in the Eastern Cape by Loxton and Venn, such as Tyefu Irrigation Scheme, Shiloh Irrigation Scheme and Ncora Irrigation Scheme. It proposed centrally managed estate farming on the major part of the land and assigned the remainder of the land to the original right holders in the form of irrigated food plots, on which they were more or less allowed to do what they wanted. As in all other cases, estate farming at Zanyokwe would rely on expensive external management and cheap local or imported labour to perform production tasks. Projections of gross production capacity and associated income generation were used to justify the capital developments in economical and financial terms.

The capital requirements to develop Zanyokwe Irrigation Scheme were considerable, because irrigation development plans proposed use of sophisticated technological solutions. This included the use of centre pivots and micro-irrigation and considerable infrastructural developments in support of irrigation and farming activities. However, implementation of the Loxton and Venn model of irrigation development at Zanyokwe was constrained by two factors, namely:

a) Suitable irrigation land was scattered over a large distance, occurred in small pockets and was situated at an altitude that was insufficient to create sufficient hydraulic head to operate overhead application of water. This caused capital outlay per unit of irrigated land to be exceptionally high, and also made the recurrent cost of supplying water high, because and intricate system of pumping stations and reservoirs was called for.

b) Most of the land identified for irrigation was in private hands held under quitrent and freehold tenure, and the last thing land right holders were prepared to consider was their alienation from the land they owned. The exchange of land rights for the right to an irrigated Food Plot was totally unacceptable to Zanyokwe land owners.

Before Agri-Carmel was able to implement the development of Zanyokwe Irrigation Scheme, the firm was asked to modify the Loxton and Venn plans. Concerns had been raised by the Development Bank of Southern Africa (DBSA), who were approached to finance Zanyokwe Irrigation Scheme. The DBSA demanded the plans to show a timed progression from estate farming in the initial phase to full transfer of the Scheme to local farmers. The final Agri-Carmel plan, accepted by the DBSA, proposed that land brought under irrigation would be farmed by Agri-Carmel as an estate farm over a three year period. This initial phase would be followed by an interim period of two years, during which farmers received formal training at Fort Cox and practical training on the estate farm. Finally, all farming land was to be handed over to local farmers, limiting the responsibility of Central Unit to that of providing farmer support services.

It was agreed that land owners would receive a rental for the use of their land during the first two phases of development. For agricultural land the initial rent was R20 ha^{-1} per annum which was increased progressively to the present rate of R150 ha^{-1} per annum in 1996. Land used in the development of infrastructure, which includes farm sheds, pump stations, booster pump sites, reservoirs and buildings, was to remain subject to rental payment at rates ranging between R250 and R1000 ha^{-1} per annum. To date, these rentals for land with infrastructure have been paid for by Ulimocor.

According to G. de Waal (pers. com.)[5] President L.L. Sebe of Ciskei intervened personally and requested the Development Bank of Southern Africa (DBSA) to finance the ZIS development. The DBSA made finance conditional to a re-design of the in-field water supply system to accommodate for independent management of "economically viable farming units". In most cases these "economically viable units" were obtained by consolidating the irrigable land holdings of two or more land owners. This required land owners to appoint a "nominee farmer" who would farm the entire unit. These "nominee farmers" were trained at Fort Cox and at the Scheme (during the estate phase) for which they received a R3,50 per day compensation. Training started in 1988 and the handing-over of farm units to "nominee farmers" in 1989, which was also the time when Ulimocor became involved in the Scheme.

The phase involving the transfer of land lasted from 1989 to 1991. In order to give "nominee farmers" a reasonable time to develop their enterprises and skills, Cis-Carmel (the local subsidiary of Agri-Carmel) and, later on, Ulimocor agreed to allow them to farm on a "no-loss" basis for a period of two years, optionally extended by one additional year. Nominee farmers could draw all their inputs and mechanical operations from Central Unit on a credit basis and received a monthly advance on production in the form of a stipend of R250 per month. This stipend was meant to keep their families afloat during interim periods when no income was derived from the sale of produce. Farm produce was expected to be marketed through Pack Mark, the marketing arm of ZIS, enabling Scheme administration to control the accounts of nominee farmers. At the end of the financial year, the Scheme drew up the balance between expenses (stipend, land rental and inputs and services drawn from Central Unit) and income generated from crop sales. When the balance was positive, the nominee farmers were paid out the profit realised. When the balance was negative Cis-Carmel or Ulimocor would write off the debt incurred by the "nominee farmer". In many cases, nominee farmers would last the three year induction period, incur debts and exit farming when required to farm for their own account. Following the exit of a nominee farmer, a new nominee was appointed and the three year induction period was re-invoked. This state of affairs has persisted until present.

In June/July 1994 nominee farmers, who had accepted full independence following the end of the induction period, requested to start dealing directly with CAB. This made them responsible for payment of land rentals. Most nominee farmers failed to pay their CAB loans and did not honour land rental agreements. In July 1995 the land owners demanded Ulimocor to pay for outstanding rentals, claiming not to have been informed by Ulimocor about the

[5] Mr G. de Waal is a staff member of the DBSA.

changes. Ulimocor settled the bill for outstanding rentals incurred by nominee farmers and informed land owners that it now absolved itself completely from the payment of any land rentals incurred by nominee farmers.

Fearing a loss of income some land owners responded by subdividing the "economically viable units" into the various individually owned parcels which had been used in the formation of the farming unit. This created problems, because the beacons which identified original farm boundaries had been removed by Scheme developers. This caused quarrels amongst owners about the exact location of the original boundaries. Furthermore, since the system was re-designed to supply water to the consolidated "viable units" and not to each of the sections comprising such a viable unit, one of the land owners would have the hydrant positioned on his or her land, whilst the others had to rely on goodwill for access to water. This situation also led to tension and quarrels amongst land owners.

At present, farming at ZIS is at a low for various reasons. These include quarrels over land and access to water, extremely poor support services supplied by Ulimocor, poor motivation amongst land owners, nominee farmers, and plot holders, and poor access to production loans because of debt incurred in the past. It is estimated that less than 20% of the land is under production at this stage (November 1996).

Irrigated food plot production occurs at two sections of the Scheme, namely Lenye North and Burnshill East. The Lenye section is situated on Trust land and generally production levels tend to be reasonably high. At Burnshill the food plots are on privately owned land. The scheme is subject to disputes about land rentals, which are supposed to be paid by the food plot holders. Food plot holders at Burnshill did not want to participate in this study.

4.6.2. Physical factors

4.6.2.1 Climate: Zanyokwe Irrigation Scheme is situated at an altitude ranging between 440m and 640m above sea level. The climate at Zanyokwe Irrigation Scheme is semiarid and relatively mild. Mean annual rainfall is estimated at about 600mm per annum Frost occurs from the middle of June to the middle of August. The nearest rainfall station is Fort Cox, located close to the dry western boundary of the Scheme. Temperature data presented in Table 4.6.2.2 were obtained from The Department of Agriculture and Forestry (1981) and are based on interpolations. Over the period 1930-1980, mean annual rainfall at Fort Cox ranged between a minimum of 368mm and a maximum of 995mm. The 90% confidence interval ranges between 561mm and 621 mm. June and July are the driest months. During the winter months April-September, 32,1% of the annual rainfall is received. The rainfall distribution is bimodal, with a peak in November and one in March. Mean monthly rainfall data for Fort Cox are presented in Table 3.6.1. Class A-pan evaporation data are also estimates by The Department of Agriculture. Actual Class-A pan evaporation is expected to be about 10% higher than is suggested by the data in Table 4.6.2.1.

Table 4.6.2.1 Rainfall recorded at Fort Cox (1930-1980) and estimated Class A pan evaporation data applying to Zanyokwe Irrigation Scheme (from The Department of Agriculture and Forestry, 1981).

Month	Mean rainfall (mm)	Estimated Class A-pan evaporation (mm)
Jan	64,3	191
Feb	70,2	147
Mar	83,6	143
Apr	43,8	108
May	36,1	98
Jun	18,8	88
Jul	22,1	98
Aug	29,4	120
Sep	39,4	136
Oct	58,5	162
Nov	66,3	164
Dec	58,3	181
Total	590,9	1636

Table 4.6.2.2. Temperature estimates for Zanyokwe Irrigation Scheme (from The Department of Agriculture and Forestry, 1981).

Month	Estimate of extreme minimum temp. (°C)	Estimated monthly mean min. temp (°C)	Estimate of extreme maximum temp. (°C)	Estimated monthly mean max. temp. (°C)	Estimated monthly mean temp. (°C)
January	9	13,5	37	26,5	20
February	10	14,5	38	27,5	21
March	9	14,0	36	26,0	20
April	6	12,0	33	24,0	18
May	2	9,5	30	21,5	15
June	0	7,5	28	19,5	13
July	-1	6,0	27	18,0	12
August	0	7,5	30	20,5	14
September	2	8,5	31	22,5	15
October	5	10,5	33	23,5	17
November	8	12,5	35	25,5	19
December	9	13,5	36	26,5	20
MEAN	-	8,9	-		

4.6.2.2 Geology and soils: The substrate at Zanyokwe Irrigation Scheme consists of shales, mudstones and fine textured sandstones of the Balfour formation of the Beaufort group sediments. Karoo dolerite also occurs. Along the Keiskamma river alluvial deposits are found. The distribution of soils at Zanyokwe is extremely complex and varied. The absence of large areas where soil conditions are homogeneous makes irrigation development difficult. Five major groups of soils are found. Along the banks of the river and on the young river terraces *alluvial soils occur*. They consist of Oakleaf and Dundee type soils and occupy 408ha of the 1069ha area that was surveyed. Red, well drained soils (Hutton and Shortlands) are found on the remnants of older river terraces and on lower middle pediment slopes. They occupy 126ha. Black clayey soils occur on lower middle slopes, where dolerite forms the sole parent material. These soils cover an area of 97ha. Common soil types are Arcadia and Mayo. Where the parent material is derived from fine textured sedimentary rocks, the lower middle slopes are often covered by shallow poorly drained soils, such as Longlands, Westleigh and Kroonstad type soils. These poorly drained soils occupy 100ha. In the absence of hydromorphy, middle and footslopes where sedimentary rocks are the dominant parent material have a soil cover that is usually shallow (Glenrosa) and, where the soil mantle is deeper, a clayey subsoil resulting from clay illuviation is usually found and Swartland and Valsrivier occur. These soils cover an area of 318ha.

Oakleaf (and Dundee) type soils, which dominate the Scheme area, occupy mainly the low lying areas and river banks and are usually developed from alluvial material. The irrigation rating of Oakleaf soils is a function of effective rooting depth and the absence or presence of hydromorphy in the subsoil. Most Oakleaf and Dundee soils are rated moderate to moderately high by Loxton *et al.* (1983). Locally, Oakleaf type soils are known to be subject to surface compaction or crusting and sub-surface compaction, especially under irrigated conditions. Both types of compaction have a negative effect on the hydraulic properties of the soil. Usually they demand very low application rates when overhead systems of irrigation are applied. Good results are usually obtained when border strip or short furrow irrigation is practised. Hutton and Shortlands type soils mostly occupy the older river terraces. When deep, these soils are well suited to irrigation, because of their superior hydraulic properties. Hutton soils are well drained and have a high intake rate. Hutton soils tend to be subject to leaching of anions such as nitrates, which can be attributed to their favourable hydraulic properties. They also have higher sorption capacities for phosphates than is the case for most of the other local soil types. Most Hutton type soils at Zanyokwe have an irrigation rating of high. Their rating is reduced when they occur on sloping land or when soil depth is limiting. Black clayey soils typically form where weathering material of dolerite forms the sole parent material and soil formation occurs under semiarid climatic conditions. These soils usually have a clay content exceeding 35% and both A and B horizon have a strongly developed structure. Local experience has shown that the structural stability of the surface horizon deteriorates when the soils are cultivated and surface crusts develop as a result. Under such conditions the soils become highly susceptible to erosion. Loxton *et al.* (1983) rates these black clayey soils low to moderate. Hydromorphic soils such as Longlands, Westleigh and Kroonstad should not be considered for irrigation because of their inherent drainage constraints. Loxton *et al.* (1983) assigns the hydromorphic soils an irrigation rating of low to moderately low. Locally Glenrosa soils develop from sedimentary rocks. They are usually shallow, and, as a result, tend to fill up with water quickly. Once saturated, the soils no longer absorb water and runoff occurs. Drainage tends to be slow and saturated conditions may persist for several days. Glenrosa soils are usually not suitable for irrigation, except perhaps for the deepest classes. Loxton *et al.* (1983) rates Glenrosa soils low for irrigation. Swartland and Valsrivier soils, both referred to as pseudo-duplex soils, because of the presence of a clayey subsoil without there being an abrupt transition between surface and subsoil horizon, are susceptible to crusting, have a low hydraulic conductivity and are susceptible to erosion. Loxton *et al.*, (1983) rates these soils low, moderately low or moderate for irrigation, depending on slope and effective rooting depth.

4.6.2.3 Water quality

According to Hill, Kaplan and Scott(1991) the quality of Zanyokwe irrigation water is excellent. The water is classified as a low salinity - low sodium water and can be used for irrigation without any restrictions (Richards, 1954). The chemical composition of Zanyokwe irrigation water is presented in Table 4.6.2.3.

Table 4.5.2.3 Chemical composition of Keiskamma river water below Sandile Dam (after Hill, Kaplan and Scott, 1991).

SAR	0,76
EC (mSm^{-1})	21
TDS (mgl^{-1})	138
Na^{+} (mel^{-1})	0,83
K^{+} (mel^{-1})	0,03
Ca^{2+} (mel^{-1})	0,60
Mg^{2+} (mel^{-1})	0,50
Cl^{-1} (mel^{-1})	0,62
$CaCO_3$ (mel^{-1})	1,16
SO_4^{2-} (mel^{-1})	0,15

4.6.3. Infrastructural factors

4.6.3.1 Water supply: One of the complicating factors at Zanyokwe Irrigation Scheme is that the difference in height between Sandile Dam and Scheme lands is in most cases insufficient to provide an adequate hydraulic head to operate pressurised irrigation systems recommended for use at the Scheme. As a result there was a need to build storage reservoirs to be fed from the main pipe line linking Zanyokwe with Sandile Dam.

The water supply system at Zanyokwe Irrigation Scheme was built according to specifications supplied by Agri-Carmel (1985). The total demand for water to supply a net area of 731ha with irrigation water was estimated at 7,765 x 10^6 m^3 per annum, which included a safety allowance equal to 50% of the mean annual rainfall to cater for droughts, and was based on an estimated irrigation efficiency at 65%. The gross water requirement for the scheme was estimated at 40 500m^3 per day, using 22 working days per month. The capacity of the main pipe line feeding Zanyokwe Irrigation Scheme with water from Sandile Dam is 40 000m^3 and a second pipe line delivering 20 000m^3 was planned at the time of the Agri-Carmel report (Agri-Carmel, 1985).

Agri-Carmel subdivided the Scheme into five zones, each consisting of one or more irrigated blocks of land. Each zone has its own offtake from the main pipe line and each block its own pump station and storage reservoir. Initially it was planned that water from the reservoirs would gravitate to the fields. However reservoirs were not positioned sufficiently high to result in an adequate pressure head to operate the field application systems, and booster pumps had to be added to that part of the system conveying water from the storage reservoir to field lines. At Kamma Furrow access to irrigation water was obtained by pumping directly from the river.

The water supply system, therefore, consists of a single main pipe line from Sandile dam, with five offtake points each served by an electrical pump, nine reservoirs and nine booster pumps each serving a small block of irrigated lands. At Kamma Furrow, water is pumped directly from the river to a reservoir. The total capacity of the reservoirs is about 20 000m^3 and individual reservoir capacity ranges between 750 and 4000m^3. The entire system is designed to operate 22hrs per day and 22 days per month. The high cost of delivering water to field edge makes water supply at ZIS an expensive operation, requiring a considerable amount of electrical energy and daily maintenance of the pumps.

4.6.3.2 Other farming related infrastructure: A Central Unit was built at Zanyokwe and it was equipped to provide a full range of farmer support services. The Scheme has nine tractors of which five are working, a shelling machine and a forced grain drying facility. There is also a marketing facility managed by Pack-Mark, a subsidiary of Ulimocor.

4.6.3.3 Communication services: A gravel road which links the rural tarred road R63 with Keiskammahoek passes through the Scheme. There is a bus service that calls at the various locations making up the Scheme. Most transport is by means of private cars and taxis. Pack-Mark, the marketing arm of Zanyokwe Irrigation Scheme, operates a truck service. The truck transports produce to East London market once a week. Transport to wholesalers in King William's Town is available also.

There is a railway station at Middledrift, but little if any produce is transported by rail.

The Scheme has access to a telephone, but the service is of a poor standard, consisting of a farm-line accessed via the Middledrift telephone exchange. A post office is available at Middledrift.

4.6.3.4 Power supply: Zanyokwe Irrigation Scheme is electrified and all its pumps are electrical. The villages surrounding the Scheme, where the farmers/land owners live, do not have electricity.

4.6.4. Institutional factors

4.6.4.1 Banking services: Zanyokwe Irrigation Scheme is part of Ulimocor and is financed through Head Office. Farmers and plot holders have to access finance individually. Those that do so open a credit line at CAB.

4.6.4.2 Land preparation services and infrastructural maintenance: Farming at the Scheme is supported by a range of services provided by a Central Unit located east of Burnshill. Central Unit is Ulimocor-managed and does not have any production land under its control. Farmer support services include mechanical operations and workshop, maintenance of main water supply system, extension, rural development and community support and marketing (Pack-Mark). Central Unit also has an administrative division and security personnel. There are 62 employees at the Scheme, consisting of 2 departmental staff, 52 permanent employees of Ulimocor and 8 casual staff of Ulimocor. Their deployment is shown in Table 4.6.4.1.

Table 4.6.4.1. Deployment of staff at Zanyokwe Irrigation Scheme.

Section/function	Number
Project co-ordinator	1
Administration	8
Workshop	5
Extension	4
Marketing	7
Mechanisation pool	10
Community development	4
Maintenance	15
Security	5
Stores	3
TOTAL	62

The Scheme is expected to supply all land preparation services on request. Ploughing costs R215 per ha. The Scheme is also responsible for the maintenance of all the components of the water supply system.

4.6.4.3 Training and extension services and facilities: There are four extension officers at the Scheme, three of whom are Ulimocor staff and the other seconded from the Department of Agriculture. In addition to extension staff, four community development officers operate in the villages surrounding the Scheme. Their appointment in 1993 was an attempt by Ulimocor to enhance the impact of the Scheme on the wider community living in the vicinity of the Scheme.

4.6.4.4 Retail outlets and marketing services: At present most vegetable crops are marketed to hawkers visiting the Scheme, buying directly from farmers and providing their own transport. Hawkers market Zanyokwe produce in King William's Town, Alice, Middledrift and Keiskammahoek. Farmers are not satisfied with the services of Pack-Mark, accusing the marketing agent of inefficiency. The time required to market crops delivered to its storage facility often causes a reduction in quality, which, in turn, results in low prices.

Most inputs are purchased from Farmarama (East London), who send a representative to the Scheme on a regular basis.

4.6.5. Social services and amenities

The social services available in and around the Scheme are very limited. According to the Section Manager, the Scheme has had very little positive influence on the quality of life of surrounding communities. The appointment of community development officers was aimed at enhancing the positive impact of the ZIS project on the quality of life of the community at large. This service has booked some results in terms of organising training in brick laying and sewing for unemployed people and by acting as facilitators for development projects.

4.6.6. Economic factors

In 1995/96 the net funding requirement of Zanyokwe Irrigation Scheme was R2,3 million or R5 581 per ha of irrigated land. The bulk of this money is needed to pay staff working at the scheme. However, most of the staff became functionally redundant once the central unit stopped its production activities and handed the scheme over to farmers. The farmer support services offered by the scheme are heavily criticised by farmers and many farmers have stopped using them. Farmers source most of their inputs from Farmarama in East London, either through a CAB loan or by paying cash on delivery. The Scheme is active mainly in supplying mechanical services, but the condition of the pool of tractors as per November 1996 was dismal, with 7 of the 9 units out of order. Many farmers expressed dissatisfaction with the mechanical services, blaming them of coming always late. Yet farmers are heavily dependent on the Scheme for water supply. Farmers do not pay for water or for the cost of extraction of water and maintaining the water supply system. It is highly doubtful that Zanyokwe Irrigation Scheme would continue to operate if this financial support would be withdrawn.

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CHAPTER FIVE

RESULTS OF THE QUESTIONNAIRE SURVEY ON IRRIGATED FOOD PLOT PRODUCTION

5.1 SOCIO-ECONOMIC PROFILE OF PLOT-HOLDERS AT SIX IRRIGATION SCHEMES

In this chapter acronyms replace the full names of the irrigation schemes. The following acronyms apply:

TIS: Tyefu Irrigation Scheme

KIS: Keiskammahoek Irrigation Scheme

SIS: Shiloh Irrigation Scheme

HAIS: HACOP Irrigation Scheme

HOIS: Horseshoe Irrigation Scheme

ZIS: Zanyokwe Irrigation Scheme

5.1.1 Household size and composition

5.1.1.1 Household size: Table 5.1.1.1 shows the mean size of households at the six irrigation schemes.

Table 5.1.1.1 Mean household size at six irrigation schemes in central Eastern Cape.

House-hold size	TIS n=147	KIS n=29	SIS n=26	HAIS n=7	HOIS n=5	ZIS n=10	All n=224
Mean	5,04	6,84	5,88	6,00	6,00	5,70	5,45

Over all the schemes, the mean size of household was 5,45, ranging from 5.04 at TIS to 6.84 at KIS. For the purpose of comparison, household size for a number of Eastern Cape localities are presented in Table 5.1.1.2. The results from the current study fall within the lower end of the range.

Table 5.1.1.2 Household size in different localities of the Eastern Cape.

District/region	Household size	Source
Peddie (Ciskei)	4.1 to 5.4	Steyn (1988)
Peddie (Ciskei)	5.1 to 6	Steyn (1988)
Zithulele (Transkei)	5.8	ARDRI (1989)
Engcobo (Transkei)	5.9	Rose (1987)
TBVC states, KwaZulu, Kangwane, and Gazankulu	6.83	Bembridge *et al.* (1992)
Mgwalana (Ciskei)	7.6	Williams & Rose (1989)
Khambashe (Ciskei)	8.0	Williams & Ward (1989)

5.1.1.2 Gender distribution and age of head of household: Gender distribution and age of head of households of plot holders at six irrigation schemes is shown in Table 5.1.1.3.

Table 5.1.1.3 Gender distribution of household heads at six irrigation schemes in central Eastern Cape.

Scheme	Proportion of respondents who are head of household	Gender distribution of heads of households		Mean age of head of household
		Male (%)	Female (%)	Years
TIS (n=148)	67	56	44	63
KIS (n=29)	72	57	43	56
SIS (n=34)	88	67	33	63
HAIS (n=28)	75	81	19	56
HOIS (n=7)	71	80	20	59
ZIS (n=13)	54	71	29	57
All (n=259)	71	62	38	61

From the total number of respondents, 71% were household heads of whom 62% were males and 38% females. The mean age of a household head was found to be 61 years. Across schemes, the age of household heads ranged from 33 to 86 years. More than three quarters (79%) of the female heads of households were widows. Of the remaining 21%, 5% were married, 14% single and 2% living apart from their partners.

These results are similar to those reported by Williams & Rose (1989) at Mgwalana in the Middledrift district (Ciskei) where 63% of the heads of households were males and 37% were females. Of the female heads of household, 78% were widows, 11% single and 4% living apart from their partners. Very similar demographic conditions were found to prevail at

Khambashe (Ciskei) where Williams and Ward (1989) found 62% male and 38% female headed households and 85% of female heads of household were widows.

5.1.2 Level of education

In Table 5.1.2.1 the level of education of respondents at the irrigation schemes is shown. These were determined by asking respondents how many years they had spent at school.

5.1.2.1 Level of education of respondents at six irrigation schemes in central Eastern Cape.

Years at school	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	ALL n=269
MEAN	3.31	4.66	5.49	5.18	4.57	5.30	5.26

Over all schemes the number of years respondents spent at school ranged from 0 to 12 years. The overall mean was 4 years. It follows that on average respondents did not obtain much formal education.

Heads of households with low levels of education appear characteristic for former homeland areas in general and Ciskei and Transkei in particular. Similar low levels of formal education amongst heads of households were reported by Steyn (1988) in Peddie district - Ciskei, ARDRI (1989) in Ngqeleni and Mqanduli districts - Transkei, Williams and Rose (1989) in the Mgwalana and Khambashe tribal areas - Ciskei and Bembridge *et al.* (1992) in the TBVC states. The effect of providing rural people with better access to education, a development dating back at least two to three decades, appears not to have had an effect on the educational levels of heads of households in the area of study. This is most probably because most heads of households are old and were of school-going age before access to education in rural areas became widespread.

According to Bembridge *et al.*, (1992), people who attended school for a period less than 4 years can be regarded as illiterate. Illiteracy has implications on extension, precluding the use of written material in the transfer of knowledge. Under such conditions, communication between farmers and extension staff has to rely on oral means, including face-to face communication, field demonstration and the use of audio-visual technology, such as flip-chart and audio-cassette programmes used in basic adult education. Bembridge (1985) identified low educational levels of farmers as a factor which may have a negative influence on productivity and rate of adoption of innovations in farming.

5.1.3 Income levels and sources

Sources and levels of gross cash income of food plot holding households were analysed for each of the irrigation schemes. A summary of the analysis of the results is presented in Table 5.1.3.1. The income source category "other" in Table 5.1.3.1 refers to salaries and wages, provident fund pay-outs, spouse or relative's pensions, welfare grants, trade and self-employment.

Mean gross cash household income over all schemes was R5717. In KwaZulu-Natal, May (1996) used an income of R750 per month for a household of five people as the poverty line, below which households are said to be subject to poverty. Overall mean monthly household income at the schemes was found to be R476 and mean household size 5,45. It would, therefore, appear that many of the plot holding households on the schemes live in poverty. There was evidence that plot holders did not reveal all their sources of income to the enumerators of the questionnaires, especially with respect to remittances. This may explain why the contribution of remittances to household income is much lower than expected. In a household income survey in five districts in former Ciskei conducted in 1990, Fabricius and McWilliams (1991) found remittances to contribute 31,5% to the income of rural households, salaries and wages 36% and pensions 18,9%. Retrenchments resulting from economic decline may have reduced the relative contribution of remittances to household income since 1990, but it is highly unlikely that its contribution would have been reduced to the apparent 1% as suggested by the survey results presented in Table 5.1.1.3.

The income data were subjected to a reliability test by triangulating sources of income with responses to related questions. Of the 269 questionnaires, 148 (55%) passed the reliability test, meaning that all apparent sources of income were revealed and quantified. Responses that were not considered reliable showed evidence of at least one source of income not having been revealed or quantified by the responding household. The reliability of the income data differed considerably from scheme to scheme. The proportion of apparently reliable responses on household income were 70% at SIS, 60% at TIS, 56% at KIS, 40% at HAIS, 29% at HOIS and only 8% at ZIS. It is, therefore, necessary to treat the income data with care.

Gross cash household income was highest at HAIS and HOIS. Both are schemes where households have access to large plots. Gross cash household income was lowest at ZIS.

Overall, pensions constituted the main source of gross cash income of plot holding households. They contributed 52% to overall gross household cash income. The importance of pensions in gross cash household income was especially evident at TIS, KIS and SIS, all schemes where farmers work on food plots 0,16ha - 0,25ha in size. Here the contribution of pensions to gross cash household income was 60% or more. The only exception to the rule was ZIS, where the contribution of pensions to gross cash household income was 48%. However, at ZIS mean total household income was considerably less than at other schemes. It should be noted that the problem of households not revealing all their sources of income to the enumerators was especially prevalent at ZIS. Accepting that in reality the overall contribution of remittances is probably higher than suggested by the data in Table 5.1.3.1, it is expected that the actual proportional contribution of pensions to household income is less than shown in Table 5.1.3.1. However, the actual contribution of pensions to household income at the schemes is still expected to be very high, compared to other areas of South Africa. The same appears to apply to rural areas surrounding the schemes. For example, in three villages located on the plateau overlooking Tyefu Irrigation Scheme, Ainslie and Ntshona (1997) found that 65,3% of the 175 rural households that were interviewed identified State transfers (old-age pensions and disability grants) as their main source of income. South Africa's well functioning social pension system is unique among developing countries. It has high coverage in the rural areas and claiming rights from the state in the form of pensions and disability grants is of critical importance to rural household income (May, 1996). Nationally, claims against the state contribute 30,8% to rural household income (May, 1996). The data obtained by the present study suggests that amongst food plot holding households that contribution is considerably higher than the national average.

The overall contribution of irrigated crop production to gross cash household income was 11%. On schemes with small plots (0,25ha or less) its contribution ranged from 2,8% at KIS to 12,7% at ZIS. From the data it would appear that irrigated crop production on small plots, i.e. on food plots *sensu stricto*, contributes to gross cash household income in a minor way only, as was envisaged in the concept of the food plot. At schemes with large plots, irrigated crop production was clearly an important source of income, contributing 27,4% to mean household income at HAIS where plots are 1ha in size and 56,9% at HOIS where households have access to 2ha plots. These observations suggest that the contribution made by irrigated crop production to the gross cash income of plot holding households is positively related to the area of irrigable land to which the households have access.

It can be concluded that on all the schemes irrigated crop production played a role in the packaging of livelihoods by plot holding households. Where plots were small, households appeared to rely mainly on state transfers, wages and salaries for their livelihood and the contribution of crop production was found to be minor. When size of plots was increased, the relative importance of crop production in the livelihood package appeared to increase also, with agriculture constituting the main source of gross cash household income at HOIS, where plots were largest.

Table 5.1.3.1. Mean gross cash income of food plot holding households at six irrigation schemes in central Eastern Cape.

Income Sources (Rand)	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Food plot	183(3.7)	170(3)	300(6)	2842(27.5)	5193(57)	435(13)	635(11)
Remittance	72(1.5)	0	0	0	0	0	73(1)
Rental payment	4(.1)	0	72(1.5)	0	0	0	16(.3)
Income in kind	4(.1)	180(2)	0	0	0	0	32(.7)
Pension	3 000(61.6)	3600(59)	3432(74)	2856(27.5)	768(8.4)	1656(48)	2980(52)
Other	1680(33)	2100(36)	852(18.5)	4680(45.0)	3168(34.6)	1344(39)	1982(35)
Total	4870	6050	4656	10378	9129	3435	5717

NOTE: Figures in parenthesis are percentage contribution of income sources to the total mean annual income.

The distribution of food plot holders according to gross cash income derived from irrigated crop production is presented in Table 5.1.3.2

As was expected, at all schemes where households had access to small plots with a size of 0,25ha or less, the majority (80% or more of respondents) reported to derive a gross cash income less than R700 per annum from irrigated crop production or did not know its annual cash contribution to household income. Where plots were large (HAIS and HOIS) two thirds of respondents reported to derive more than R700 per annum. This finding confirms the general positive relationship between income derived from irrigated crop production and plot size.

Table 5.1.3.2. **Distribution of food plot holders at six irrigation schemes in central Eastern Cape according to estimated gross cash income derived from irrigated crop production (n=269).**

Income Range (Rand)	% of Food Plot Holders in					
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13
Do not know	59.62(93)	46.67(14)	51.52(17)	16.67(5)	16.67(1)	23.08(3)
1-100	5.12(8)	13.33(4)	6.06(2)	0.00	0.00	7.69(1)
101-200	7.69(12)	6.67(2)	3.03(1)	0.00	0.00	0.00
201-300	9.61(15)	13.33(4)	3.03(1)	0.00	0.00	7.69(1)
301-400	3.21(5)	3.33(1)	3.03(1)	3.33(1)	16.67(1)	7.69(1)
401-500	3.21(5)	6.67(2)	9.09(3)	6.66(2)	0.00	7.69(1)
501-600	1.28(2)	3.33(1)	6.06(2)	0.00	0.00	7.69(1)
601-700	1.92(3)	0.00	0.00	6.66(2)	0.00	23.07(3)
701-800	1.92(3)	0.00	3.33(1)	3.33(1)	0.00	0.00
801-900	1.28(2)	3.33(1)	0.00	0.00	0.00	0.00
901-1 000	1.92(3)	3.33(1)	9.09(3)	3.33(1)	0.00	0.00
> 1 000	3.20(5)	0.00	6.06(2)	59.99(18)	66.68(5)	15.38(2)
Mean gross cash income	183	170	300	284	605	435

<u>NOTE</u>: Figures in parenthesis indicate the actual number of food plot holders in that particular income range.

5.1.4 Spending patterns

An analysis was made of the expenditure of households at each of the six irrigation schemes. Generally, household expenditure matched household income reasonably closely and differences between schemes in mean gross cash household income were also reflected in household expenditure.

Overall, food and groceries was the main expenditure category of responding households, constituting 57,3% of total household expenditure. The large proportion of household income that is being spent on food and groceries by plot holding households indicates that irrigated food plot production does not enable households to subsist on plot produce only. There was a tendency for the proportion of household income spent of food and groceries to be reduced as household income increased. Other important household expenditure categories were furniture (10,2%), home maintenance (9,0%) and clothing (6,8%). These findings are similar to those reported by Fabricius and McWilliams (1991) for rural households in five magisterial districts of Ciskei, where food and groceries constituted 59,8% of household expenditure, furniture 10,0% and clothing 7,2%.

Table 5.1.4.1. Mean household expenditure per expenditure category of plot holding households at six irrigation schemes in central Eastern Cape.

Expenditure categories	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Food & Groceries	2760 (63)	3288(76)	2844(49)	3528(51)	3780(35)	1752(64.6)	2892(57)
Water	0	0	0	0	0	0	0
Electricity	0	0	0	0	0	0	0
Telephone	0	0	0	67(1.0)	0	0	67(1.3)
Clothing	396(9)	120(3)	300(5)	372(5)	264(2.6)	0	345(6.8)
Bond & Rent	30(0.7)	0	0	0	0	0	30(.6)
Medical Drugs	228(5)	84(2)	168(3)	228(3)	864(8)	276(10)	223(4.4)
Furniture	372(8.5)	336(8)	528(9)	960(14)	3000(28)	228(8.4)	514(10.2)
Agricultural Input	168(3.8)	0	96(1.6)	816(12)	2088(19.6)	0	303(6)
Home Maintenance	206(4.7)	285(6.6)	1789(31)	630(9)	93(0.9)	188(7)	452(9)
Education/Child	131(3)	0	40(0.7)	133(2)	279(2.6)	210(8)	127(2.5)
Clinic OPD	35(0.8)	0	40(0.7)	47(0.7)	279(2.6)	31((1)	44(.9)
Social travel	52(1.5)	18(0.4)	20(0.3)	102(2.3)	79(0.7)	27(1)	49((1)
Total	4378	4339	5825	6883	10726	2712	5046

NOTE: Figures in parenthesis are percentage contribution of expenditure item to the total mean annual expenditure.

Stated expenditure on agriculture (inputs) constituted 6,0% of household expenditure and was considerably higher at schemes with large plots (11,9% at HAIS and 19,5% at HOIS) than was the case at schemes with small food plots (0,25 ha or less). The difference in the actual amounts of money spent on agricultural inputs at the schemes with large plots, relative to the schemes with small plots, is not explained merely by a difference in plot size. It also suggests that farming on large plots involves a different type of farming system from that on small plots, whereby farming at schemes with large plots relies more heavily on external (purchased) inputs.

Food plot holders were asked if they had any savings (see Table 5.1.4.2), and if they had, where these savings were kept (see Table 5.1.4.3). About 20% of households on schemes with small plots kept savings. The exception was ZIS where none of the respondents reported saving money. ZIS was also the scheme where household income was lowest of all. At schemes with large plots the proportion of households with savings was higher. At HAIS, where the plots are 1ha in size, 30% of respondents kept savings. This increased to 57% at HOIS, where the plots are 2ha. It would appear that there was a positive relationship between plot size and saving. Formal institutions such as banks, building societies and life assurance companies were found to hold most of the savings of food plot holders.

Table 5.1.4.2. Saving by food plot holding households at six irrigation schemes in central Eastern Cape.

Response	% of Food Plot Holders						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Do not know	0.00	3.33	0.00	0.00	0.00	0.00	0,4%
Will not answer	0.64	0.00	0.00	0.00	0.00	0.00	0,4%
Yes	18.59	23.33	30.30	20.00	57.14	0.00	20,8%
None	80.77	73.33	69.70	80.00	42.86	100.00	78,4%

Table 5.1.4.3. Types of savings held by food plot holders at six irrigation schemes in central Eastern Cape.

Types of saving	% of Respondents						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
No savings	81.41	76.67	69.70	80.00	42.86	100.00	78,4%
Formal institution (bank, trusts)	17.31	20.00	30.30	20.00	57.14	0.00	19,7%
Informal institution (stockvel)	0.64	0.00	0.00	0.00	0.00	0.00	0,4%
Society (burial)	0.00	3.33	0.00	0.00	0.00	0.00	0,4%
Other	0.64	0.00	0.00	0.00	0.00	0.00	0,4%

5.1.5 Major felt household and community needs, and the main constraints affecting irrigated food plot production.

The major felt household and community needs and the main constraints affecting irrigated food plot production were investigated at all six schemes. The question aimed at identifying constraints related to food plot production preceded those on household and community needs. As a result, the needs related to plot production (problems and constraints and the need for solutions) were identified first. Thereafter, respondents considered the needs related to food plot production as having been dealt with. This explains why respondents did not identify food plot related issues when stating their major community and household needs.

5.1.5.1 Major household needs: The major household needs stated by food plot holders at the six irrigation schemes are presented in Table 5.1.5.1. Respondents were asked to state their three major household needs. Only those household needs identified by at least 10% of the total number of respondents appear in Table 5.1.5.1. Many of the needs were found to relate to quality of life in general and life around the house in particular. Proper housing, water taps, electricity and furniture all contribute to the achievement of a good standard of living, free from the inconveniences of fetching water at a far away source, repairing rain-damaged mud walls, collecting firewood and not having a decent place to sit or sleep. Amongst local rural households the need for livestock often relates to a need for security. Livestock is a multi-purpose asset which can be sold in times of need. The need for money for education is evidence that parents consider education as a possible way out of poverty.

Table 5.1.5.1 Major household needs of respondents at the six irrigation schemes in central Eastern Cape.

Needs	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Proper housing	54%	47%	45%	70%	57%	62%	54%
Livestock	17%	20%	30%	43%	14%	38%	23%
Electricity	19%	27%	36%	13%	29%	23%	22%
Furniture	26%	3%	9%	30%	0%	23%	21%
Water taps	16%	27%	21%	16%	0%	31%	18%
Money for education	17%	17%	15%	23%	14%	8%	17%
Tractor	2%	0%	6%	0%	29%	8%	3%

5.1.5.2 Major community needs: Community needs were identified and presented in Table 5.1.5.2 using the same procedure as used for household needs. Water and electricity again featured on top of the list of needs, indicating that rural households wish to see an improvement in rural infrastructure, as are the need for schools, clinics, better roads and telephones. It would appear that infrastructure at the schemes is inadequate to provide rural households with access to an acceptable standard of life. The availability of an adequate infrastructure in rural areas was one of the factors identified by Lipton (1996) as being necessary to enable the emergence of a vibrant small scale agricultural sector.

Table 5.1.5.2. Major community needs at six irrigation schemes in central Eastern Cape.

NEEDS	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Water taps	35%	37%	55%	67%	57%	54%	43%
Electricity	26%	87%	58%	43%	71%	31%	40%
Schools	19%	0%	0%	30%	29%	23%	16%
Jobs	20%	13%	3%	10%	0%	15%	15%
Clinics	17%	7%	0%	30%	0%	8%	14%
Road reconstruction	16%	3%	18%	7%	0%	31%	14%
Telephones	10%	17%	6%	3%	29%	15%	10%
Proper housing	10%	3%	0%	17%	14%	0%	8%
Fencing of grazing camps	0%	3%	18%	0%	14%	23%	10%

5.1.5.3 Problems and constraints in irrigated food plot production: Within the 1995/96 set of institutional arrangements at the schemes, inadequate access to proper and timely land preparation services was the most prevalent constraint, affecting plot holders at all schemes, but especially at ZIS, KIS and HAIS. Delayed availability of tractors caused farmers to plant late or on occasions not to plant at all, contributing to extended fallow periods. The decline in the quality of land preparation services offered by Ulimocor managed schemes is partly due to the precarious financial status in which the parastatal has found itself since 1994. Inadequate budgetary allocations have interfered with tractor maintenance and replacement requirements, resulting in frequent breaking down of the machinery. It is expected that this problem will become more acute when Ulimocor is closed and the schemes are handed over to farmers and other stakeholder groupings.

Water related constraints were also identified. Breaking down of irrigation pumps delaying irrigation was a constraint identified mainly by HAIS farmers, who are using very old pumping equipment. TIS also appears subject to water supply problems, especially the Ndwayana section, where water is pumped into a small concrete reservoir, limiting the reserve supply at times of engine trouble.

At all schemes a minority of farmers identified the ineffectiveness of the available insecticides as a constraint. Theft of produce is a major constraint at SIS situated close to the Sada urban settlement.

Table 5.1.5.3 Main problems and constraints related to food plot production at six irrigation schemes in central Eastern Cape.

Problem	TIS n=156	KIS n=30	SIS n=34	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Delays in ploughing	46%	83%	45%	73%	14%	100%	55%
Improper soil preparation	27%	0%	6%	7%	0%	0%	17%
Insecticides not strong enough	19%	3%	9%	13%	29%	8%	15%
Engine breakdown delays irrigation	17%	0%	3%	27%	14%	0%	14%
No extension service	22%	7%	0%	0%	0%	0%	14%
Water shortage	17%	13%	0%	13%	0%	0%	13%
Improper management water supply	13%	0%	6%	30%	0%	0%	12%
Theft	1%	3%	61%	3%	14%	0%	9%
No market place	1%	17%	27%	13%	0%	0%	7%
Poor soil	6%	3%	9%	3%	14%	0%	6%
No transport to market	2%	7%	0%	23%	0%	0%	5%

5.2 ASSESSMENT OF IRRIGATED FOOD PLOT PRODUCTION SYSTEMS

5.2.1 LAND USE AND LAND USE INTENSITY

5.2.1.1 Land use: At all six schemes irrigated plots are used for the production of crops for human consumption only. Fiber and other industrial crops or crops that are primarily used for animal fodder are not grown. The range of crops is limited and is focused on products which feature prominently in the diet of local black people and for which the general demand is high and sustained. It mirrors that grown locally under rainfed conditions in fields and home gardens (ARDRI, 1996). These crops consist of what could be termed field crops (maize, pumpkin and potatoes) and vegetables (cabbage, beetroot, carrots and spinach). All crops are grown under irrigation. Rainfed production on parts of the plots is not practised, the growing of peach trees on plot boundaries at SIS being the only exception.

5.2.1.2 Land use intensity: Land use intensity is the ratio obtained by dividing the area of land under crops over a full year by the total area of land, expressed as a percentage. It is generally accepted that when climatic conditions are favourable (relatively warm temperatures) double cropping of an irrigated area of land is possible (two crops per year on the same area of land). By making use of suitable cropping sequences, local climatic conditions should permit for land use intensities of 150 to 200%.

Land use intensity was determined by means of three procedures. The first procedure involved a field survey conducted during the 1996 summer season at all schemes and during the winter of 1995 at TIS only. To determine the land use intensity by means of field observations, the ratio between the area of land cropped in winter and that of land cropped in summer was determined at TIS. This ratio was found to be 58,9%, meaning that the total area under crops in winter was 58,9% of that under crops in summer. The same ratio was applied to the other schemes (multiplying the area under summer crops by 58,9%) to determine the area under crops in winter, thus enabling an estimation of land use intensity. The second procedure involved asking respondents directly what area of land they plant in summer and in winter. Lastly land use intensity was estimated indirectly from questions directed at finding out from respondents what areas they had planted to each of the crops during the previous year. The results of this analysis are presented in Table 5.2.2.1.

Table 5.2.1.1. Land use intensity at six irrigation schemes in central Eastern Cape using three different procedures.[1]

Procedure	TIS	KIS	SIS	HAIS	HOIS	ZIS	All
Field observations and interpolation	92%	98%	113%	92%	55%	66%	94%
Direct question	133%	167%	156%	125%	107%	181%	140%
Indirect estimate	120%	78%	100%	74%	45%	113%	105%
Mean	115%	114%	123%	97%	69%	120%	113%

Estimates based on field observations showed land use intensities to range between 55% at HOIS and 113% at SIS. Direct questions about land use intensities resulted in estimates that were considerably higher ranging from 107% at HOIS to 181% at ZIS. Estimates of land use intensity based on respondent's recollection of what areas were planted to each crop were fairly similar to those based on field observations and ranged between 45% at HOIS and 120% at TIS.

[1] Under local irrigated conditions it is possible to grow two crops per year, which would result in a land use intensity of 200%. Land use intensities less than 150% are, therefore considered to be an indication that irrigated land is not used as intensively as could be.

Irrespective of the methods used, the results show that irrigation land is not used as intensively as could be. The land use intensity at schemes where plots are 0,25ha or smaller in size (TIS, SIS, KIS and ZIS) was generally higher than at those where plot size was 1 ha (HAIS) and 2 ha (HOIS). This would suggest that for many participating farming households plots of 1 ha or more are too large to handle within the constraints of their current farming system. However, as is shown in Table 5.2.2.1, farmers on large plots tend to grow more high-value cash crops, such as cabbage, than is the case on small plots, where maize is the most common crop. At all schemes there is potential to increase the use intensity of land. This may require the introduction of alternative crops and cropping patterns.

5.2.2 Choice of crops and cropping sequences

As was indicated in section 5.2.1.1, the range of crops grown on irrigated plots was found to be limited. The proportional areas assigned to each crop at each of the schemes as derived from responses to the questionnaire survey are presented in Table 5.2.2.1 and those based on field observations during the 1995/96 summer season in Table 5.2.2.2.

Table 5.2.2.1 Proportional area assigned to each of the crops grown on irrigated food plots at six irrigation schemes in central Eastern Cape based on questionnaire responses.

CROP	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Maize	50,4%	61,2%	40,0%	8,1%	0,0%	35,0%	43,6%
Cabbage	28,6%	12,8%	24,0%	36,6%	86,7%	12,0%	27,9%
Potatoes	18,5%	25,5%	32,0%	35,2%	0,0%	35,0%	23,1%
Beetroot	0,5%	0,1%	0,8%	1,4%	5,6%	9,0%	1,1%
Carrots	0,2%	0,1%	0,8%	1,4%	4,4%	0,0%	0,5%
Spinach	0,6%	0,1%	0,8%	0,5%	3,3%	0,0%	0,6%
Onion	1,0%	0,1%	0,8%	0,5%	0,0%	0,0%	0,7%
Pumpkin	0,2%	0,1%	0,8%	16,3%	0,0%	9,0%	2,5%

Table 5.2.2.2 Observed proportional area assigned to each of the crops grown during summer on irrigated food plots at six irrigation schemes in central Eastern Cape (summer season of 1995/96).

CROP	TIS	KIS	SIS	HAIS	HOIS	ZIS	All
Maize	74,4%	88,6%	90,3%	15,0%	0,0%	86,0%	64,7%
Cabbage	15,2%	2,0%	4,4%	73,5%	85,8%	9,0%	25,7%
Potatoes	7,9%	8,0%	4,4%	11,0%	0,0%	0,8%	7,0%
Beetroot	0,1%	0,4%	0,0%	0,0%	9,7%	1,7%	0,7%
Carrots	0,4%	0,6%	0,0%	0,0%	3,5%	0,0%	0,5%
Spinach	0,0%	0,2%	0,0%	0,0%	1,0%	0,0%	0,1%
Onion	2,0%	0,0%	0,0%	0,0%	0,0%	0,0%	1,0%
Pumpkin	0,0%	0,2%	0,9%	0,5%	0,0%	2,5%	0,3%

The results presented in Tables 5.2.2.1 and 5.2.2.2 show that between 90 and 95% of cropped land is planted to three crops only, namely maize, cabbage and potatoes. At schemes where the plot sizes are small (0,25ha or less) maize is by far the most important crop in terms of area planted. Where the plot size is larger, cabbage is more important. Nearly all other crops are grown on small patches only. Field observations indicated that at schemes with standard food plots farmers either practice a rotation of cabbage followed by maize, potatoes, maize and back to cabbage or monoculture maize on part of the land and a rotation of potatoes and cabbage on the rest. The high aerial proportion planted to maize during the 1995/96 season (see Table 5.2.2.2) relative to the results presented in Table 5.2.2.1, may be in response to a scaling down of farmer support services at many of the Ulimocor managed schemes, preventing farmers from accessing the necessary production inputs (potato seed and cabbage seedlings) to plant the desired areas to cabbage and potatoes.

5.2.3 Inputs and costs

5.2.3.1. Introduction: The data set that was obtained by means of the questionnaire survey was insufficiently detailed to enable a reasonably accurate assessment of operating costs holders of irrigated food plots incur. Therefore, it was decided to work with a standard set of operating costs for each crop at each of the schemes. These standard sets of operating costs were derived from data obtained from scheme management and service providers and responses from food plot holders.

5.2.3.2. Operating costs: Standard sets of operating costs for maize, cabbage and potatoes, the three major crops, are presented in Tables 5.2.3.1, 5.2.3.2 and 5.2.3.3 respectively. The data apply to the 1996 production season. A summary of total operating costs for all crops grown at the six schemes is presented in Table 5.2.3.4. The data presented in Table 5.2.3.4 were used in the financial analysis of food plot production presented in section 5.6. The reader is referred to Appendix B for details on the way in which these total cost estimates were derived. Some operating costs were not brought into account. Omitted were cost of water and hired labour. The cost of packaging of certain crops was also not taken into account fully (see Appendix B for details).

Table 5.2.3.1. Operating costs for maize (R per ha) at six irrigation schemes in central Eastern Cape (1996 production year).

Input	TIS	KIS	SIS	HAIS	HOIS	ZIS	Mean
Seed	306	196	196	196	-	196	218
Fertiliser	789	236	740	346	-	236	469
Mechanical operations	235	300	0	320	-	400	314
Pesticides	336	160	26	153	-	160	167
Total	1666	892	962	1015	-	992	1105

Table 5.2.3.2. Operating costs for cabbage (R per ha) at six irrigation schemes in central Eastern Cape (1996 production year).

Input	TIS	KIS	SIS	HAIS	HOIS	ZIS	Mean
Plant material	2200	2400	2000	3250	1250	2400	2250
Fertiliser	1754	235	740	414	2278	236	420
Mechanical operations	235	300	-	320	423	400	336
Pesticides	996	180	38	259	888	180	388
Packaging	83	85	85	85	85	85	85
Total	5268	3200	2863	4328	4924	3301	4046

Table 5.2.3.3. Operating costs for potatoes (R per ha) at six irrigation schemes in central Eastern Cape (1996 production year).

Input	TIS	KIS	SIS	HAIS	HOIS	ZIS	Mean
Plant material	1045	672	4640	4640	-	672	2289
Fertiliser	1334	236	740	379	-	236	585
Mechanical operations	235	300	-	320	-	400	314
Pesticides	1730	180	-	358	-	180	612
Packaging	69	-	69	69	-	-	69
Total	4413	1388	5449	5766	-	1488	3869

Table 5.2.3.4 Total operating costs (R per ha) for crops grown by food plot holders at six irrigation scheme in central Eastern Cape (1996 production year).

CROP	TIS	KIS	SIS	HAIS	HOIS	ZIS	Mean
Maize	1666	892	962	1015	-	992	1219
Cabbage	5268	3201	2863	4328	4924	3301	4115
Potatoes	4413	1388	5449	5766	-	1488	3741
Beetroot	1234	746	950	668	2925	846	1423
Carrots	1150	662	866	584	2840	772	1340
Spinach	1392	904	1108	688	5361	1004	1938
Onion	1269	781	985	565	-	881	1010
Pumpkin	1129	640	845	687	-	741	922

Operating costs varied widely amongst schemes. They were highest at HOIS, because of the high levels of inputs that are being maintained at that scheme. Input costs at KIS were generally lowest of all, and in reality, they are probably even lower than is presented in Table 5.2.3.4, because many plot holders have replaced chemical fertilisers with manure and some have converted to open pollinated varieties of maize, using their own seed selection to plant, thus avoiding the costs attached to the purchase of fertilisers and hybrid seed.

5.2.4 Amount and division of labour

5.2.4.1 Introduction: An important factor that influences economic activity is the return on labour invested. Some authors argue that in the developing areas of Africa, including South Africa, there is an ample supply of labour, but a lack of opportunities to use this labour productively. As a result, labour is cheap. Others suggest that the availability of labour in the rural areas of South Africa is actually very limited, because the *de facto* resident population consists mainly of children, women and elderly people. A large proportion of the *de jure* local active male population of the area lives and works elsewhere, where opportunities for employment are more abundant and the return on labour more rewarding.

Irrigated food plot production presents participating households with an opportunity to invest their available labour productively. Work conducted in rural locations of the former Ciskei (see section 2.6) found that most farming activities were conducted by women and the elderly, and that young able-bodied men were seldomly active in farming. The present study investigated the labour distribution in irrigated food plot production. An attempt was made to determine which production activities are most demanding in terms of labour and to quantify the amount of labour that is expended on the food plots by plot holder families and hired labour. Finally, the importance and cost of hired labour in irrigated food plot production was determined.

5.2.4.2Assignment of labour in irrigated food plot production by plot holding households. The distribution of labour in the food plot schemes was assessed by asking respondents who in the household does most of the work on the plots. The responses are presented in Table 5.2.4.1.

Table 5.2.4.1. Sources of labour used by plot holders at six irrigation schemes in central Eastern Cape.

Source of labour used	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Husband	34%	24%	61%	63%	0%	54%	39,5%
Wife	48%	43%	15%	23%	0%	23%	38,1%
Husband & wife	6%	10%	9%	7%	57%	0%	8,0%
Children	9%	10%	0%	0%	14%	23%	7,8%
Relatives	1%	13%	3%	0%	0%	0%	2,4%
Hired labour	2%	0%	6%	7%	29%	0%	3,4%

The division of labour within the family differed from scheme to scheme. However, over all schemes, most work on the plots was done by either husband (39,5%), wife (38,1%) or a combination of both (8,0%). Responsibility for irrigation of the crops is also shared mainly by husband and wife, as can be seen from Table 5.4.2.2. At four of the six schemes children were found to contribute significantly to food plot production, but overall the contribution by children appeared to be considerably smaller than that of their parents. Hired labour was an important source of labour at HOIS only. This is most likely the case because of all schemes included in this study HOIS has the largest plots and production is predominantly sales oriented. Characteristic also for HOIS is the predominance of husband & wife combinations doing most of the work on the plots, confirming the finding that at HOIS households consider agriculture as their main economic activity (see section 5.1.3).

Generally the results do not conform with the image of crop production being a female dominated activity in farming by Africans in the Eastern Cape. The responses indicated that women do most of the work at TIS and KIS and men at SIS, HAIS and ZIS. Several reasons could be responsible for this anomaly. In order to understand men's and women's different roles it is essential to do a gender analysis. A gender analysis is the qualitative and quantitative dis-aggregation by gender of activities, resources and constraints, benefits, and participation in project activities, (Saito and Spurling, 1992). In the current study no attempt was made to obtain quantitative information with respect to division of labour within the household as pertaining to small scale agricultural activities. As a result, the questionnaire that was used in the survey was not gender sensitive. Absent from the questionnaire were questions on work patterns of household members. There were no questions directed at finding out gender related aspects. The study did not involve active recording of observations by researchers. As a result, the data obtained may not reflect the true situation. Furthermore, on average only one third of respondents was female and two thirds male (see Table 5.1.1.3), which may have resulted in gender bias in the responses, exaggerating the importance of men. Even though that may be the case, there are a number of factors related to irrigated agriculture, which may result in gender patterns that differ from those applying to rainfed agriculture. The introduction of specific farmer support services such as private extension, input delivery, access to credit, the promotion of specific enterprises or technologies (such as irrigation) may have different impacts on male and female farmers, (Saito and Spurling, 1992). It is also possible that the introduction of irrigated plots necessitated a shift in the traditional division of labour, because of the specific requirements of irrigation farming. At TIS and KIS plots are small and most of the work can still be handled by women. At HOIS and HAIS plots are quite large demanding more male involvement. Irrigated agriculture is usually also more intensive than rainfed farming and the level of inputs tend to be higher. As a result, farmers have to generate economic returns by producing higher yields and that inevitably creates a greater demand for labour, encouraging males to become more involved. At all irrigation schemes use is made of tractors, generally regarded as a male province. When mechanised agriculture is promoted, women are typically marginalized, because male farmers suit the criteria of farmer selection.

Table 5.2.4.2. Sources of labour used for irrigation by plot holders at six irrigation schemes in central Eastern Cape.

Source of labour	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Husband	38%	10%	61%	73%	43%	54%	42,5%
Wife	45%	50%	30%	13%	43%	15%	38,6%
Children	4%	10%	0%	3%	0%	8%	4,1%
Relatives	1%	7%	0%	3%	0%	0%	1,7%
Other	10%	23%	3%	7%	14%	23%	11,0%
No answer	1%	0%	6%	0%	0%	0%	1,3%

5.2.4.3. Relative labour demand of different food plot production activities:
Respondents were asked which food plot production activity they consider most demanding in terms of labour. Responses are presented in Table 5.2.4.3.

Table 5.2.4.3. Production activity identified by holders of irrigated food plots at six schemes in central Eastern Cape as being the most labour demanding.

Activity	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Ploughing	4%	0%	0%	0%	0%	0%	2,3%
Planting	5%	3%	3%	3%	0%	8%	4,3%
Irrigation	7%	3%	3%	0%	0%	0%	4,7%
Weeding	74%	90%	88%	87%	100%	90%	80,4%
Spraying	4%	0%	0%	0%	0%	0%	2,3%
Harvesting	4%	0%	0%	10%	0%	0%	3,4%
Don't know	5%	3%	6%	0%	0%	0%	4,0%

Eight out of ten respondents (80,4%) single out weeding as the activity demanding most labour. Differences between schemes were minor. Most weed control in food plots is conducted by means of hand-hoeing. Even at HOIS, where the application of pre-emergence weedicides is common practice, respondents appear to spend a major part of their time hoeing weeds.

5.2.4.4. Amount of time assigned to work on food plots: Respondents were asked how many hours were spent weekly working on the plots in summer and in winter. A summary of the responses is presented in Table 5.2.4.4

Table 5.2.4.4. Number of hours per week plot holders at six irrigation schemes in central Eastern Cape spent on plot activities during winter and during summer.

Season	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Summer (hrs)	38,3	42,4	37,9	47,2	39,6	46,5	40,1
Winter (hrs)	28,0	24,0	28,6	26,1	39,2	27,3	27,7
Mean (hrs)	33,2	33,2	33,3	36,6	39,4	36,9	33,9
Estimated total number of hours per annum	1724	1727	1729	1905	2047	1919	1763
Estimated total number of 8 hr days per annum	216	216	216	238	256	240	220

The results presented in Table 5.4.2.4 suggest that food plot production is more or less a full time activity for at least one person in the household. Interestingly, plot size appeared to have little influence on the time plot holders said to be spending on the food plots. Plot holders at HOIS, where plots are 2ha, were found to spent an mean of 6 hrs per week more on their plots than plot holders at TIS, where the weighted mean plot size was smallest (0,1882ha). Furthermore, the number of hours plot holders at TIS and HOIS spent working on their plots during the summer season was nearly the same. At some schemes, such as ZIS and HAIS, plot holders were found to spend more time in the field during summer than at HOIS. The major difference between HOIS and the other schemes is that the amount of time spent in the field during summer and winter is approximately the same at HOIS, whereas at the other schemes winter cropping appeared to require about one third less time than summer cropping. This is not surprising, since the area under crops during winter was found to be about 60% of that under crops during summer.

Not all time spent on plot activities is necessarily allocated to production. In some cases a considerable amount of time may be spent on travelling between homestead and plot and on transporting produce from plot to homestead (see also section 5.4.6.2).

None of the respondents had a particular time of the day (e.g. morning or afternoon) assigned to working on the plots.

5.2.4.5 Use of hired labour in food plot production: Respondents were asked for which activities they hired labour and for how many days labour was hired for. Responses are presented in Table 5.2.4.5.

Table 5.2.4.5. Proportion of plot holders at six irrigation schemes in central Eastern Cape who hire labour for a particular food plot production activity, and the number of days labour is hired for.

Operation	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Irrigation	3%	0%	3%	3%	0%	0%	2,4%
number of days	1,25	0	1,00	1,00	0	0	0,96
Land preparation	3%	3%	3%	0%	14%	0%	2,8%
number of days	2,39	1,00	1,00	0	1,00	0	1,65
Planting	8%	0%	12%	3%	29%	23%	8,3%
number of days	1,67	0	1,25	1,00	1,50	1,00	1,32
Weeding	14%	3%	61%	10%	71%	31%	20,4%
number of days	3,79	1,00	4,37	3,00	7,20	1,75	3,45
Spraying	3%	0%	3%	3%	0%	0%	2,4%
Number of days	1,20	0	1,00	2,00	0	0	1,04
Fertiliser application	2%	0%	3%	0%	14%	0%	1,9%
number of days	1,33	0	1,00	0	1,00	0	0,92
Harvesting	8%	3%	24%	10%	29%	31%	11,3%
number of days	2,31	1,00	1,38	7,00	2,00	1,75	2,53
Average total number of hired labour days per plot holder	1,02	0,09	3,27	1,12	6,41	1,32	1,21

Hiring of labour occurred at all schemes, but was most prevalent at HOIS. In order of importance weeding, planting and harvesting were the activities for which most hired labour was engaged. On average plot holders hired labour for 1,2 days per year. At HOIS the average was 6,4 days. It follows that irrigated food plot production is an activity which involves the plot holder family mainly and which does not make an important contribution to the generation of employment outside the family.

5.2.4.6 Daily rates paid to labour hired by holders of irrigated food plots to work on the plot: Respondents were asked how much money they pay per day to a worker assisting them with production activities on their food plot. Responses are presented in Table 5.2.4.6.

Table 5.2.4.6. Daily rates paid by food plot holders at six irrigation schemes in central Eastern Cape to hired labour assisting them with production activities on the plot.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Daily rate (R/day)	12,36	20,00	13,04	11,66	11,84	10,83	13,13
No response (%)	78%	90%	67%	80%	14%	54%	75,4%

Daily rates paid by plot holders to hired labour working on their plot were found to range between R2 and R32. Scheme means ranged between R10 and R20. At HOIS where hiring of labour is common practice, the Section manager claimed that daily rates were R7 for a normal day's work, which would be increased to R8 or R9 when overtime was required. The mean daily rate determined by means of questionnaire responses was R11,66 or 1,67 times the section manager's estimate. Since the section manager of HOIS was quite confident about the reliability of his estimate, it would appear that rates indicated by respondents at HOIS tended to be higher than what is actually paid out by them. If this anomaly would also apply to the other schemes, the overall estimated daily rate paid to hired labour would be about R8.

5.2.4.7Land preparation: Respondents were asked how they prepare the land. Responses are presented in Table 5.2.4.7.

Table 5.2.4.7. Means of preparing land used by holders of irrigated food plots at six irrigation schemes in central Eastern Cape.

Use	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Tractor	99%	93%	100%	100%	100%	92%	98,3%
Hand hoe or spade	5%	0%	0%	0%	0%	15%	3,6%
Oxen	1%	7%	0%	0%	0%	0%	1,4%
Other (horse)	0%	7%	0%	0%	0%	0%	0,8%

From Table 5.2.4.7 it is clearly evident that mechanised land preparation is by far the main method of preparing land for planting. At this stage of their development, plot holders at all six schemes are dependent on the availability of tractors. Over time a conversion to other means of land preparation may be economically advantageous, but this will require a major research, technology development and demonstration effort on the part of suppliers of such services. It is most likely that a sudden withdrawal of tractors from the schemes would result in a major collapse of production on the irrigated plots. Considering the imminent closure of Ulimocor, this threat is very real.

5.2.5. Yields

Mean yields of the three major crops, namely maize, cabbage and potatoes obtained by plot holders at the six irrigation schemes are presented in Table 5.2.5.1. Generally, the mean yields were relatively low for irrigated conditions. Cabbage was the exception with yields in some cases approaching what could be considered as on-farm potential and the overall mean being about 75% of on-farm potential. Potato yields were found to be well below potential, probably as a result of low nutrient input and the use of inferior seed at some schemes. The only exception was HAIS where a mean yield of 21 tons per ha was obtained, which is about half of on-farm potential. The overall mean yield of 9,5 tons per ha is about 25% of on-farm potential.

Table 5.2.5.1 Mean yields of maize, cabbage and potatoes (tons per ha) obtained by food plot holders at six irrigation schemes in central Eastern Cape.

Crop	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Maize	4,1	2,3	4,7	3,0	-	3,8	3,77
Cabbage	31,5	34,0	25,0	22,5	25,8	41,5	30,00
Potatoes	9,2	4,6	8,2	21,1	-	4,5	9,58

5.2.6 Use of crops: sales, donations and home consumption

5.2.6.1 Allocation of total annual plot produce to sales, donations and home consumption: Respondents were asked what uses they made of the different crops grown on their plots. For each crop the proportions that were sold, donated to friends and relatives and consumed by the farming household were determined. Using monetary value of the crops (sales price), the allocation of total annual plot produce to sales, donations and home consumption was determined. The results are summarised in Table 5.2.6.1.

Table 5.2.6.1. Mean contribution of sales, donations and home consumption to total net value of crops produced on irrigated food plots at six irrigation schemes in central Eastern Cape.

Use	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Sales	41%	48%	70%	83%	98%	69%	52,9%
Donations	3%	10%	2%	7%	1%	4%	4,1%
Home consumption	56%	42%	28%	10%	1%	27%	43,0%

At all schemes crop produce was sold, consumed at home and donated to friend or relatives, but the proportional allocation differed widely between schemes. Irrespective of the scheme, at least 40% of the produce was sold. TIS was the only scheme where the largest part (56%) of the produce was consumed at home. The proportion of produce consumed at home (42%) was also high at KIS. At the two other schemes with standard 0,16ha-0,25ha food plots, namely SIS and TIS, the proportion of produce that consumed at home was less than 30% of total production, and about 70% was said to be sold. At the two schemes where plots were large, sales dominated even more, with 83% of HAIS produce and 98% of HOIS produce being sold. At socially closely knit communities, such as KIS and HAIS, donations appeared to play a fairly important rôle and a significant part of food plot produce was used as gifts. This could be a indication of the persisting importance of social linkages within contemporary rural African society in central Eastern Cape, where helping community members in times of need was part of the approach to life.

It follows that the benefits derived from irrigated food plot production are multiple and include the generation of cash income, the supply of food to the plot holding household and the maintenance of social linkages through donations. The relative importance of each of these benefits differs from scheme to scheme and appears to be influenced by plot size and socio-economic conditions. Observations made at the schemes also indicated that many food plot holders cart maize stover to their homestead for use as a winter feed.

5.2.6.2 Contribution of irrigated food plot production to household food supply: The supply of food to the plot holding household was the main objective of the designers of food plot schemes. Respondents were asked to indicate the period of time during which they could rely on the harvest from their plot for the consumption of a particular food crop. The responses are summarised in Table 5.2.6.2.

Table 5.2.6.2 Mean number of days plot holding households at six irrigation schemes in central Eastern Cape could rely on the harvest from their plot for home consumption of selected food crops.

Crop	TIS n=149	KIS n=29	SIS n=33	HAIS n=28	HOIS n=7	ZIS n=13	All n=259
Maize	161	234	160	36	17	108	149
Cabbage	46	56	54	50	37	29	47
Potatoes	43	91	53	52	9	58	50
Beetroot	16	40	28	11	34	29	21
Carrots	8	43	17	9	36	62	17
Spinach	19	61	64	21	43	30	31
Onion	17	56	64	9	0	27	27
Pumpkin	26	98	53	27	9	26	37

On average food plot holders produced a substantial amount of their household requirements for a range of food crops. Clear differences between schemes with standard food plots (0,16-0,25ha) and those with large plots emerged. Producing food for the household was an important objective on the schemes with standard food plots, as was also evident from Table 5.2.6.1. Three crops feature prominently in the diet of local people, namely maize, cabbage and potatoes. At KIS and TIS, where a large proportion of the plot produce was used for home consumption (see Table 5.6.1.1), plot holders produced on average enough maize to supply their household for a period of 5 months (TIS) to 8 months (KIS). Differences between these two schemes in the amount of maize produced appeared to be related mainly to the difference in plot size which at TIS (weighted mean of 0,1882ha) was only 75% of that at KIS (0,2500ha). Standard food plots also supplied households with cabbage during a period of 47 days and potatoes during a period of 50 days. Clearly emerging from Table 5.6.2.2 was the difference between standard food plot schemes and those with larger plots, where production was essentially market oriented, i.e. HAIS and HOIS. Despite plots at HAIS and HOIS being several times larger than those at schemes with standard food plots, the amount of food farming households derived from their plots was much less, indicating that supplying the household with home grown produce was not a major motive behind the farming activities of plot holders at HAIS and HOIS.

The actual quantitative contribution of irrigated food plot production to household food supply was determined for the three main crops, namely maize, cabbage and potatoes. The results are summarised in Table 5.2.6.3.

Table 5.2.6.3 Mean quantities of plot produce of maize, cabbage and potatoes plot holding households at six irrigation schemes in central Eastern Cape consume at home.

Crop	TIS n=149	KIS n=29	SIS n=33	HAIS n=28	HOIS n=7	ZIS n=13	All n=259
Maize (kg)	363	260	208	33	0	286	282
Cabbage (kg)	241	155	67	182	52	84	190
Potatoes (kg)	197	90	42	492	0	107	187

Taking into account the results presented in Table 5.2.6.2, plot holding households overall derived the following "average" benefits from their plot with respect to home-grown food: 1,89 kg of maize over a period of 149 days, 4,04 kg of cabbage over a period of 47 days and 3,74 kg of potatoes over a period of 50 days.

Irrigated food plot production did not make plot holding households self-sufficient in terms of their food requirements. Plot holders were asked why they were unable to produce enough food. The responses are presented in Table 5.2.6.4.

Table 5.2.6.4 Reasons offered by plot holders at six irrigation schemes in central Eastern Cape for not being able to produce enough food on their plots to become self sufficient in terms of food.

Reason	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Land too small	23%	47%	27%	33%	0%	46%	28%
Poor soil	17%	13%	9%	0%	0%	8%	13%
Labour scarcity	4%	3%	3%	0%	14%	0%	3%
Lack of knowledge of irrigation	12%	13%	0%	0%	14%	0%	9%
Other	44%	20%	58%	67%	86%	46%	53%

Respondents identified a wide variety of reasons for not being able to supply their households with enough food. Of the options provided by the questionnaire, only the small size of the plots was considered a major cause. Other reasons were institutional and socio-economic. Institutionally, major issues raised were timely access to good quality land preparation services and to a reliable supply of water. In the absence of timely access to the means to prepare plots for planting, the plot may be left fallow until the next planting season. Responses contained in the "other" category show that long fallow periods resulting from not being able to prepare the plot in time was one of the main reasons why plot holders were unable to produce enough food. This confirms the importance of access to the mechanised means of land preparation in the irrigated food plot production systems at the six schemes. In three of the six schemes, namely HOIS, TIS and SIS, land preparation is centrally managed and is a responsibility of Ulimocor. The development of an effective way of transferring tractors from Ulimocor to the schemes will be a determining factor in the immediate future of irrigated food plot production at these schemes following the liquidation of Ulimocor on 31 July 1997. It is expected that over the next few years most food plot holders will either stop producing or produce on small parts of their plot only if they have no access to an effective and affordable mechanised land preparation service. Major socio-economic reasons were the need to sell part or all of the crop, the large size of the household, the lack of money to buy the required inputs that are needed and the theft of produce from the plots.

Food supplied by irrigated crop production was found to be supplemented mainly by buying at local shops (92% of all respondents), from the nearest town (3% of respondents) and from other farmers (2% of respondents).

5.2.6.3 Main uses assigned to the different crops grown on irrigated food plots at six irrigation schemes: The analysis of land use presented in section 5.2.1 showed that on average more than 90% of plot area is used to grow three main crops, namely maize, cabbage and potatoes. The rest of the land was found to be assigned to five vegetables, namely beetroot, carrots, spinach, onions and pumpkins. From section 5.2.6.1 it is evident that at all schemes part of production is grown for home consumption and part for the generation of cash. What remains to be answered is why each of the different crops are grown, i.e. mainly for home consumption or mainly for the market, or do plot holders merely sell the surplus of all the crops they grow. The apportioning of each of the three major crops and the combination of the remaining five vegetables was analysed and the results of this analysis are presented in Tables 5.2.6.5 to 5.2.6.8.

Table 5.2.6.5. Apportioning to sales, donations and home consumption of the maize crop grown by holders of irrigated food plots at six schemes in central Eastern Cape.

Use of maize	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Sales	17%	8%	29%	37%	-	7%	19,3%
Donations	2%	6%	0%	4%	-	3%	2,5%
Home consumption	81%	86%	71%	59%	-	90%	78,2%

Table 5.2.6.6. Apportioning to sales, donations and home consumption of the cabbage crop grown by holders of irrigated food plots at six schemes in central Eastern Cape.

Use of cabbage	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Sales	79%	69%	87%	86%	99%	70%	79,7%
Donations	7%	12%	3%	5%	1%	8%	6,7%
Home consumption	14%	18%	10%	9%	0%	22%	13,4%

Table 5.2.6.7. Apportioning to sales, donations and home consumption of the potato crop grown by holders of irrigated food plots at six schemes in central Eastern Cape.

Use of potatoes	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Sales	53%	52%	86%	83%	-	88%	62,2%
Donations	2%	6%	1%	4%	-	2%	2,6%
Home consumption	45%	42%	13%	13%	-	10%	35,2%

Table 5.2.6.8. Apportioning to sales, donations and home consumption of the combination of five vegetable crops (beetroot, carrots, spinach, onions and pumpkin) grown by holders of irrigated food plots at six schemes in central Eastern Cape.

Use of vegetables	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Sales	47%	40%	67%	74%	89%	65%	53,6%
Donations	3%	11%	3%	5%	4%	5%	4,2%
Home consumption	50%	49%	30%	21%	7%	30%	42,1%

From the data presented in Tables 5.2.6.5 to 5.2.6.8 it appears that plot holders grew different crops for different purposes. Maize was essentially grown for home consumption and on average less than a quarter of the crop is sold. Cabbage, on the other hand, was mainly grown for the market and served primarily as a cash crop. On average only 13,4% of the cabbage grown by plot holders was consumed at home. This would also explain why growers at HOIS focus on cabbage production. Potatoes and vegetables appeared to be multi-purpose crops. On average 35,2% of potatoes and 42,1% of vegetables were consumed by the plot holding household, the rest being sold or given away. Crops that are used as donations to family and friends consisted mainly of perishables, i.e. cabbage and vegetables.

5.3. PLOT HOLDER ASSESSMENT OF PHYSICAL FACTORS INFLUENCING CROP PRODUCTION

5.3.1. Climatic factors

The effect of climate on irrigated food plot production was assessed by asking respondents which elements of the climate at their scheme they perceive as constraints. Climate related constraints identified by respondents are presented in Table 5.3.1.1.

Table 5.3.1.1 Proportion of plot holders at six irrigation schemes in central Eastern Cape who identified specific elements of climate as constraints.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Hail	23%	60%	27%	43%	29%	15%	29,6%
Heat	90%	13%	42%	57%	57%	23%	67,7%
Wind	58%	7%	39%	20%	29%	23%	43,3%
Cold	31%	67%	73%	33%	29%	38%	40,7%

Over all schemes, heat, cold and wind were the main climate constraints identified by respondents. Heat was identified as a constraint by more than half of the respondents at TIS, HAIS and HOIS. TIS is notorious for its high temperatures, which may exceed 40°C. SIS and HAIS are also expected to experience hotter summers than is the case at KIS, ZIS and HOIS. Cold was identified as a constraint by more than half of the respondents at KIS and SIS. Of all schemes under consideration, SIS has the shortest frost-free season, followed by HAIS and KIS. Winters at TIS, ZIS and HOIS are considerably milder.

At TIS more than 50% of respondents identified wind as a constraint. This could be because of its close proximity to the sea.

Generally, hail was not considered a major constraint at most schemes, with the exception of KIS. Incidence of hail increases away from the coast in a north eastern direction. As a result, incidence of hail is expected to be highest at SIS, HAIS and KIS (about 3 to 4 hail events per annum). At TIS, which is relatively near to the coast, the incidence of hail is expected to be the lowest of all schemes.

5.3.2. Soil And Land Factors

As was the case with climate, soil and land factors were assessed by asking respondents which aspect or feature of land they considered to be a constraint in irrigated crop production. Soil and land related constraints identified by respondents are presented in Table 5.3.2.1.

Table 5.3.2.1. Proportion of plot holders at six irrigation schemes in central Eastern Cape who identified soil and land related constraints on their plots.

		TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Soil depth		22%	10%	18%	13%	14%	8%	18,3%
Texture	Clay	49%	3%	18%	30%	29%	31%	36,6%
	Sand	41%	20%	30%	20%	43%	0%	33,0%
Drainage		38%	20%	36%	40%	57%	38%	36,5%
Infiltration		37%	7%	21%	23%	29%	38%	30,0%
Runoff		26%	7%	24%	30%	43%	23%	24,4%
PAWC		47%	23%	30%	17%	43%	15%	37,2%

Over all schemes, farmers did not perceive the quality of their soils to be a major constraint in irrigated crop production. Restricted drainage and high clay content of the soil appeared to be the most important limitations. At HOIS, more than half of respondents identified restricted drainage as a constraint. Visits to the lands showed that ponding was indeed a problem in some lands. Inadequate PAWC resulting in rapid depletion of the available water was identified as a constraint by more than 40% of respondents at TIS and HOIS. However, respondents did not associate low PAWC to shallow soil depth, which is a problem in some parts of TIS.

The general impression that farmers did not perceive production to be affected by major soil and land related constraints was confirmed when farmers were asked to rate the overall quality of the soil on their plots, the results of which are presented in Table 5.3.2.2. A large majority (75,7%) of respondents assessed the quality of their soil as being good.

Table 5.3.2.2. Overall assessment of soil quality on food plots by plot holders at six irrigation schemes in central Eastern Cape.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Good	71%	83%	85%	80%	86%	77%	75,7%
Not good	27%	17%	15%	17%	14%	15%	22,4%
Don't know	2%	0%	0%	3%	0%	8%	1,9%

5.3.3 Constraints related to water quality

Assessment of water quality by respondents is presented in Table 5.3.3.1. Two questions were asked, namely an indirect question (salinity 1) and a direct question (salinity 2). The desk study showed all irrigation waters, with the exception of TIS to be of good quality. At Tyefu, saline Fish river water is used in an undiluted form at the Glenmore and Ndwayana sections, whilst at the other three sections it is diluted with runoff water. Farmers at TIS showed acute awareness of the poor quality of their water, with more than 80% of respondents identifying salinity as a constraint. It also appeared that the quality of water in many of the other Eastern Cape rivers has deteriorated over the past few years, resulting in higher salinity and sodicity levels. A sudden increase in the sodium content of HOIS soils (see also 5.3.4) may have been caused by a deterioration of the quality of Buffalo river water, resulting from an increase in population pressure, increasing the amount of effluent released into the river.

Table 5.3.3.1. Proportion of plot holders at six irrigation schemes in central Eastern who identified water quality as a limitation in irrigated crop production at their scheme.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Salinity 1	82%	23%	39%	53%	57%	38%	64.1%
2	88%	3%	12%	13%	14%	8%	55,0%

5.3.4. Soil fertility and productivity trends

Perceived soil fertility and productivity trends were assessed and responses are presented in Table 5.3.4.1. In Ulimocor managed schemes TIS, SIS, ZIS and HOIS, there has been a transfer of the responsibility of soil nutrient management from scheme to farmers. Farmers are now responsible for the purchase of fertilisers and this may have resulted in a reduction in application rates, explaining the perception of many farmers that soil fertility and productivity has declined over the past years. This perception was most expressed at SIS, TIS and HOIS. At some schemes, actual fertility trends based on soil analysis did indicate a decline in fertility.

For example, SIS management stated that the overall P-content of scheme soils had decreased by about 10ppm over the last 5 years. A recent soil analysis conducted at HOIS did not show any particular nutrient deficiencies, but identified a marked increase in the sodium content of scheme soils. It could be that high sodium levels are affecting the chemical and physical properties of the soils negatively, causing an overall decline in yield. This would explain why farmers at HOIS did not see a reduction in the application rate of fertiliser as being the cause of a perceived decline in productivity. HAIS is a relatively new scheme and over the past two years farmers have invested in fertilisers, explaining their generally positive view on soil fertility and productivity trends. Farming at KIS has been without financial assistance for a long time and the application of kraal manure has become a major way in which farmers replenish soil nutrients.

Table 5.3.4.1. Assessment of soil fertility and productivity trends by plot holders at six irrigation schemes in central eastern Cape.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Declined 1	73%	50%	76%	13%	71%	46%	62,8%
2	62%	27%	55%	17%	71%	31%	51,0%
Improved	20%	33%	18%	47%	29%	38%	25,3%

5.3.5. Pests and diseases: crop damage as a constraint in irrigated cropping

Respondents were asked to assess the impact of a range of possible causes of damage to crops growing on their plots. Their responses are presented in Table 5.3.5.1.

At all the schemes insects and fungal diseases were identified as major pests, which cause reductions in yield. Crop damage by livestock or wild life was not a major constraint at any of the schemes. Birds were identified a presenting a problem at HOIS, TIS and KIS. HOIS is known to have a major problem with geese feeding on the vegetables, especially during the winter months. Small birds feeding on grain crops (maize) were the main bird problem at TIS and KIS.

Table 5.3.5.1. Proportion of food plot holders identifying particular causes of damage to crops as a constraint in irrigated food plot production at six schemes in central Eastern Cape.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Livestock	24%	3%	24%	30%	29%	15%	19,0%
Insects	85%	37%	48%	60%	86%	77%	72,0%
Wild life	12%	3%	0%	13%	0%	0%	8,7%
Birds	73%	90%	30%	20%	100%	46%	63,1%
Fungus	84%	57%	76%	47%	57%	84%	75,2%

5.4. PLOT HOLDER ASSESSMENT OF INSTITUTIONAL FACTORS INFLUENCING IRRIGATED FOOD PLOT PRODUCTION.

5.4.1. Land tenure. land rights and land availability

5.4.1.1 Land ownership

A summary of responses on land ownership is presented in Table 5.4.1.1. High degrees of perceived land ownership by plot holders were recorded at TIS, KIS and SIS and ZIS.

At KIS the land is owned co-operatively, being registered in the name of the 84 land owning families, although three of the farms that form part of the co-operatively owned area are still registered in the names of the previous white owners (which was not known by the farmers).

At TIS the land is tribally owned, with the exception of Glenmore. Traditionally, the Chief would be the custodian of that land. However, most people at Tyefu perceived the plots they have been allocated to be theirs and did not consider the tribe or local Chief to be the owners.

At SIS the land is probably state-owned. When the Scheme was developed, compensation plots were allocated to those families whose land allocations were incorporated into the Scheme and also to people who lost rainfed arable land when Sada township was developed. As a result, most people perceived their plots to be theirs. People without land rights rent plots from the scheme and perceived ownership of the land to be in the hands of the Scheme mainly, most probably because the Scheme has been collecting rent.

At HAIS the land is state-owned. Yet no-one identified the state as the owner.

At HOIS, the land is state-owned also. Recently, some farmers voluntarily returned their plots to the Scheme (in 1996 the Scheme charged R50 per month for holding land, money which is used to pay towards the cost of pumping water and maintain the supply system), which, subsequently, were allocated to other people. This explains why some respondents identified the scheme's management organisation Ulimocor as the owner of the land.

Table 5.4.1.1. Identification of ownership of irrigation plots by plot holders at six irrigation schemes in central Eastern Cape.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Farming family	85%	90%	76%	33%	29%	90%	77,4%
Tribe/Chief	0%	0%	0%	0%	0%	0%	0,0%
Government	1%	0%	0%	23%	0%	0%	3,1%
Scheme manager	0%	0%	15%	0%	0%	0%	1,8%
Ulimocor	4%	0%	0%	23%	29%	0%	5,6%
Dept of Agric.	0%	0%	0%	0%	0%	0%	0,0%
Community	6%	0%	0%	3%	0%	0%	3,8%
Other	5%	10%	9%	17%	43%	8%	8,5%

5.4.1.2 Transferability of land From the responses on transferability of land, shown in Table 5.4.1.2, it is evident that farmers perceive ownership of their plots to be subject to restrictions (limited breadth of rights). However, plot holders appeared not to know the actual breadth of the rights they have over their plots. Transfer of plots within the family is perceived by most farmers as being allowed. Only a very small proportion of food plot holders considered themselves as being free to sell their plot if they wanted to, but restrictions on renting out one's plot appeared to be less severe. At all schemes farmers felt less free to sell or rent their plot to a stranger than to a community member. These findings clearly indicate that there is a need for a clear definition of the breadth of rights that holders have over their plots at the different schemes, and to communicate this to plot holding households.

Table 5.4.1.2. Perceptions of food plot holders at six irrigation schemes in central Eastern Cape about the transferability of their plots (responses indicate that the plot holder feels free to enter into the transaction).

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Transfer to family/friend	56%	73%	67%	73%	43%	62%	61,1%
Sell plot to community member	17%	10%	9%	27%	0%	8%	15,5%
Rent plot to community member	30%	7%	39%	50%	29%	31%	30,8%
Sell plot to stranger	10%	0%	3%	10%	14%	0%	7,6%
Rent plot to stranger	18%	7%	30%	33%	14%	15%	19,7%

5.4.1.3. Adequacy of plot size The assessment by farmers of the adequacy of the size of their plots is presented in Tables 5.4.1.3 and 5.4.1.4.

Generally, farmers assessed their plots to be too small or at best of the right size (see Table 5.4.1.3). Only one respondent considered his or her plot as being too large. The actual size of the plots, which ranged from 0,16ha to 2,0 ha appeared to have little influence on the perceptions of plot holders about the adequacy of the size of their plots. The need for more land appeared more acute in summer than in winter (see Table 5.4.1.4). A high proportion of plot holders expressed an interest in renting or buying additional land.

The interest shown by respondents in acquiring more land contrasts with the relatively low general use intensity of irrigated land at the schemes. It would appear that irrigated land represents more than just a productive asset to rural households. It is may be that irrigated land also adds to the general security of a household, being an asset that could be converted into cash or food through rentals, share crop arrangements and possibly sales, not unlike the security function of livestock (ARDRI, 1996).

Table 5.4.1.3. General assessment of plot size by plot holders at six irrigation schemes in central Eastern Cape.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Actual plot size	0,16-0,25ha	0,25ha	0,25ha	1ha	2ha	0,2ha	0,34 ha
Too big	1%	0%	0%	0%	0%	0%	0,6%
Too small	43%	47%	48%	73%	57%	62%	48,7%
Right size	56%	53%	52%	27%	43%	38%	50,7%

Table 5.4.1.4. Seasonal need for more land and interest in acquiring access to additional land by plot holders at six irrigation schemes in central Eastern Cape

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Area too small in summer	69%	80%	79%	97%	86%	92%	76,1%
Area too small in winter	69%	80%	76%	87%	100%	92%	75,0%
Want to buy more land	44%	43%	55%	97%	86%	62%	53,1%
Want to rent more land	38%	23%	55%	83%	71%	85%	46,6%

5.4.1.4 The land market at the schemes

SUPPLY OF LAND

Participating plot holders were asked what they would charge if they were to sell their plot and what rental they would charge annually if they were to rent out their plot. From Table 5.4.1.5 it is evident that most respondents either did not want to sell (33%) or lacked a clear idea of the sale value of their plot (44%). Overall, only 23% of respondents stated a price at which they would be prepared to sell their plot. The trend applying to rentals was similar (see Table 5.4.1.6), with 30% of respondent not prepared to rent out their plots, 39% stating not to know what rental they would charge annually for their plot, and only 24% stating a monetary value.

The price of land suggested by potential sellers

Proposed sale prices are presented in Table 5.4.1.5. To make comparison between schemes possible, the monetary values are presented on a ha basis. At TIS and HAIS relatively large numbers of responses were obtained, warranting statistical analysis of the data. An analysis of the combined responses over all schemes was also done.

At TIS the range in proposed sale prices was very wide. Exceptionally high prices proposed by some respondents caused the mean to be considerably greater than the median, suggesting that the median price might be a better representation of average land value at the scheme. The same applies to the combined data set for all schemes. At HAIS the range of proposed sale prices was a lot narrower than at TIS, and mean and median price were similar.

Accepting the median as a suitable estimate of the average proposed sale price, it appeared that irrigated land on the schemes would sell for about R4000 to R6000 per hectare. In 1994, the minimum price asked for irrigated land in the East Cape (white-owned) area of Eastern Cape was R2000 per ha (Beinart and Kingwill, 1995). It follows that the overall median asking price of R4000 per ha of developed irrigated land was not excessively high. The estimated price of irrigated land at the schemes increased to R16000 when using the mean as an estimate of average price.

The rental value of land as suggested by potential suppliers

Proposed rental values are presented in Table 5.4.1.6. At three of the six schemes relatively large data sets were obtained, namely TIS, HAIS and SIS. Proposed annual rentals varied widely at TIS and HAIS but not at SIS.

The mean of proposed rentals varied widely at TIS and HAIS, but not at SIS. In all cases the mean rental value was higher than the median, because of some exceptionally high values proposed by some respondents. It would appear, therefore, that the median value may be a better estimate of the "average" of proposed rental values. The mean of proposed rental values ranged from R1000 per ha at SIS to R4097 at TIS and the overall mean was R2948. The median value at SIS was R800 per ha or 20% of the overall median proposed sale price of land at the six schemes. At TIS the median proposed rental value was R1875 per ha. This represented 30% of the median proposed sale price of land at the scheme and 47% of the overall median proposed sale price of land at the six schemes. Intermediate values applied to HAIS where the mean proposed rental value was R2192 and the median value R1000, which was 20% of the median proposed sale price at HAIS and 25% of the overall median proposed sale price of land at the six schemes.

As is shown in Table 5.4.1.8, renting out of plots appeared to be common practice at SIS. Relative to TIS, where renting out of plots appeared to be a rare occurrence, the comparatively low mean and median values of proposed rentals at SIS, and the absence of much variation among the proposed rental values, may indicate that proposed rental values were converging towards the actual values offered on the rental market at the Scheme.

Table 5.4.1.5. Sale value (per ha) as proposed by plot holders at six irrigation schemes in central Eastern Cape.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Consult expert	2%	0%	3%	3%	0%	0%	1,5%
Won't sell	21%	93%	50%	10%	43%	31%	32,4%
Don't know	51%	7%	34%	30%	43%	69%	42,3%
TOTAL	74%	100%	87%	43%	86%	100%	76,2%
Mean of land prices asked for (R/ha)	17 355	-	-	4 219	250	-	15 689
n	36	-	4	17	1	-	58
Min value (R/ha)	1 875	-	1 200	600	-	-	250
Max value (R/ha)	93 750	-	120 000	10 000	-	-	120 000
s_{n-1} (R/ha)	3 709	-	-	609	-	-	3 228
Median (R/ha)	6 250	-	-	5000	-	-	4 000

Table 5.4.1.6. Rent value of irrigated plots (per ha) proposed by plot holders at six irrigation schemes in central Eastern Cape (renting out of land).

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Consult expert	1%	0%	0%	0%	0%	0%	0,6%
Won't rent	21%	97%	24%	7%	14%	54%	29,7%
Don't know	49%	0%	33%	27%	43%	46%	38,8%
TOTAL	71%	97%	57%	34%	57%	100%	69,1%
Mean of rentals proposed (R/ha)	4 097	6 000	1 000	2 192	1 267	-	2 948
n	39	1	14	19	3	-	76
Min value (R/ha)	400	-	600	100	300	-	100
Max value (R/ha)	31 250	-	2 000	8 000	2 500	-	31 250
s_{n-1} (R/ha)	908	-	119	529	-	-	501
Median (R/ha)	1 875	-	800	1 000	-	-	1 500

DEMAND FOR LAND

A large proportion of plot holders considered their plots to be too small, and expressed a wish to acquire additional land. Respondents were asked what rental they would be prepared to pay for one additional plot. To make comparison between schemes possible the responses were converted to a per ha basis. They are presented in Table 5.4.1.7.

Proposed rentals varied quite widely, ranging from R40 to R7500 per ha. The mean ranged from a high of R1 599 per ha per annum at TIS to a low of R400 at KIS. Median values ranged from R400 at KIS to R1 200 at TIS.

The mean rental value respondents were prepared to pay per ha over all schemes was R1000 and the median R663. The respective estimates of what the average plot holders would charge for renting out land were about three times higher. There was an overlap between prices people are prepared to pay to rent in extra land and what they would charge to rent out their land, suggesting that a potential market for rented land existed at the schemes. It is expected that this market could be opened further by increasing the security of tenure of plot holders (see also section 5.4.1.4).

Table 5.4.1.7. Annual payment of rent per ha proposed by plot holders at six irrigation schemes in central eastern Cape (renting in of land).

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
No response	81%	90%	48%	23%	0%	92%	70,2%
Mean	1 599	400	507	664	811	700	1 000
Min.	200	400	40	50	50	-	40
Max.	7 500	400	2 000	3 500	2 500	-	7 500
n	31	3	17	21	7	1	80
s_{n-1}	291	-	138	165	331	-	137
Median	1 200	400	192	500	500	-	663

ACTUAL LAND TRANSFERS

Farmers were asked if they had knowledge of land transfers that had occurred within their scheme and their responses are shown in Table 5.4.1.8. Handing over of plots to family members or friends were a common occurrence at KIS and ZIS and were known by some to also have occurred at most other schemes. Sales and renting out of land were transaction of which fewer people had knowledge, but both appeared to have occurred at most schemes. Renting out of land appeared to be very common at SIS, which was also the scheme with the lowest mean (R1000/ha) and median (R800/ha) rental value and the least variation in proposed rentals. An apparent active rental market at the Scheme appeared to have contributed to the development of rental prices acceptable to both lessors and lessees. SIS also demonstrated the highest land use intensity of all schemes, which would suggest that the market for land rentals at that Scheme increased allocative efficiency and land use intensity as was predicted by Thomson and Lyne (1995).

Table 5.4.1.8. Plot holder knowledge of land transfers that have occurred at six irrigation schemes in central eastern Cape.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Anyone hand over land	22%	67%	24%	17%	0%	46%	27,3%
Anyone sold land	17%	3%	6%	0%	0%	8%	11,3%
Anyone rent land	13%	7%	73%	3%	0%	8%	18,0%

5.4.1.5 Preferred tenure At all schemes where land was not legally owned by the plot holders by means of title deed, respondents expressed a desire to obtain title deed for their plots (see Table 5.4.1.9.). The general expressed desire to obtain title deed to their plots may be an indication of a perceived lack of security of tenure amongst plot holders within the current system of holding land. This lack of security of tenure might not affect those plot holders who continue farming their plots themselves, but mainly those who wish to sell, transfer or rent out their plots. This would indicate that the present breadth of rights over plots limits land transfers and, therefore, also allocative efficiency. It appeared that in practice plot holders were reluctant to rent out their land, fearing that the lessee might, over time, lay claim to their plot. Even at KIS, where the land is legally owned by a co-operative of farmers, there was still a relatively large group of people wishing for individual title deed, which appeared to be perceived as the most secure form of tenure.

Table 5.4.1.9. Plot holder interest in obtaining individual title to their plots at six irrigation schemes in central Eastern Cape.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Yes	94%	47%	100%	97%	100%	85%	89,6%
No	1%	10%	0%	0%	0%	10%	2,2%
Undecided	5%	43%	0%	3%	0%	5%	8,2%

5.4.2. Access to Water

5.4.2.1 Availability, payment and efficiency of irrigation water use

Water for irrigation in almost all the six schemes comes from reservoirs constructed by the state. The scheme managements or the organisations running the schemes are tasked with the duty of supplying water to individual farmers. Although very few farmers pay for water, generally they considered water availability to be adequate most of the time (see Table 5.4.2.1). Unlike at schemes where water supply is maintained by the state, the operation and maintenance (O&M) of the irrigation infrastructure at HAIS is carried out by farmers themselves. The revenue received from farmers in payment for water at HOIS is used by scheme management to pay a contracted mechanic to maintain the infrastructure. The proportion of farmers who were aware that they pay for water was high at HAIS (50%) and HOIS (71%) when compared to other schemes (see Table 5.4.2.1). Water is supplied free of charge to all food plot holder in KIS and ZIS.

Despite the water problems at TIS, only 31% of the food plot holders stated that they never have enough water. This is a high proportion relative to other schemes where only 3-8 % of farmers identified the same problem. The problem of water shortage at TIS is a compound one. The Great Fish River, which is the main source of irrigation water at TIS, is saline. Water from the river has to be mixed with good quality water from other catchments. However, a connection to good quality water from the Glen Melville Dam, which is supplied from the Orange River via Orange/Fish and Fish/Ecca Tunnels, will alleviate this problem.

Table 5.4.2.1 Payment by farmers for irrigation water and farmers' assessment of availability of irrigation water at six irrigation schemes in central Eastern Cape.

Assessment Criteria	Proportion of farmers claiming to pay for water, and assessment of availability of water						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	ALL n=269
Farmers paying for water	12%	0%	24%	50%	71%	0%	17%
Water always enough	12%	57%	12%	10%	57%	54%	20%
Water enough but not always	57%	43%	79%	83%	43%	38%	59%
Water never enough	31%	0%	3%	7%	0%	8%	20%

As indicated in Table 5.4.2.2, at all the schemes periods during the year when water is not available were identified by farmers. Problems related to shortage of water supply appeared to occur mainly in summer, but farmers at TIS, SIS and HAIS also experience a lack of water in winter. Generally, periodical lack of water appeared to occur most frequently at TIS, SIS and HAIS where the proportion of farmers reporting water shortages was 96%, 85%, and 90% respectively.

Table 5.4.2.2 Proportion of farmers at six irrigation schemes in central Eastern Cape who experience water shortages at certain periods of the year or day.

Water shortages		Percentage of responding farmers (%)						
		TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Farmers experiencing periodical water shortages		96	43	85	90	43	46	84,3%
Periods of water shortage	Summer	71	33	58	73	29	15	61,6%
	Winter	56	33	55	70	43	23	52,9%

Water is an important limitation in South African agriculture and it should be utilised as efficiently as possible. This did not appear to be always the case at the six schemes under investigation. For example, the WRC (1996) reported the average yield obtained by South African irrigation farmers to be 6,0 tons per ha and that of potatoes 30,8 tons per ha. At the six schemes, overall mean yield was 3,6 tons per ha for maize and 9,5 tons per ha for potatoes. This suggests that water is not used very efficiently at the schemes. One of the reasons could be that farmers try to save on inputs, causing low yields and low water use efficiencies. Any factor which enhances growth and increases yield is expected to increase the efficiency of water use by plants. Yields can be increased by alleviating a number of limitations, including plant nutrition, weed competition, plant pests and diseases and the use of inferior planting material. Only when these factors are addressed will physical and economic water use efficiency at the schemes be improved.

In the proposed policy on irrigation, it is suggested that land rights are separated from water rights. This would have a significant impact on farmers, especially on large scale farmers (WRC, 1996). At present, water at most schemes in the former homeland areas of Eastern Cape is supplied virtually free of charge to most farmers and this could contribute to its inefficient use. Adoption and implementation of the proposed policy for irrigated agriculture in South Africa (WRC, 1996) may improve WUE at these schemes. Gradual introduction of water tariffs with a certain degree of subsidy may be a first step in the process of implementation of the new policy at these schemes. However, full recovery of the cost of O&M of the irrigation infrastructure from small scale farmers at the schemes, as proposed by WRC (1996) will most probably never be achieved, because most farming households live below the poverty line already.

5.4.2.2 Water supply problems and their solutions: a farmers perspective

Farmers identified a range of problems with water supply at the various schemes. From the preceding section, some of the problems identified were periodical water shortages at all schemes, and environmental water problems at TIS. Although the problems with water supply were both human and infrastructural, they appeared mainly related to the way in which water supply is managed.

Some of the problems with water supply other than management related included disputes over water among farmers themselves, and disputes between farmers and scheme managements, often related to delays in the repair of the irrigation infrastructure. These problems are discussed in some more detail.

With the exception of HAIS and HOIS, there was no evidence of serious disputes between farmers around water availability. In most cases farmers tended to blame scheme management for problems related to a lack of water (see Table 5.4.2.3). Where water supply management is centralised, as is the case in four of the schemes (TIS, KIS, SIS, ZIS), farmers are usually not consulted when decision are made. As a result, they can only blame the decision makers when they are not happy with the decisions made or with the delivery of services. In future, management of water should include farmers in the process of decision making. This is expected to improve the efficiency of water supply at the schemes.

HAIS and HOIS showed a high incidence of farmer-to-farmer disputes (40 and 43% respectively), relative to other schemes, which had 8-15% of farmers blaming each other for water shortages (see Table 5.4.2.3). At HAIS and HOIS farmers tended to get into disputes with each other, because their involvement in decision making is closer than at other schemes. There is no real scheme management at HAIS, where farmers have united into a co-operative responsible for managing the scheme. At HOIS a scheme management exists but many of the decisions are made by the farmers, leaving scheme management responsible for carrying out what has been decided. In the absence of a central body (that makes the decisions) to point a finger at in case of problems, farmers will more readily seek the cause of water supply problems among themselves.

Table 5.4.2.3 Types of disputes over shortage of water identified by plot holders at six irrigation schemes in central Eastern Cape.

Factors Analysed	Proportion of responding farmers (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Incidence of farmers blaming each other over water shortage	15	7	9	40	43	8	16,6%
Incidence of farmers blaming Management over water shortage	55	0	73	33	29	15	46,0%
Incidence of preferential water supply by Management	6	3	12	3	0	0	5,6%
Incidence of preferential water supply to non-plot holders by Management	8	3	12	0	0	0	6,4%

The proposed policy on irrigation (WRC, 1996) recommends that water legislation should address among other things water rights, the organisation of water user associations (WUAs) and water prices. To avoid disputes over water and other matters regarding the running of irrigation schemes, it was recommended that farmers form WUAs. In small irrigation schemes in Kenya, WUAs have proved very efficient in dealing with water disputes especially under conditions of water shortages (M'Marete, 1997). Experience in Kenya also showed that WUAs should preferably consist of small groups of farmers, and should not exceed 20 to 30 farmers (M'Marete, 1997).

The policy on irrigation proposed by WRC (1996) also recommends that existing farmers' organisations should be encouraged to assume the role of WUAs. However, of the six schemes studied, only three had a farmers' organisation that was sufficiently organised and representative to be able to assume the duties of a WUA, namely KIS, HAIS and HOIS. All three are relatively small schemes and the number of farmers involved is less than 100. At present, farmers' organisations at the other three schemes are insufficiently representative and lack the organisational capacity to assume the responsibilities of a WUA. Future involvement of WUAs in water management and administration at these schemes will depend on support being provided to the process of developing effective farmers' organisations.

Table 5.4.2.4 shows that farmers rated scheme management's water supply services as "good" to "very good", despite claimed disputes concerning water shortages between farmers and management. The overall rating of scheme management by farmers with respect to water supply was "above average". TIS with a rating of "below average" was the exception. At some sections of TIS, water supply is a real problem (e.g. Ndwayana). Many farmers at TIS (63%) complained about frequent engine failure (see Table 5.4.2.5), and had a problem with the delays in having the engine repaired, for which they blamed scheme management, explaining their low rating of TIS management water supply service. At HAIS 50% of the plot holders identified engine failure as a problem (see Table 5.4.2.5), but still they rated their co-operative's water supply service as "good" (see Table 5.4.2.4). This would suggest that a transfer of responsibility for the supply of water from a service organisation to farmers themselves leads to a reduction in the level of dissatisfaction amongst farmers when the supply is subject to problems.

Table 5.4.2.4. Rating awarded by plot holders at six irrigation schemes in central Eastern Cape to managements' performance in supplying water.

Rating/Level		Percentage of responding farmers						
		TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
No response		7	0	7	0	15	23	6,5%
Very good	5	7	63	6	13	57	15	15,5%
Good	4	24	37	30	77	14	54	33,3%
Average	3	24	0	42	7	14	0	20,2%
Bad	2	17	0	12	3	0	8	12,0%
Very bad	1	21	0	3	0	0	0	12,5%
Mean rating		**2.8**	**4.6**	**3.3**	**4.0**	**4.5**	**4.0**	**3,3**

SIS Management did not enjoy the high rating accorded to other scheme managements. Since SIS did not record a high frequency of engine breakdowns (see Table 5.4.2.5), it was not possible to identify why not.

Problems relating to irrigation infrastructure and possible solutions identified by responding farmers are presented in Tables 5.4.2.5 and 5.4.2.6 respectively. Some of the major problems related to irrigation infrastructure identified by farmers affecting the process of water application to their food plots appeared to be the clogging of sprinklers, weakness of the sprinkler springs, leakages in various connections, and failure of pump engines (see Table 5.4.2.5). Farmers were not always sure how to solve problems (see table 5.4.2.6.) and often identified external sources as holding solutions. One of the possible factors contributing to the apparent inability of farmers to solve water supply problems could be their low level of education (see Table 5.1.2.1). On average, farmers in the six schemes had only four years of formal education.

Table 5.4.2.5 Problems with water supply and irrigation infrastructure identified by food plot holders at six irrigation schemes in central Eastern Cape.

Problems Experienced	Frequency of various problems (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Sprinkler does not turn	90	100	88	83	86	77	88,4%
Clogged sprinkler	88	97	88	83	86	77	87,9%
Sprinkler connection leaks	76	100	51	87	86	69	76,8%
Hydrant connection leaks	63	93	76	83	71	77	71,1%
Engine failure	63	0	27	50	29	15	46,9%
Leaking pipes	9	17	6	3	29	15	9,7%
Not enough water	6	0	3	33	14	0	7,9%
Inconsistent opening and closing times of water supply system	7	3	0	0	0	0	4,4%
Not enough sprinklers	4	0	0	7	0	0	3,1%
Delay in pump repairs	4	0	6	0	0	0	3,1%
Blocked sprinklers	3	0	0	3	0	0	2,1%
Not enough pipes	3	0	0	0	14	0	2,1%
Preferential supply to commercial farmers	0	0	12	0	0	0	1,5%
Stolen sprinklers	1	0	6	0	0	0	1,3%
Stolen pipes	0	0	3	0	0	0	0,4%
Salty water	0	0	3	0	0	0	0,4%

Table 5.4.2.6. Solutions proposed by food plot holders to various problems with water supply and irrigation infrastructure at six irrigation schemes in central Eastern Cape.

Suggested solutions to the various problems that were identified	Frequency of identified solutions (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Scheme management solves problems	10	0	6	0	14	0	6,9%
Flexible opening lines of water	3	3	3	3	0	0	2,4%
Management buys new pipes	4	0	0	0	29	0	3,1%
Install new engine	12	7	6	30	14	0	12,1%
Speedy repairs	20	10	3	7	0	23	15,0%
Good mechanics	8	0	0	13	0	0	6,1%
Water available at all time	0	0	6	17	14	0	3,0%
Alternative water supply system	5	0	3	10	0	0	4,4%
More powerful engine	1	0	0	3	0	0	0,9%
Reserve engine	0	0	3	0	0	0	0,4%
Orange river water must be used	1	0		3	0	0	0,9%
Extension Officer	0	0	0	0	0	15	0,7%
Don't know	4	0	3	3	14	0	3,4%
No response	24	80	45	17	14	61	33,6%

5.4.3 Irrigation Infrastructure, on-farm water management and appropriateness of technology

5.4.3.1 Irrigation Infrastructure

At most schemes farmers were found to rely heavily on scheme management to address problems with irrigation infrastructure, including draglines and sprinklers (see Tables 5.4.3.1 - 5.4.3.3). Cases of individual farmers accepting responsibility for this infrastructure were few. In the projects where scheme management is absent or delegated to farmers, respondents often identified a selected group of farmers as being responsible for maintenance and repairs (e.g. HAIS and KIS). At HOIS, the fees farmers pay for water is used to hire a mechanic to maintain and repair motor and pump. The co-operative at HAIS maintains the irrigation infrastructure. At all other schemes farmers mainly rely on management to maintain and repair irrigation infrastructure.

Table 5.4.3.1 shows that on average, 79% of the farmers identified scheme management as being responsible for maintaining the main water supply system. Conversely, only 6.9% of responding farmers identified themselves as being responsible. The greatest degree of farmer participation in maintaining and repairing the main supply line was observed at HAIS, HOIS and ZIS. Attitudes would have to change if and when the proposed policy on irrigation (WRC, 1996) were to come into effect.

Table 5.4.3.1 Present responsibility for maintaining the main water supply system as perceived by plot holders at six irrigation schemes in central Eastern Cape.

Person(s) or organisational structure	Responsibility as perceived by plot holders (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Community	1	0	0	3	0	0	0,9%
Management	94	50	94	13	86	77	79,0%
Outsider	1	0	0	0	0	0	0,6%
Selected farmers	1	40	0	50	0	0	10,6%
Respondent	3	0	0	33	14	23	6,9%
Government	1	0	0	0	0	0	0,6%
Others	1	10	6	0	0	0	2,4%

Similarly, plot holders mainly identified scheme management as being responsible for maintaining the dragline and sprinklers as is shown in Tables 5.4.3.2 and 5.4.3.3 respectively. Each of the plot holders handles these particular components of the irrigation system almost every day. Malfunction means that the supply of water to the crops of affected farmers will be sub-optimal at best. Yet, at this stage it appears that the degree of ownership of, and responsibility over O&M of these components is low. An active land rental market, as is the case at SIS, appeared to encourage farmers to assume responsibility over dragline and sprinkler. Where farmers rent land they will be encouraged to derive adequate income from irrigated agriculture, increasing the need to keep irrigation infrastructure in a working condition.

Table 5.4.3.2. Present responsibility for maintaining the dragline/pipe delivering water to plots as perceived by plot holders at six irrigation schemes in central Eastern Cape (1995/96).

Person(s) or organisational structure	Responsibility as perceived by plot holders (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	ALL n=269
Community	1	0	0	3	0	0	0,9%
Management	80	23	52	13	71	23	59,7%
Outsider	1	0	0	0	14	0	0,9%
Selected farmers	3	43	0	43	0	0	11,3%
Respondent	10	30	42	40	14	77	22,8%
Government	1	0	0	0	0	0	0,6%
Others	5	3	6	0	0	0	4,0%

Table 5.4.3.3. Present responsibility for maintaining the plot sprinklers as perceived by plot holders at six irrigation schemes in central Eastern Cape (1995/96).

Responsible person(s) or organisational structure	Sprinkler maintenance responsibility (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Community	0	0	0	3	0	0	0,3%
Management	88	10	39	13	86	23	61,7%
Outsider	0	0	0	0	0	0	0,0%
Respondent or selected farmers	8	43	18	53	0	0	17,6%
Government	1	0	0	33	14	0	4,6%
Others	9	47	36	0	0	77	18,6%

Deficient maintenance and repair systems are expected to affect the efficiency by which crops are produced at the schemes. An attempt was made to find out how often plot holders are prevented from irrigating as a result of damage to or malfunctioning of the water supply infrastructure. The frequency by which damage to the various components of the irrigation infrastructure occur are presented in Tables 5.4.3.4 -5.4.3.6. The relative frequencies ranging from "never" to "very often" are rated in a sliding scale from 5 to 1 as shown in the tables.

Table 5.4.3.4. Incidence of damage to the main supply system preventing irrigation at six irrigation schemes in central Eastern Cape.

Frequency of occurrence	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Never 5	12	7	6	43	0	23	14,4%
Rarely 4	38	70	52	47	57	54	45,0%
Sometimes 3	23	23	27	10	14	15	21,4%
Often 2	28	0	9	0	0	8	11,9%
Very often 1	14	0	0	0	29	0	5,4%
No response	1	0	6	0	0	0	1,3%
Rating	**2.6**	**3.8**	**3.6**	**4.3**	**3.0**	**3.9**	**3.5**

Tables 5.4.3.4 - 5.4.3.6 show that damage to the water supply system preventing farmers from applying water occurred mainly to pipes or draglines and sprinklers. Generally, it appeared that infrastructure was in a reasonable state of repair at most schemes. Nevertheless, most food plot holders did state that malfunction of the main supply system sometimes prevented

them from irrigating. Damage to this part of the irrigation infrastructure seemed to be most prevalent at SIS and HOIS.

Table 5.4.3.5. Incidence of damage to dragline or pipes preventing irrigation at six irrigation schemes in central Eastern Cape.

Frequency of occurrence	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Never 5	10	3	6	17	14	23	11,9%
Rarely 4	20	13	39	37	29	23	23,8%
Sometimes 3	30	57	24	33	43	15	32,7%
Often 2	14	13	18	13	14	8	14,1%
Very often 1	25	13	6	0	0	31	12,3%
No response	7	3	6	0	0	0	5,2%
Rating	**2.8**	**2.8**	**3.2**	**3.6**	**3.4**	**3.0**	**3.1**

Table 5.4.3.6. Frequency of damage to sprinklers preventing irrigation at six irrigation schemes in central Eastern Cape

Frequency of Occurrence	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Never 5	4	3	0	3	14	31	5,9%
Rarely 4	16	30	64	20	29	15	24,2%
Sometimes 3	31	50	18	37	29	31	32,3%
Often 2	17	13	0	33	29	23	17,1%
Very often 1	32	3	12	7	0	0	19,3%
No response	1	6	0	0	0	0	1,1%
Rating	**2.4**	**3.2**	**3.4**	**2.8**	**3.3**	**3.5**	**2.8**

Table 5.4.3.7. Identification of the most problematic component of the water supply system by plot holders at six irrigation schemes in central Eastern Cape.

Component of the water supply system	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Engine	1	0	3	0	10	0	0,7%
Main line	11	17	30	0	0	23	13,4%
Drag line or pipes	19	67	27	7	7	46	25,7%
Sprinklers	57	13	33	83	83	15	49,1%
None	12	3	0	10	0	8	10,0%
No response	0	0	6	0	0	8	1,1%

Sprinklers appeared to get damaged or malfunction more often than the draglines, especially at TIS and HAIS (see Table 5.4.3.6). At KIS and ZIS, farmers had problems mainly with draglines.

5.4.3.2 On-farm water management by food plot holders

Irrigation scheduling can be carried out to meet one of the following water management objectives:

- to maximise yields per unit area or
- to maximise yields per unit water applied.

Maximising yields per unit area may be economically justified only when and/or where water is not a limiting resource. In that case water management is carried out in such a way as to supply adequate water for plants to meet the day-to-day water requirements. However, when availability of irrigation water becomes a limiting factor the management objective should be to maximise yield per unit water applied, as should be the case in South Africa.

Good water management is essential in maintaining a high irrigation efficiency. Irrigation efficiency can be maximised by maximising the conveyance, application, storage and distribution efficiencies. Irrigation efficiency is greatly influenced by among others the losses that occur during application of irrigation water. In order to maximise application efficiency, it is necessary to determine and apply:

- the correct irrigation interval;
- the correct application rates of water;
- the correct method of water application;
- the correct amount of water at each application;

By applying these management practices, in-field water losses can be minimised, thus improving or maintaining a high application efficiency. In the study area, all these factors were considered during the design of the schemes. An attempt was made to evaluate qualitatively how efficiently water is managed on-farm at the various schemes and how plot holders schedule irrigation. The results are presented in Tables 5.4.3.8 to 5.4.3.16.

Considering the general low level of education of the scheme farmers, irrigation technology transfer is expected to rely heavily on farmer training programmes and extension advice. Extension would be expected to advise farmers on matters such as irrigation scheduling, but from Tables 5.4.3.8 and 5.4.3.9, it is apparent that extension does not play an important role in water management. HAIS was the only exception. In the absence of extension, scheme management could also transfer knowledge to farmers, but their present role in this regard was also found to be small (see Tables 5.4.3.8/9/11/13&15).

At all schemes, irrigation scheduling appeared to be based mainly on farmers' judgement of condition of plants and soil (refer to Tables 5.4.3.8/9/11/13/17/15). On average, 89.2% (Table 5.4.3.8) of food plot holders reported to irrigate when "plants look thirsty", i.e. the use of a morphological indicator of water stress. Morphological indicators of water stress can be used in irrigation scheduling, but visible wilting is not the first indicator of water stress in plants, and by the time they are observed, crops have already suffered water stress that could significantly reduce yields. Morphological indicators can be used only to avert severe water stress. It follows that poor irrigation scheduling might be a factor contributing to the low yields obtained at the schemes, in addition to low levels of inputs.

Table 5.4.3.8. Factors plot holders at six irrigation schemes in central Eastern Cape use in deciding on when to irrigate their plots.

Decision factors used to determine when to apply water	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Management tells farmers	1	0	0	7	0	0	0,7%
Told by extension officer	1	0	0	7	0	0	1,1%
When plants look thirsty	90	100	91	63	100	100	89,2%
No rain for a long time	1	0	0	0	0	0	0,7%
Copy neighbour	1	0	0	0	0	0	0,4%
On specific week days	3	0	0	10	0	0	2,6%
Combination of two factors	11	0	3	27	14	0	10,0%
No response	0	0	6	0	0	0	0,7%
Others	4	0	3	20	0	0	4,5%

Table 5.4.3.9 shows that 88.1% of food plot holders use soil surface conditions when deciding on the duration of irrigation based on the condition of the soil. Most farmers reported that they stop irrigating once their soil looks "nice and wet". This practice may result in plants getting too much or too little water and is not conducive to obtaining a high water use efficiency.

Table 5.4.3.9. Factors plot holders use in deciding on the duration of irrigation.

Decision Factors	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Told by management	0	0	0	3	0	0	0,4%
Told by extension officer	2	0	0	23	0	0	3,7%
Irrigate till soil looks nice and wet	91	100	85	60	86	100	88,1%
Copy a neighbour who usually gets good yields	1	0	0	3	0	0	0,7%
Irrigate longer during dry spells	1	0	3	0	0	0	0,7%
Fixed time per spot	3	0	6	10	29	0	3,7%
Combination of two factors	1	0	6	7	43	0	3,3%
No response	0	0	6	0	0	0	0,7%
Others	3	0	0	3	0	0	1,9%

Table 5.4.3.10. Factors plot holders at six irrigation schemes in central Eastern Cape use when deciding on the duration of water applications during summer.

Decision factors used in determining the duration of water applications during summer	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
In accordance with the drying rate of the soil	32	23	27	17	0	23	27,4%
My own judgement	20	43	12	3	14	38	20,4%
In accordance with the infiltration rate of the soil	13	13	9	20	0	8	12,7%
My judgement with no advice/training	13	0	24	13	0	8	12,3%
Depending on availability of sprinklers	9	0	0	7	0	0	6,0%
The need to control heat	4	0	6	0	14	8	5,0%
Take summer rainfall into account	1	10	3	7	43	15	4,7%
Fixed time so as to irrigate whole plot	4	0	0	17	14	0	4,6%
Management sets time	1	0	3	17	0	0	2,8%
Depending on growth stage of crop	2	3	6	0	0	0	2,2%
Depending on time available	1	3	0	0	0	0	0,9%
Depending on the texture of the soil	1	0	3	0	0	0	0,9%
Availability of diesel	0	0	0	3	0	0	0,3%

The factors farmers use when deciding on the duration of water application in summer and winter are presented in Tables 5.4.3.10 and 5.4.3.11. Most farmers were found to use their own judgement (18,8%) or to base decisions on the duration of water application on the rate at which the soil dries out (43,1%) (see Table 5.4.3.11) At schemes where extension services are active (e.g. HOIS), farmers appeared to have good knowledge of irrigation, which included the use of irrigation in alleviating heat stress (see Table 5.4.3.10).

Table 5.4.3.11. Factors plot holders at six irrigation schemes in central Eastern Cape use when deciding on the duration of water application during winter

Decision factors used in determining the duration of water applications during winter	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
In accordance with the drying rate of the soil	45	17	54	43	57	46	43,1
Depending on the availability of sprinklers	3	0	0	0	0	0	1,7
Depending on time available	2	13	0	0	14	0	3,0
Copy from other farmers	1	0	0	0	0	0	0,6
Depending on the infiltration rate of the soil	8	3	3	3	0	8	6,1
Cut off water when the wind starts blowing	4	17	6	0	0	23	6,1
Own judgement	21	33	15	3	14	8	18,8
Depending on the growth stage of the crop	2	0	6	0	14	0	2,3
Depending on the interval between applications	3	3	3	0	0	0	2,4
Management sets time	1	0	3	13	0	0	2,4
Depending on the pressure related delivery rate of the supply system	1	0	0	0	0	0	0,6

The degree to which plot holders adjust the time interval between water applications and the duration of the applications to the stage of development of their crops was investigated, and the results are presented in Tables 5.4.3.12 to 5.4.3.16. It would be expected that the amount of water applied to the crop per time interval is increased as the crop develops. This could be achieved by applying water more frequently or by applying more water per application (irrigate for a longer time), or both.

The results showed that the majority of farmers (61%) did not adjust the amount of water applied to the crop in accordance with crop development (see Table 5.4.1.16). In fact, many farmers did not seem to know why they adhere to a certain interval or duration of irrigation (see Table 5.4.3.13 and 5.4.3.15). The main exception was HOIS (see Table 5.4.3.13) where farmers increase the frequency of water application because they recognised that as the crop grows and the leaf area increases, the crop requires more water. The efforts of the scheme manager to train farmers on a weekly basis on aspects of irrigated crop production appeared to have contributed meaningfully to farmers' knowledge base.

Table 5.4.3.12 Proportion of plot holders at six irrigation schemes in central Eastern Cape who reduce the interval between applications as the crop develops.

	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Yes	19	23	9	17	43	54	20
No	78	77	85	83	57	46	77

Table 5.4.3.13 Reasons provided by plot holders at six irrigation schemes in central Eastern Cape for increasing the frequency of water applications as the crop develops.

Reasons	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
As the crop grows and leaf area increases it requires more water	14	13	0	13	57	30	14,0%
As the crop grows water needs to be applied more frequently in order to keep the soil moist	13	0	6	10	14	0	9,8%
Maize needs a lot of water when it flowers	1	10	6	3	0	15	3,5%
More water is needed because as the crop grows it is also getting hotter(summer crops)	4	0	3	0	0	0	2,7%
Allows for better time management(CF other farming operations)	3	0	0	0	0	0	1,7%
Increasing the frequency of applications increases crop growth rate	3	0	0	0	0	0	1,7%
Increasing frequency of applications is better than increasing duration because too much water at once spoils the crop	1	0	0	0	0	0	0,6%
The water requirement of crops increases with root proliferation	1	0	0	0	0	0	0,6%
Indigenous knowledge - own experience	1	0	0	0	0	0	0,6%
No response/unrelated response	84	88	92	88	64	77	85,0%

Table 5.4.3.14 Proportion of plot holders at six irrigation schemes in central Eastern Cape who adjust the duration of water application to the growth stage of the crop.

Response	Percentage for positive and negative responses						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Yes	29	27	24	23	57	15	28
No	70	73	70	73	43	85	71

Table 5.4.3.15 Reasons why plot holders at six irrigation schemes in central Eastern Cape increased the duration of water application as the crop develops.

Reasons farmers use for increasing the duration of application with crop growth	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
As the crop grows it needs more water	13	20	18	27	29	0	15,7%
Maize needs a lot of water when it flowers	10	0	0	0	0	0	5,8%
To avoid frequent irrigation	3	0	3	0	14	0	2,5%
Because it results in good yields	1	3	3	0	0	8	1,7%
Because my measuring device (inserting a stick into the soil) tells me to	1	0	0	0	14	0	0,9%
No response - Don't know - Irrelevant response	74	76	76	63	43	93	73,3%

Table 5.4.3.16 Summary of irrigation scheduling actions taken by food plot holders at six irrigation schemes in central Eastern Cape in response to crop development and associated changes in crop water demand.

Action taken by food plot holder	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Adjust both irrigation interval and duration	11	17	3	3	14	16	10%
Adjust only irrigation interval	8	7	6	14	29	38	10%
Adjust only application period	13	7	21	17	43	0	14%
Do not adjust either irrigation interval or duration	61	69	67	66	14	46	61%
No response or don't know	7	0	3	0	0	0	5%

5.4.3.3 Appropriateness of Technology

Bembridge (1996) quoted by WRC (1996), observed that the success of small-scale farmer irrigation schemes depends on the integration between technology, management participants and the socio-economic situation. Therefore, the success of an agricultural enterprise, depends on the appropriateness of the technology employed. No matter how good the technology is to the designer, if the farmers do not adopt it, the enterprise will fail. Van Heerden (1991) cautioned that adoption of innovations is a human trait and therefore the problem of successful technology transfer should be approached from the human and not the technological side. As a result, availability of new technology does not guarantee adoption. Adoption is mainly dependent on the mobilisation of motivational forces in a way that will promote adoption.

Bearing in mind that at the time of irrigation development farmers at most of the schemes where this study was carried out were either settlers or subsistence farmers practising rainfed agriculture who had no experience in irrigation farming, it can be understood why sophisticated technology could not be adopted easily. At some of the schemes (e.g. KIS and SIS), surface irrigation was practised before, but overhead irrigation was introduced when the new developments took place. The Great Fish River Valley has irrigation schemes that were started in the 1920s, which still practice surface irrigation. However, when TIS was developed, sprinkler irrigation was introduced. Would surface irrigation have been more appropriate for use in food plot scheme development? This study was unable to provide the answer. Most farmers who had experience with surface irrigation (HAIS, KIS) said they preferred overhead methods. However, Catling (1996) argued that the irrigation technology selected for use on schemes in former Ciskei and Transkei was excessively sophisticated, high-tech and clearly inappropriate. He assessed the selected technology as being expensive to procure and maintain, and designed for labour saving, which, according to Lipton (1996) is not appropriate for small scale farming conditions.

The results of this study showed that farmers did not accept responsibility for maintenance and repair of in-field infrastructure, such as draglines and sprinklers which are located on their food plots. Generally farmers identified scheme management as being responsible for this service. This attitude could be in response to the imposition of decisions and technology on them and the absence of a clear message demanding farmers to assume responsibility over some components of the irrigation infrastructure. Fact is that as long as scheme management was found prepared to accept responsibility for maintenance and repairs, the farmers could not be bothered. At the time of planning and implementation of the various schemes, there was apparently little involvement of the beneficiaries -the farmers. According to the Department of Agriculture and Forestry, Ciskei, (1982), it was however intended that farmers be involved in decision making right from the beginning and that increasingly responsibility for project affairs would be delegated to them. According to Catling (1996), "*the farmers were either deceived or coerced into accepting a regimented farming system where all decision-making was made by the scheme staff at the Central Units where farmers were not represented*". Therefore, in a way farmers might feel that after all they were not responsible for bringing the draglines and sprinklers to their plots and hence they should not be held responsible for maintaining them.

5.4.4 Scheme Management Services

At the schemes under investigation, scheme management services did not vary much from scheme to scheme. The main services rendered by scheme managements included water supply, land preparation, extension, transportation and marketing. Since these services individually or otherwise have been discussed in other sections of this report, only the important aspects are summarised here. Table 5.4.4.1 shows some of the functions that were being performed in 1995/96 by the scheme managements in various schemes.

Table 5.4.4.1 Scheme management services at six irrigation Schemes in central Eastern Cape, and problems food plot holders at these schemes experience with these services.

Scheme management services and problems food plot holders experience with those services	Responses (%)						
	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Rating by farmers of managements' performance in supplying water refer to Table 5.4.2.4 for rating)	2.8	4.6	3.3	4.0	4.5	4.0	3.3
Plot holders receiving ploughing services from scheme management	88	73	100	87	100	0	84.0
Plot holder receiving transport services to carry produce	17	0	6	17	29	0	11.5
Plot holders desiring the scheme managements to market their produce	58	37	73	83	71	38	59.5
Respondents receiving extension services from scheme management	6	2	9	0	42	18	7.0

Generally, scheme managements are rated highly in supplying irrigation water to plot holders except in those schemes in where water problems occur (TIS). Most plot holders were found to rely on mechanised land preparation services supplied by scheme management. Farmers pay for ploughing in most cases. At KIS, farmers pay cash for the use of a tractor to plough their plots. The tractor is owned by their co-operative. CAB loans help farmers at HAIS to meet the cost of land preparation using a tractor owned by the scheme co-operative. Although farmers at ZIS pay for land preparation, the service there is very poor. Free land preparation at SIS is available free of charge for plot holders with land rights. At HOIS, land preparation is supplied to farmers by the scheme on a cash basis.

Many farmers desired scheme management to transport and market their produce, but dislike the proceeds of sales to be deducted from their loans. Hence, they prefer to market their own produce. There are other problems related to marketing which are discussed in section 5.4.6..

5.4.5 Access to finance and credit

5.4.5.1 Sources where plot holders get loans

Respondents were asked where they borrow money from. Responses are presented in Table 5.4.5.1. It appears that respondents had little hesitation revealing the sources of formal loans, such as those obtained from CAB. However, those respondent who do not have access to formal credit institutions appeared reluctant to reveal information about loans. As a result, in most schemes the response was low. CAB is active mainly in lending money to farmers who produce for the market mainly, in this case HAIS and HOIS. Farmers at TIS (and possibly other schemes) can access CAB loans only when they make a loan as a group. This appears to deter many small plot holders from applying for a loan.

Table 5.4.5.1. Sources where plot holders at six irrigation schemes in central Eastern Cape obtained loans (1995/96).

Source	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Ciskei Agricultural Bank (CAB)	6%	0%	6%	90%	100%	0%	16,9%
Community members	7%	3%	6%	0%	0%	8%	5,5%
Informal loan providers (shops, saving club, money lender)	6%	0%	3%	0%	0%	0%	3,8%
CSDC	3%	0%	0%	0%	0%	0%	1,7%
FNB (Bank)	0%	0%	6%	7%	0%	0%	1,1%
Government	1%	0%	0%	0%	0%	0%	0,6%
Community members	7%	3%	6%	0%	0%	8%	5,5%
CSDC	3%	0%	0%	0%	0%	0%	1,7%
No response	78%	97%	82%	3%	0%	92%	70,9%

5.4.5.2 Sources where plot holders can get loans Respondents were asked where they could borrow money if they wanted to. Responses are presented in Table 5.4.5.2.

Table 5.4.5.2. Sources where plot holders at six irrigation schemes in central Eastern Cape thought think they could obtain loans (1995/96).

Source	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
CAB	21%	0%	15%	93%	100%	0%	27,0%
Money lender	25%	23%	39%	20%	29%	8%	25,2%
Relatives	6%	23%	9%	0%	0%	15%	7,9%
Friends	6%	20%	6%	0%	0%	0%	6,4%
Savings club	4%	10%	0%	3%	0%	8%	4,2%
Shoppers	2%	0%	0%	0%	0%	0%	1,2%
Stockvel	1%	0%	0%	0%	0%	0%	0,6%
Other	1%	0%	0%	3%	0%	0%	0,9%
No response	71%	67%	61%	7%	0%	77%	60,6%

Respondents identified CAB as the main formal source where loans can be obtained, and money lenders as the main informal source. Relatives, friends and to a lesser extent savings clubs could also be approached when a plot holders needed a loan.

An impression was gained that access to credit was not a major constraint in irrigated production on standard sized food plots and that when formal sources of credit attach conditions to extending credit, such as group loans, farmers preferred not to make use of such credit facilities. Where plots were larger and production was more market oriented the need for credit appeared to become more urgent. Formal institutions such as Ciskei Agricultural Bank appeared to cater reasonably well for the needs of farmers on irrigation schemes. However, poor servicing of loans by farmers often resulted in the suspension of credit facilities by the Bank, as was the case at HOIS. It appeared that poor servicing of loans could partially be attributed to poor financial management skills of farmers, which was probably linked to low levels of education. From the experience at HOIS, assistance with management of agriculturally related finance and a system where services are provided on a cash basis are measures which can be employed successfully to address problems of indebtedness by farmers.

5.4.6 Transport and access to markets

5.4.6.1 Introduction: In addition to enabling production of food for home consumption, irrigated food plot production was also intended to provide holders with an opportunity to recover production costs of all crops grown and to realise a small cash profit, by selling part of the produce for cash. Obviously, recovery of operating costs and cash generation would be dependent on plot holders being able to market their cash crops profitably. This would be possible only when a market for these crops existed and was accessed relatively easily by the small scale growers. Considering that some schemes involved hundreds of growers, it was unlikely that the market in the immediate vicinity of the growers would be sufficiently large to absorb all what was being produced under conditions of high land use intensity. Under such conditions access to markets would be determined, at least in part, by the availability of transport needed to access more remote markets.

The present study investigated the market for cash crops at the schemes, by paying attention to the availability and means of transport, the role of scheme services in marketing, the types of markets that were active at the different schemes, and the problems plot holders experienced with marketing their produce.

5.4.6.2 Distance between home and food plot: One of the factors that is expected to influence food plot production in general is the distance from food plot to homestead of the plot holder. It is expected that when plots are close to home, members of the plot holding household would be are able to spend short period of times on their plot, tending to particular activities which require little time (i.e. changing of the position of sprinklers), without this interfering with activities around the homestead. Plot holding families would also be able to continuously harvest small quantities of their crops and carry these home for consumption or sale. Long distances between plots and homestead, on the other hand, would demand plot holders or their families to assign large parts or all of a day to working on the plots, because of the amount of time required to reach their plots. Long distances would also make it hard to carry produce home by hand.

The distance from plot to homestead was estimated by asking respondents how long it took them to walk to their plot. Responses are summarised in Table 5.4.6.1.

Table 5.4.6.1 Time it took holders of irrigated food plots at six irrigation schemes in central Eastern Cape to walk from their home to their plot.

Time in minutes	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
0-10	3%	10%	6%	47%	29%	38%	11,4%
11-20	19%	57%	30%	33%	0%	31%	26,2%
21-30	25%	33%	27%	13%	0%	23%	24,1%
≥30	52%	0%	33%	7%	71%	8%	37,2%
Don't know	1%	0%	3%	0%	0%	0%	0,9%
Mean time (min)	27	17	24	13	26	15	23
Estimated average distance (km)	2,3	1,4	2,0	1,1	2,2	1,3	1,92

On average and over all schemes, plot holders were found to live a 23 minute walk away from their plots. Accepting a walking speed of 5km per hour, the estimated average distance between plot and homestead is 1,9km. Differences in mean walking time and estimated distance between schemes were not very large. At HAIS plot holders stay closest to their plots, travelling an average 1,1km and the longest mean distance of 2,3km between homestead and field occurred at TIS. The relatively long mean return distance from plot to homestead (a 46 minute walk and an estimated 3,8km) is expected to prevent most plot holding family members from spending short periods of time tending to production activities on their plots, i.e. time intervals occurring between two tasks that have to performed at the homestead. It also expected to prevent plot holders from carrying major parts of their produce home by hand and to require them to seek access to some form of transport for bulk carriage.

5.4.6.3 Transport of produce: The means of transport used by plot holding households to get produce from plot to homestead and from home to markets are presented in Table 5.4.6.2 and Table 5.4.6.3 respectively.

Transport of produce from plot to homestead The mode of transport used by plot holders differed considerably between schemes, and was influenced by particular conditions at the schemes. At TIS, where access to grazing is relatively limited, because of severe deterioration of the natural range, the use of donkeys was very common. At KIS, where the Upper Gxulu community has access to rangeland that is in relatively good condition, oxen were used a lot. At SIS and HAIS the scheme provides plot holders access to relatively cheap scheme transport, and a large proportion of plot holders made use of this opportunity to transport their produce home. At HOIS the amounts of produce that is carried home was limited, and was used mainly for home consumption. Most produce at HOIS was sold at field edge to hawkers who visited the scheme providing their own means of transport for bulk carriage. At ZIS the use of a wheel barrow was most common.

Table 5.4.6.2. Means of transport holders of irrigated food plots at six schemes in central Eastern Cape used to carry produce from plot to homestead (1995/96).

Mode of transport	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Hired donkey cart	51%	20%	0%	27%	0%	0%	34,8%
Hired truck or tractor and trailer	22%	37%	63%	43%	29%	8%	30,6%
Carry by hand	10%	0%	6%	13%	29%	15%	9,5%
Own donkey cart	9%	3%	0%	10%	0%	8%	7,1%
wheel barrow	1%	0%	9%	0%	29%	54%	5,0%
ox-drawn sledge	0%	37%	0%	0%	0%	8%	4,5%
Community owned tractor	6%	0%	0%	3%	0%	0%	3,8%
Own small truck	1%	3%	12%	3%	0%	8%	3,1%
No response	1%	0%	9%	0%	13%	0%	2,0%

Transport of produce from home to market From the responses presented in Table 5.4.6.3 it is evident that a large proportion of plot holders were not actively involved in marketing their produce by transporting crops to places where customers might be found. On average, more than 60% of all respondents either did not market the produce that was brought to their home (16,2%) or sold from their door step (49,5%). Those plot holders that did transport produce to markets mainly used hired transport (10,9%) or scheme transport (13,2%). The use of hired transport or scheme transport (also a form of hiring) was most common at HOIS and HAIS, where the plots and the amount being produced were largest.

Table 5.4.6.3. Means of transport holders of irrigated food plots at six schemes in central Eastern Cape used to carry produce from homestead to market (1995/96).

Mode of transport	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Customers buy from my home	43%	63%	58%	47%	29%	92%	49,5%
Do not market	24%	17%	0%	0%	0%	8%	16,2%
Scheme transport	17%	0%	6%	17%	29%	0%	13,2%
Hired transport	6%	7%	15%	33%	43%	0%	10,9%
Small truck	2%	3%	6%	3%	0%	0%	2,6%
Donkey cart	1%	0%	3%	0%	0%	0%	0,9%
Wheelbarrow	0%	0%	3%	0%	0%	0%	0,4%
Ox wagon	0%	3%	0%	0%	0%	0%	0,3%
No response	8%	7%	9%	0%	0%	0%	6,5%

5.4.6.4 Marketing of produce: The study investigated marketing channels and problems related to marketing.

Buyers of food plot produce Respondents were asked who they sold their produce to. The responses are presented in Table 5.4.6.4. The importance of the local community and outside produce traders in the marketing of food plot produce was clearly evident. Local shops and, where they occur, scheme marketing services appeared not to be major clients of plot holders.

Table 5.4.6.4. The main groups of buyers to whom food plot holders at six irrigation schemes in central Eastern Cape sold their produce (1995/96).

Buyer	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Produce traders outside the community	63%	77%	70%	90%	100%	85%	70,5%
To other households in the local community	38%	70%	88%	60%	42%	85%	52,5%
Local shops	15%	0%	33%	37%	0%	0%	16,9%
The scheme	13%	0%	0%	0%	14%	0%	7,9%
No response	5%	7%	6%	0%	0%	0%	4,4%

Problems with selling produce Respondents were asked to identify the problems they experience with marketing of their crops. The responses are summarised in Table 5.4.6.5.

Table 5.4.6.5. Main problems holders of irrigated food plots at six schemes in central Eastern Cape experienced with marketing and selling their crops (1995/96).

Problems	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Transport is expensive or not available	24%	13%	21%	50%	14%	8%	24,3%
No customers	20%	40%	33%	7%	0%	23%	22,0%
Produce is spoilt because of long storage time	16%	13%	12%	20%	0%	0%	14,4%
Absence of a physical market place	1%	6%	3%	20%	14%	8%	4,6%
Poor scheme marketing services	4%	0%	0%	0%	0%	0%	2,3%
Low market prices	1%	0%	0%	7%	29%	0%	2,2%
Scheme does not give income from sales to producers	2%	0%	0%	0%	14%	8%	1,9%
Insufficient production capacity	1%	0%	0%	0%	0%	0%	0,6%
No problems identified or no response	47%	30%	42%	20%	29%	61%	41,7%

Four out of ten plot holders did not identify a particular problem with marketing. The proportion of plot holders experiencing marketing problems at schemes where the size of plots is large (HAIS and HOIS) was considerably higher than at schemes with standard food plots (0,16-0,25ha). A lack of customers (limited size of the market) and cost or availability of transport to markets were the main problems experienced by plot holders. Limited size of the market was mainly identified as a constraint at KIS, and high cost of transport by plot holders at remote HAIS. Low market prices were considered a major constraint by HOIS producers. At several schemes a minority of growers identified the need for a local market place.

Role of the scheme in marketing of food plot produce Respondents were asked if they would like the scheme to actively market their produce. Responses are presented in Table 5.4.6.6.

Table 5.4.6.6. Interest expressed by holders of irrigated food plots at six irrigation schemes in central Eastern Cape in the active involvement by the scheme in marketing of food plot produce (1995/96).

Interested	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Yes	58%	37%	73%	83%	71%	62%	60,8%
No	42%	63%	18%	17%	29%	38%	38,1%
Undecided	0%	0%	9%	0%	0%	0%	1,1%

Nearly 2/3 of respondents favoured active involvement of scheme services in the marketing of their produce. Exceptions are KIS and to a lesser degree ZIS. Both communities have been exposed to marketing of produce by the scheme, namely marketing of milk at KIS and vegetables by Pack-Mark at ZIS. It appears this experience was not very positive. At TIS, SIS and HOIS the scheme is also involved in marketing, but plot holders appeared more positive than at KIS and ZIS, suggesting that the service at these three schemes was of better quality than at KIS and ZIS. Issues that influenced plot holder's assessment of scheme marketing services were the linking of income from sales by the scheme to plot holder debt at CAB (Ciskei Agricultural Bank), which farmers disliked, the deterioration of quality during storage, and the cost of transport charged by scheme services for bringing produce to the markets. These issues are dealt with in the next section.

Problems with scheme marketing Respondents were asked to identify problems they experience when using scheme services to market produce. Responses are presented in Table 5.4.6.7.

Table 5.4.6.7. Problems plot holders at six irrigation schemes in central eastern Cape experienced with marketing of produce by the scheme (1995/96).

Problems	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Dissatisfied with monetary returns	40%	10%	6%	17%	0%	0%	26,9%
Monetary returns are not paid out by the scheme	13%	3%	3%	0%	14%	0%	8,6%
Produce gets rotten	2%	7%	0%	3%	0%	0%	2,3%
Do not want to tell	3%	0%	0%	0%	0%	0%	1,7%
No problems	10%	13%	51%	27%	29%	15%	18,0%
Have not used scheme marketing	29%	37%	18%	27%	0%	76%	29,8%
No response	13%	33%	27%	27%	57%	15%	20,8%

A little more than half of all plot holders had either not yet made use of scheme marketing services (29,8%) or did not respond to the question (20,8%). This left 49,4% of respondents who had made use of the marketing services of their scheme, of whom 18,0% were satisfied with the service. Scheme marketing services were appreciated especially by plot holders at SIS. The main problem plot holders had with scheme marketing services was the low monetary returns they received from selling their produce when using the scheme as a marketing agent. This was especially evident at TIS and HAIS.

5.4.6.5 Input markets Responding farmers were asked where they purchase their main inputs. The responses are summarised in Table 5.4.6.8 to 5.4.6.11.

Table 5.4.6.8 Input markets where plot holders at six irrigation schemes in central Eastern Cape obtain seed (1995/96).

Source	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Local shop	0%	0%	0%	0%	0%	0%	1.5%
Nearest town	7%	0%	9%	0%	29%	0%	7.4%
Co-operative	1%	0%	0%	10%	14%	0%	3.2%
Scheme	67%	67%	52%	30%	14%	67%	56.4%
Scheme & other sources	17%	30%	30%	30%	14%	30%	21.0%
Other	4%	0%	9%	30%	29%	0%	7.5%
No response	4%	0%	9%	30%	0%	0%	3.0%

Table 5.4.6.9 Input markets where plot holders at six irrigation schemes in central Eastern Cape obtain seedlings (1995/96).

Source	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Local shop	0%	0%	0%	0%	0%	0%	0.0%
Nearest town	3%	0%	9%	0%	43%	15%	4.7%
Co-operative	1%	0%	6%	10%	0%	0%	2.4%
Scheme	80%	53%	70%	50%	14%	0%	66.8%
Scheme & other sources	3%	7%	12%	13%	14%	0%	5.8%
Other	3%	20%	3%	27%	29%	38%	10.0%
No response	10%	20%	0%	0%	0%	47%	10.3%

Table 5.4.6.10 Input markets where plot holders at six irrigation schemes in central Eastern Cape obtain chemical fertilisers (1995/96).

Source	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Local shop	0%	0%	0%	0%	0%	7%	0.3%
Nearest town	1%	0%	0%	0%	14%	7%	1.3%
Co-operative	2%	0%	0%	7%	57%	15%	4.1%
Scheme	89%	83%	97%	63%	14%	8%	80.5%
Scheme & other sources	1%	0%	0%	3%	0%	8%	1.3%
Other	0%	0%	0%	27%	14%	0%	3.4%
No response	7%	17%	3%	0%	0%	69%	9.7%

From Tables 5.4.6.8 to 5.4.6.11 it is evident that the majority of plot holders obtained their inputs at the scheme. Other minor sources where inputs were obtained were nearby towns and farmers co-operatives. Local shops appeared not to be involved in the sale of agricultural inputs. At SIS, ZIS and HAIS there is a retail outlet where farmers can buy inputs. At HAIS the co-operative buys inputs in bulk and sells these to its members. At KIS inputs can be obtained from central unit and at TIS a private entrepreneur took over input supply, but this business has since failed. Faculty of Agriculture and ARDRI (1996) found that at large irrigation schemes, such as Qamata Irrigation Scheme in Cofimvaba district, input supply was profitable and presented entrepreneurs with a viable business opportunity. Farmer co-operatives may be a better way of purchasing inputs at smaller schemes. Alternatively, local shops could be encouraged to stock agricultural input products.

Table 5.4.6.11 Input markets where plot holders at six irrigation schemes in central Eastern Cape obtain crop protectants (1995/96).

Source	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Local shop	0%	0%	0%	0%	0%	8%	0.4%
Nearest town	3%	0%	0%	0%	0%	8%	2.1%
Co-operative	2%	0%	0%	3%	14%	23%	3.0%
Scheme	87%	73%	91%	67%	71%	8%	79.5%
Scheme & other sources	0%	0%	0%	3%	0%	0%	0.3%
Other	0%	0%	0%	27%	0%	0%	3.0%
No response	8%	27%	9%	0%	15%	53%	11.7%

The large number of farmers at ZIS and KIS who did not respond to the questions on where they obtained their seedlings, chemical fertilisers and crop protectants from (see Tables 5.4.6.9 to 5.4.5.11), suggests that these farmers were not in the habit of purchasing these particular inputs, and it would appear that they were relying mainly on on-farm resources. This resources included the production of seedlings in seed beds, the use of kraal manure as a fertiliser and the use of plant extracts and ash as crop protectants.

5.5 PLOT HOLDER ASSESSMENT OF SUPPORT SERVICES

5.5.1 Sources of Advisory Services

Small holders cannot always find solutions to their problems and they have very few sources of information. On the other hand they usually do not make use of extension services if these are readily available. At some of the schemes specialised extension services were provided by scheme management. The quality of the services however, was sometimes questioned by outsiders.

All the schemes had extension offices attached to the scheme or had an officer in the district, yet in total only a quarter indicated that they were aware of extension services (see Table 5.5.1.1). The conclusion is therefore that either the respondents are not telling the truth[2], or the extension officers did not do their work properly. There could also be a problematic relationship between the two groups which had a negative influence on the respondents.

[2] Local people will often deny knowledge of a public person or service when they are not satisfied with his or her or its performance. The statement "*I do not know him, her or it*" should, therefore, not be taken literally, but rather as an indication of dissatisfaction with the services provided by the public service provider.

Table 5.5.1.1 Distribution of responding plot holders' awareness of the availability support services in their region (1996).

Scheme	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Aware	27%	3%	15%	47%	57%	0%	25%
Not Aware	73%	97%	85%	53%	43%	100%	75%

Considering the information in Table 5.5.1.2 it does seem as if the problem was located within the extension service. When the respondents were asked where they obtained advice, the response was that 38 % received it from the extension service while 44 % indicated that they did not get extension advice. It is important to note that the respondents at the three big and capital intensive schemes Tyefu (TIS), Shiloh (SIS), and Keiskammahoek (KIS) had extension staff on the scheme. Respondents indicated a low rate of extension contact at these schemes. At Hertzog (HAIS) on the other hand, which could almost be regarded as a community project had much better extension contact.

Table 5.5.2.2 Distribution of responding plot holders at six irrigation schemes in central Eastern Cape according to sources of information (1996).

Scheme	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Neighbours	9%	0%	9%	0%	0%	8%	7%
Extension	37%	13%	42%	93%	57%	0%	38%
Management	6%	0%	18%	0%	43%	0%	7%
Not Received	44%	84%	46%	0%	0%	77%	44%
Other	4%	3%	3%	7%	0%	15%	4%

5.5.2 Assessment of Advisory Services

It could be argued that farmers do not always know how to rate the work of an extension officer. The credibility the officer has in the community is a valuable indication of the people's attitude towards him, and whether he will be an effective extension officer. The extension officer's effectiveness can also be measured by the frequency of their visits to the farmers. The table below (Table 5.5.2.1) gives an indication of the frequency of visits as perceived by the farmers.

Table 5.5.2.1 Distribution of responding plot holders according to the frequency of visits by extension staff at six irrigation schemes in central Eastern Cape (1996).

Scheme	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Daily	8%	0%	9%	3%	29%	0%	7%
Weekly	3%	0%	6%	30%	0%	0%	6%
Monthly	10%	7%	12%	7%	14%	0%	9%
Bi-monthly	3%	3%	3%	7%	14%	0%	4%
Rarely	76%	90%	70%	53%	43%	100%	74%

Overall, almost three quarters of the respondents indicated that they had very limited contact with the extension staff. The extension service at the scheme appears to lack supervision and management and does not appear to work according to a well defined plan.

Perception of quality of service provided by extension agents Farmers in the six schemes were asked to rate the quality of service provided by the extension officers/agents assigned to those schemes. Each scheme had an extension agent responsible to help the farmers with their farming. The responses that were elicited ranged from 1-excellent to 5-very poor (see Table 5.5.2.2).

Table 5.5.2.2 Plot holder's perceptions of the quality of service provided by extension agents/officers at six irrigation schemes in central Eastern Cape (1996).

Scheme	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Mean	4,26	4,38	4,00	2,30	3,00	4,50	3,94

(1=Excellent; 2=Very Good; 3=Satisfactory; 4=Poor; 5=Very Poor)

Overall the respondents gave extension officers a poor (3,94) rating for the quality of service they provided. The respondents at the Hertzog (HAIS) scheme seemed to have been more pleased with the work of the extension agents rating the workers with a very good service.

5.5.3 Farmer organisations and their functions

It has been accepted that farmer participation in organisations can be regarded as a measure to gauge progressiveness and success. More than 82 per cent of all respondents indicated that they do not belong to a farmer organisation (See table 5.5.3.1). However, those respondents in Shiloh (SIS) were equally divided between those who do belong to a farmer organisation and those who do not. Horseshoe (HOIS) respondents overwhelmingly belong to one or more farmer organisation.

Table 5.5.3.1 Membership of a farmer organisation amongst plot holders at six irrigation schemes in central Eastern Cape (1996).

Scheme	TIS n=154	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=267
Member	12%	10%	48%	3%	86%	8%	17%
Not Member	88%	90%	52%	97%	14%	92%	83%

When asked what services the farmer organisations perform 78 percent had no answer. Of those who did respond four percent said that the organisations were representing the farmer at the scheme level and another 11 percent indicated that the organisations were facilitators of finance. Training was not perceived to be a function of farmer organisations (see Table 5.5.3.2).

Table 5.5.3.2 Services that a farmer organisation performs for plot holders at six irrigation schemes in central eastern Cape (1996).

Scheme	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Scheme Rep	4%	0%	15%	0%	0%	0%	4%
Regional Rep	6%	0%	9%	3%	29%	0%	6%
Training	1%	3%	6%	0%	0%	0%	1%
Financing	3%	20%	24%	13%	57%	8%	11%
No Answer	86%	77%	46%	84%	14%	92%	78%

5.5.4 Community based organisations

5.5.4.1 Farmer organisation in the scheme areas Respondents were asked to name which farmers organisation they belong to. Of the 269 respondents questioned 86 % could not name a farmer organisation to which they belong (see Table 5.5.4.1). However, of those who could name an organisation to which they belong 5 % mentioned the Progressive Farmer's Union (PROFUSA) and another 5 % belong to Shiloh Farmers Association. The latter were from the 43 % respondents at the Shiloh Irrigation Scheme. Membership of PROFUSA came from respondents at the Tyefu (TIS), Zanyokwe (ZIS), and Horseshoe (HOIS) schemes.

Table 5.5.4.1 Names of farmer organisations to which responding plot holders at six irrigation schemes in central Eastern Cape belonged (1996).

Scheme	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Not Appl	92%	91%	54%	97%	29%	92%	86%
PROFUSA	5%	0%	0%	0%	71%	8%	5%
Ndwayana	3%	0%	0%	0%	0%	0%	2%
Shiloh	0%	0%	43%	0%	0%	0%	5%
Masivuke	0%	0%	3%	0%	0%	0%	.3%
Upper Gxulu	0%	3%	0%	0%	0%	0%	.3%
Vukani	0%	3%	0%	0%	0%	0%	.3%
Farmer Coop	0%	3%	0%	3%	0%	0%	1%

Overall, very few farmers at the six irrigation schemes appear to value membership of a Farmer Organisation. It would be important for the extension officers assigned to each of the irrigation schemes to encourage participation in farmer organisations. Extension Officers as well as farmer organisation leaders should devise ways to educate and encourage membership of their organisations. The benefits of membership should be emphasised.

5.6 FINANCIAL ANALYSIS OF IRRIGATED FOOD PLOT PRODUCTION

5.6.1 Financial analysis at food plot level

An analysis per respondent of the area planted to each crop, the total operating costs involved, the yields that were obtained and the prices that were charged enabled a fairly accurate financial assessment of food plot production at the different schemes. In Table 5.6.1.1 mean net operating income per plot holder at each of the six irrigation schemes is presented. In the calculation of gross income, the monetary value of produce consumed at home or used as gifts was estimated by multiplying quantity produced by the price paid to the farmer for that part of the produce he sold. Net operating income was obtained by subtracting the relevant operating costs from gross income. Not all operating costs were taken into account. For details see Appendix B.

Table 5.6.1.1. Mean net operating income realised by holders of irrigated food plots at six irrigation schemes in central Eastern Cape (1996 Rand value).

Use	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Sales	344	548	531	3 006	10 710	982	987
Donations	25	114	15	254	109	57	63
Home consumption	471	479	212	362	109	384	414
Total	840	1 141	758	3 622	10 929	1 423	1 464

From Table 5.6.1.1 it is apparent that at all schemes farmers derived financial and other benefits from their involvement in irrigated crop production. These benefits were relatively modest at schemes with standard sized food plots (0,16-0,25ha), but increased with an increase in plot size. At HOIS, where plots were 2ha, farmers derived an estimated mean net operating income of close to R11 000, and according to scheme management this could be increased to more than R1000 per month, by improvements in production practices.

Total gross cash sales of food plot produce by farmers was compared with the total amount of money spent on operating costs, as is shown in Table 5.1.6.2. The results showed that on average farmers at five of the six schemes were able to recover their main operating costs by means of sales and to realise a small profit (in the case of schemes with small plots) and a fairly large profit in the case of HOIS, where plots were 2ha. The only scheme at which money spent on operating costs was not recovered fully through cash sales was TIS. This could be explained, at least in part, by the effect of Glenmore on the economics of TIS food plot production. Farmers at Glenmore, who represent more than one third of the food plot holders at TIS, all had access to a Trust fund to pay for major operating costs involved in food plot production. As a result, the need for Glenmore farmers to recover money spent on operating costs through cash sales was less urgent.

Table 5.6.1.2. Crop sales (R) and operating costs incurred by plot holders (R) at six irrigation schemes in central Eastern Cape.

Use	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Cash sales	557	671	874	5 912	15 146	1 381	1 625
operating costs	679	256	491	3 501	4 526	578	1 019
Surplus/ Deficit	-122	+415	+383	+2 411	+10 620	+803	+606

The mean operating ratios[3] at the six schemes, obtained by dividing the (main) operating costs per plot holder by mean total gross income per plot holder are presented in Table 5.1.6.3.

[3] For a definition of operating ratio, as determined here, the reader is referred to Nelson, Lee and Murray (1973).

Mean total gross income included income in cash (sales) and in kind (sales and donations), whereby the value of income in kind was taken as being equivalent to the monetary value of the crops using the sale prices provided by respondents.

Table 5.1.6.3 Mean operating ratio at food plot level at six irrigation schemes in central Eastern Cape, 1995/96.

	TIS n=156	KIS n=30	SIS n=33	HAIS n=30	HOIS n=7	ZIS n=13	All n=269
Operating ratio	0,45	0,18	0,39	0,49	0,29	0,29	0,41

From Table 5.6.1.3 it would appear that farmers at all six schemes derived real benefits from irrigated food plot production, the operating ratio being less than 1 in all cases. This explains why most farmers showed an interest in continuing with their engagement in this activity.

5.6.2 Gross farm income-subsidy ratio at food plot section level

5.6.2.1 Capital investments: Huge capital investments were made when some of the irrigation schemes, where standard food plots are found, were developed. According to Catling (1996) amounts of money invested in capital development at the time of the development were as follows:

Keiskammahoek Irrigation Scheme: R8,87 million

Tyefu Irrigation Scheme: R6,78 million

Shiloh Irrigation Scheme: R6,29 million

Zanyokwe Irrigation Scheme: R11,60 million

All of these schemes have without exception required an annual subsidy from the state in order to continue functioning, which implies that the state never recovered any of the capital investments it made in these schemes. The schemes, therefore, represent enormous capital investments on the part of the state. These investments consist largely of sunken costs, but one would expect the annually recurrent subsidy requirement of these schemes to remain low.

5.6.2.2 Annual subsidy requirements: According to Catling (1996) and Commission of enquiry (1996), the subsidy requirements of the schemes in 1995/96 were as follows:

			Source of funding
Keiskammahoek Irrigation Scheme:	R1,00 million	(1995/96)	E Cape Dept of Agric (ECDOA)
Tyefu Irrigation Scheme:	R2,31 million	(1995/96)	transfer by ECDOA to Ulimocor
Shiloh Irrigation Scheme:	R1,66 million	(1995/96)	transfer by ECDOA to Ulimocor
Zanyokwe Irrigation Scheme:	R2,90 million	(1995/96)	transfer by ECDOA to Ulimocor
Horseshoe Irrigation Scheme:	R0,40 million	(1995/96)	transfer by ECDOA to Ulimocor
HACOP Irrigation Scheme:	R0,00 million	(1995/96)	-

The gross income-subsidy ratio was defined as the ratio between the sum total of gross income realised by all farmers at the food plot scheme and that part of the annual subsidy that was allocated to the food plot section. Total gross income by farmers was obtained by multiplying mean total gross income per plot holder by the total number of plot holders at the food plot section of the scheme. The portion of the 1995/96 subsidy allocated to the food plot section of the schemes could not always be determined. In such cases, it was taken to be directly proportional to the area occupied by food plots relative to total scheme area. The results of this analysis are presented in Table 5.6.2.1.

Table 5.6.2.1. Estimated gross income-subsidy ratio of irrigated food plot production at scheme or sub-scheme level at six irrigation schemes in central Eastern Cape (1995/96).

Scheme	(a) Sum total of farmers' gross income from food plot production (R)	(b) Subsidy (R)	(a/b) Gross income-subsidy ratio
TIS	2 258 753	1 003 275	2,25
SIS	568 295	415 728	1,37
ZIS	102 051	71 655	1.42
KIS	122 936	31 797	3.87
HOIS	278 190	400 000	0.70
HAIS[3]	576 963	-	-

From Table 5.6.2.1 it is evident that at most schemes the estimated gross income-subsidy ratio was low. At HOIS where farmers derive a reasonable income from production, the ratio was lowest of all, mainly because the scheme is small, relative to the cost of farmer support. In the case of HOIS it would actually make financial sense to pay each plot holder a proportion of the subsidy, instead of using this money to support food plot production. However, this would be a simplistic view of reality.

A major part of the 1995/96 subsidy of irrigation schemes went to wages and salaries of staff working at the scheme. A large number of this staff had little or nothing to do with food plot production. Many staff remained employed by the scheme following the withdrawal of the management agent from direct production, because politically, retrenchment was not acceptable. According to Catling (1996) the number of staff employed by the schemes is as follows:

Keiskammahoek Irrigation Scheme: 50

Tyefu Irrigation Scheme: 64

Shiloh Irrigation Scheme: 75

Zanyokwe Irrigation Scheme: 64

Horseshoe Irrigation Scheme: 18

HACOP Irrigation Scheme: 0

[3] At present, food plot holders at HAIS do not pay a water charge (R120 per ha per annum in the Kat river basin). If this is considered as a cost incurred by the State, the annual subsidy to HAIS by the state would be R9 720 and A/B would be 59,4.

Historically, one of the main benefits communities derived from irrigation schemes was through employment by the scheme. In 1995/96 the annual income derived by workers hired by plot holders was estimated at about R22 000, whereas annual income derived by the scheme employees was probably in the region of R4 million. Restructuring of the schemes in function of essential farmer support at minimal cost is urgent, but resistance from the main beneficiaries of the schemes, namely the employees is considerable. A conservative estimate suggests that the cost of staff employed at the schemes could be reduced to 20% of the current cost, without materially affecting irrigated food plot production. Such restructure would increase the gross income-subsidy ratio at scheme or sub-scheme level by several units.

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CHAPTER SIX

A CRITICAL ASSESSMENT OF IRRIGATED FOOD PLOT PRODUCTION AS AN AGRICULTURAL DEVELOPMENT MODEL

6.1. REALISATION OF THE OBJECTIVES OF IRRIGATED FOOD PLOT PRODUCTION

When the Eastern Cape irrigation schemes where standard 0,16-0,25ha food plots occur were planned, irrigated food plots were incorporated into the scheme design in order to meet the main social objective of local irrigation scheme development, namely enabling local households to produce their own food in a fairly risk-free manner. Loxton, Venn and Associates (1983) defined an irrigated food plot as a small area (0,16-0,25ha) of irrigated land that provides the holder with an opportunity to grow food for subsistence and a small cash profit. From this definition it is evident that the main intention of irrigated food plots was production of food for the plot holding household, a subsistence activity. The definition also implied that food plot holders would be involved in the production of crops that generate cash, whereby the cash income to be generated would be sufficient to pay for all production costs and, in addition, provide the farmer with a small profit.

At the four schemes where these small plots of 0,16 to 0,25ha were introduced by the planners, namely TIS, KIS, SIS and ZIS, the intentions of food plots are essentially being realised. As can be seen in Table 6.1.1, plot holders were found to derive benefits from food plots in the form of food (27-56% of the mean gross monetary value of crops produced) and from the sale of cash crops (41-69% of the mean gross monetary value of crops produced). From Table 6.1.1.2 it is evident that at three of these four schemes mean gross cash income, realised through the sale of produce, exceeded operating costs for all crops grown. As a result, plot holders at these three schemes were able to make a small profit, which averaged R71 per year over all four schemes. At TIS, where operating costs were found to exceed gross cash income generated through sales, the mean deficit of R122 was relatively small. TIS was also the scheme where the proportion of the produce that used for home consumption was highest of all. A further reason for the apparent gross cash deficit incurred by TIS plot holders is that farmers at Glenmore, which represent more than one third of the food plot holders at TIS, have been able to access a Trust fund to pay for all production cost. As a result, the need for Glenmore farmers to recover total variable production costs through cash sales might have been less urgent.

Table 6.1.1.1. Proportion of gross income realised through sales, donations and home consumption at four irrigation schemes in central Eastern Cape where the size of the food plots ranged between 0,16ha and 0,25ha (1995/96).

Use	TIS n=156	KIS n=30	SIS n=33	ZIS n=13	All n=232
Sales	41%	48%	70%	69%	47,6%
Donations	3%	10%	2%	4%	3,8%
Home consumption	56%	42%	28%	27%	48,6%

Table 6.1.1.2. Crop sales (R) and operating costs incurred by plot holders (R) at four irrigation schemes in central Eastern Cape where the size of the food plots ranged between 0,16ha and 0,25ha (1995/96) .

	TIS n=156	KIS n=30	SIS n=33	ZIS n=13	All n=232
Gross cash income from sales (A)	557	671	874	1381	663
Total variable production costs (B)	679	256	491	578	592
Difference (A-B)	-122	+415	+383	+803	+ 71

In addition to the four schemes with food plots of 0,16-0,25ha, two other schemes with plot sizes of 1ha (HAIS) and 2ha (HOIS) also formed part of this study. The objective of the irrigated plots at these two schemes was found to be distinctly different from the original food plot concept. Farmers at both these small scale irrigation schemes had as their main objective the generation of cash income from commercially oriented irrigated crop production. This is reflected in the way in which produce was apportioned to home consumption and sales. Relative to the four schemes with standard plots, where on average farmers consumed 48,6% of their plot produce, farmers at HAIS consumed 10% and those at HOIS only 1%. Market orientation at HAIS and HOIS is also reflected in the choice of crops. At both schemes cabbage or a combination of cabbage and potatoes was grown on at least 3/4 of the planted area. Both these crops were mainly grown for cash and are considered to be high value crops. The proportion of land planted to maize, which is mainly a food crop, was small relative to that at the other four schemes. In fact at HOIS hardly any maize was being planted.

The demands of commercial production of crops under irrigation are high, and it is, therefore, expected that a substantial portion of farmer household income will be derived from this activity. Results discussed in 5.1.3 of this report clearly demonstrated that this was the case, especially at HOIS, where income derived from agriculture was the main source of household income.

The results of this study suggest that an increase in plot size from the standard 0,16-0,25ha to 1ha or more tends to encourage a market oriented approach to crop production aimed at generating cash income. It would therefore appear that the small size of the standard food plots matches the original concept and intentions of these land allocations.

6.2 CRITICAL FACTORS THAT INFLUENCE THE DEGREE TO WHICH THE OBJECTIVES OF IRRIGATED FOOD PLOT PRODUCTION ARE BEING REALISED

Small plots (0,25ha or less) It appears that the main motive of the designers for the development of irrigated food plots at the four schemes where standard food plots are found, was to compensate land right holders for granting the use of the bulk of their land to the estate component of these schemes. The decision on the size of a food plot appears to have been influenced by the production capacity of irrigated land relative to dryland. It appears planners tried to ensure that farmers would have access to a large enough area of land to produce at least as much food (maize) as they were producing on their rainfed fields. These rainfed fields were considerably larger in size, usually 1 or 2ha, but in the absence of irrigation yields were low and not very stable. Most assessments of local rainfed maize production suggested that local yields of rainfed maize were of the order of 0,5 ton per ha, and that on average farmers harvested about one ton of maize annually. Conventionally one ton of maize is considered more or less adequate to fulfil the maize requirements of a family of six people (175kg of maize per person per year). The scheme designers appeared to have worked with the assumption that under irrigated conditions it would be possible for farmers to achieve yields of 4 tons per ha, especially if farmers would make use of modern technology and employ high levels of inputs, which were to be supplied by central unit. Irrigated plots of 0,25ha in size, therefore, appeared to have been considered large enough to produce the food (maize) requirements of land holding households, namely one ton of maize grain.

The development of irrigation schemes during the period 1976-1985 in former Ciskei (Tyefu, Keiskammahoek, and Zanyokwe) and Transkei (Ncora) demanded from land right holders that they handed over the right of use to the bulk of their land to the central unit of the scheme. In order to maintain a supply of food to their households, farmers were expected to change their farming system from a traditional rainfed based system to a modern irrigation based system. The change in farming system was quite fundamental. Before irrigation arrived, farmers would rely heavily on on-farm resources for agricultural production. This involved animal traction, the use of manure as a fertiliser and the use of open pollinated home-selected seed varieties. On irrigated food plots, conditions encouraged or even forced farmers to make use of mechanised land preparation, chemical fertilisers, hybrid seed, chemical pest control and in some cases chemical weed control. Many of the farming operations were actually carried out by the scheme and in some cases the only involvement of the farmer was to weed and harvest his or her plot (Commission of Enquiry, 1996). This obviously created a high degree of dependency and resulted in an erosion of the farming skills present within the farming community. Legoupil (1985) referred to farmers on these schemes as being the spectators instead of the actors. It is not surprising that the financial demise of all of these centrally managed schemes and the resulting withdrawal of subsidised farmer support services by the schemes has caused, and in many cases continues to cause, considerable unhappiness amongst farmers and land right holders. This is quite understandable, because the food plot farming system was designed to be dependent on the services offered by a central unit. Out of frustration land right holders at some schemes are demanding a return of the land occupied by the estate component (Ncora) and small farm sections (Shiloh). As long as these conflicts persist, agriculture, in this case food plot production, will suffer. It is, therefore, imperative that the future of agriculture at schemes where there are land conflicts and uncertainty about which services will be on offer are resolved as soon as possible.

Where conflict is absent and where central unit support to irrigated food plot production has been withdrawn for some time (e.g. Upper Gxulu at Keiskammahoek), farmers appeared to have adapted their farming system to suit the new conditions. Relative to farmers at the other three schemes with standard food plots, Upper Gxulu farmers have managed to reduce input costs considerably. In section 5.2.3 of this report is was shown that the annual operating production costs incurred by Upper Gxulu farmers was R256, which was only 43% of the average operating costs incurred by farmers at the other three schemes with standard food plots. The reduction in operating costs was achieved primarily by making more use of on-farm resources (manure) and by increasing the area planted to maize, which was produced at low cost. However, farmers at Upper Gxulu continue to rely on access to mechanised land preparation. They also rely on a reliable supply of irrigation water, essentially free of charge.

The results of the present study suggest that there is general agreement amongst plot holders that a reliable supply of irrigation water and timely access to mechanised land preparation services are the two critical factors that sustain irrigated food plot production.

Where the issue of who pays for land preparation was not clouded by conflict emanating from agreements entered into by the scheme in the past (e.g. SIS), it appeared that farmers are prepared to pay for land preparation services. Rates of R250 to R400 per ha for a package that includes primary tillage and seed bed preparation (ploughing and disking) appeared to be acceptable, but in most cases this rate appeared too low to ensure entry of an adequate number of private suppliers of such a service. Considering the economics of food plot production and the level of poverty amongst plot holding households, it is also unlikely that plot holders are able to afford to pay much more. Use of animal traction could present an alternative to mechanised land preparation in the medium to long term, but at this stage most farmers are not in a position to convert to animal traction. In order to sustain current levels of production at irrigated food plot schemes over the medium term, it would be necessary for the state to continue to provide farmers with access to a reliable source of mechanised land preparation at a subsidised rate.

Historically, the state, through its parastatal, has subsidised water supply at irrigation schemes in central Eastern Cape and has assumed responsibility for the operation and maintenance of irrigation infrastructure. In all centrally managed schemes the only responsibility of a farmer wanting to irrigate land was to connect a hose-pipe to the hydrant and open the valve. Partial payment for water at these schemes may at one stage have been part of a service charge, but at present farmers are no longer paying these charges, with the exception of lessees of plots at SIS (and farmers at HAIS and HOIS). The results of the present study clearly demonstrate the nearly absolute dependency of plot holders on the scheme to provide and maintain water supply. The impression was gained that farmers could be persuaded to assume responsibility of the in-field water-related infrastructure, namely the hose, sprinkler and nozzle component of the system. Farmers may also be found prepared to pay a token amount of money towards supply and maintenance of water. However, it would be unrealistic to expect plot holders to carry a substantial part, let alone the full cost of water supply and its maintenance. Experiences gained in Zimbabwe on small scale irrigation schemes showed that attempts by government to recover as little as 1/3 of the cost of supplying water, by increasing water charges to about 15% of the value of the annual crop, caused farmers to reject irrigation and demand government to withdraw the scheme. Currently Zimbabwean small scale irrigators carry under 4% of the cost of water supply and its maintenance (Manzungu and Van der Zaag (1996).

Large plots (1 ha and larger) The results of the present study show that when plot size is larger than the standard food plot size, as is the case at HAIS and HOIS, water supply and access to mechanised land preparation remain critical factors, but other factors also become important. Four major factors were identified, namely access to markets, access to specialised production advice (extension), access to credit (production loans) and assistance with financial management.

At present farmers at HAIS and HOIS produce mainly crops that are consumed locally by the majority of the population in the Eastern Cape, e.g. cabbage. Many other producers also supply this market and competition is fierce. Factors such as distance to the market play an important role. HOIS has a comparative advantage over HAIS by being located very close to the urban centre of King William's Town, resulting in most of their produce being bought by traders visiting the scheme and providing their own transport. HAIS farmers on the other hand have to market their produce themselves and often find a large part of their income going to transport and market commissions. For example a load of 15 tons of cabbage sold for R4000 on the East London market resulted in a return of R1100 for HAIS farmers, the remaining R2900 going to transport and transaction costs (Madikizela, pers comm.)[1] Farmers at HAIS are fully aware of the unfavourable location of their scheme in relation to markets for locally popular crops, such as cabbage and potatoes. Because of their particular unfavourable location with regard to markets, farmers at HAIS are interested and willing to grow other crops which would provide better returns (Nel and Hill, 1996). However, at this stage they have not been able to identify suitable alternative crops, mainly because they lack information about which crop to grow and how to access markets. The growing of paprika is being considered.

As production objectives shift from household food supply to market oriented production, it appears that farmers' need for, and interest in specialised advice increases. Farmers on the four schemes with standard food plots were not very appreciative of the extension advice that was being provided to them. The impression was created that only a minority of farmers on these schemes would mind if these services were to be withdrawn. Part of the reason for this lack of interest in extension services is undoubtedly the questionable general standard of this service, but it also appeared that holders of standard food plots feel relatively confident about their current production practices. At the other two schemes, where production was mainly market oriented, farmers did appreciate specialist advice, stating that extension staff is the main source of information. Especially at HOIS, where many participating farmers did not have a farming background, the services of the section manager and extension officer have been a key factor in enabling farmers to reach the production levels they maintain at present.

The cost of inputs and services required to maintain production on standard food plots are usually small, and it appeared that in most cases plot holders did not require a loan to pay for these costs (see section 5.4.5). At the two schemes where production is commercially

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[1] Patrick Madikizela, a researcher at ARC and student at the University of Pretoria monitored marketing of produce at HAIS during the 1996-97 summer season.

oriented access to finance appeared crucial. Most farmers at HAIS and HOIS were found to make use of a credit facility to maintain production. This facility was provided to them by Ciskei Agricultural Bank (CAB). Servicing of loans requires farmers to manage their finances responsibly, but most farmers lacked the educational level to do so (see section 5.1.2). At HOIS direct dealing by farmers with CAB resulted in rising debts and a suspension of the credit facility by the Bank. Thereafter, financing of production was handled internally by the scheme, and a scheme staff member assisted farmers with the handling of their financial affairs. This assistance resulted in an improvement of the cash flow of farmers and a gradual reduction in the moneys owed to the scheme. At HAIS the accounts of farmers are handled centrally by Coop management, but this body identified a dire need for assistance in financial management.

6.3 CRITICAL FACTORS FOR SUSTAINABLE IRRIGATED FOOD PLOT DEVELOPMENTS

From the financial analysis of food plot production presented in section 5.6 of this report, it appeared that an irrigated food plot production development is not really a worthwhile investment on the part of the state. However, most of the food plot schemes could be supported reasonably well by the state at a fraction of the current costs. This would undoubtedly increase the gross income-subsidy ratio of food plot production schemes considerably. When taking into account the socio-economic status of food plot holding households, and the modest contribution that a food plot makes to total gross cash household income, it becomes evident that irrigated food plot production in the Eastern Cape context offers little if any opportunity to ever become economically self-sustainable. In order to sustain production at existing schemes with standard food plots, the state will need to continue carrying most of the cost of supplying water. Farmers can be expected to make a token contribution towards water supply, but it is expected that this would not reduce the cost to the state in a significant way. Farmers can also be expected to assume responsibility for the in-field components of the water supply system, which would lead to a greater degree of ownership and responsibility for this equipment. Involving farmers in decision making on issues of water supply at scheme level is expected to have a similar effect with regard to attitudes towards other irrigation infrastructure such as pumps and conveyance systems.

At this stage of the evolution of Eastern Cape food plot schemes the reliance on mechanised primary tillage is still very high, with 97,4% of farmers making use of tractor services. Without access to these services it is expected that a lot of farmers will leave their land fallow. It is also unlikely that income from standard food plots can be increased sufficiently to warrant farmers to accept land preparation charges which would make it economically viable for private contractors to provide this service in a sustainable way. There is potential for a change in the tractor based farming system practised at present at the schemes. Animal traction has the potential to suit the small scale nature of food plot production, but at present the necessary skills, equipment and draught animals are not available. A change from mechanised to animal drawn land preparation will require a major technology development and demonstration effort on the part of service providers. Suitable farming systems enabling farmers to keep draught animals in working condition throughout the year will have to be developed and demonstrated.

All available evidence suggests that existing irrigated food plot schemes in their current form will remain a mechanism by which the State through recurrent expenditure on at least water supply enables households participating in the scheme to add to their income in cash and kind.

At present this form of social welfare does not make much sense as the gross income-subsidy ratio is about 1 at most schemes. However, reorganisation of the scheme services in a way that addresses the crucial needs of plot holding producers, whilst keeping costs as low as possible, is expected to result in a major increase in this ratio. When this much needed restructuring has been effected, support of existing food plot scheme may prove to be a worthwhile form in which state funding is used productively in the alleviation of poverty in a large number of rural households. On the basis of evidence presented in section 5.4.1, it could be argued that the creation of a land market within these schemes, by removing insecurities related to current tenure, may lead to increases in the holdings of some plot farmers, through plot rentals or sales. As was pointed out in section 6.1, an increase in land size appears to shift the orientation of farmers from mainly subsistence towards mainly market oriented production. From the evidence collected at HAIS and HOIS, increases in cash income, derived from farming a larger area and directing production mainly at markets, do seem to provide farmers with the means to pay a larger proportion of the cost of water supply and, when working as a group, with the financial means to maintain a tractor service. If existing standard food plot schemes would progress in such a direction, the sustainability of these schemes may be improved further.

6.4 IRRIGATED FOOD PLOT PRODUCTION: IS IT A TRAP OR A STEPPING STONE IN THE PHASED PROGRESSION FROM SUBSISTENCE TO MARKET ORIENTED FARMING?

6.4.1 Food plots in irrigation scheme design

On irrigation schemes developed in central Eastern Cape during the period 1976-1985, the standard food plot (0,25ha or less) was part of a scheme design, whereby the incorporation of food plots by planners was essentially aimed at compensating existing land right holders for making available their dryland allocations for the development of a scheme. From a planning point of view, the incorporation of food plot sections into the overall design of the scheme was considered more of a requirement than a focus of interest. Most of these schemes, which include the Tyefu, Keiskammahoek and Shiloh Irrigation Schemes, were designed with a view that estate farming involving labour and management would form the locomotive of agricultural and rural development in areas where development was seen as desperately needed. Planned around a central unit it was expected that production on the estate would be sufficiently large to result in employment generation over and above that created by activities at the schemes themselves. Scheme planners envisaged the emergence of up-stream suppliers of services (e.g. input suppliers and maintenance) and down-stream suppliers of services (e.g. produce processing and marketing). The food plot sections formed part of the design, because it ensured approval of the project by existing land right holders.

Scheme design did not really consider food plot production to be part of the main stream production activities of the schemes. It was never the intention that food plot holders would evolve into small scale out-growers, supporting the marketing or processing section of central unit by adding to the total amount of specific produce grown on the centrally controlled estate. On the contrary, designers viewed the food plot section as operating fairly independently from central unit and granted food plot holders a relatively high degree of freedom with respect to on-farm decision making. The main function of central unit in the food plot section was to support farming by providing access to a range of services, including water supply, land preparation and inputs, at prices the plot holders would be able to afford. In the design of the schemes, food plots were viewed as performing a social function, whereas the centrally controlled estate was responsible for the economic function of the schemes.

Most of the schemes were planned to be economically viable, and therefore it made sense to maximise the proportional area assigned to the estate component and keep the food plot section as small as possible. This consideration must have had an influence when planners decided on the size of the food plots. A second consideration was that a food plot would need to enable production of a yield at least equivalent to the average long term yield farmers obtained from farming on their rainfed allocations. The size of the plots was made sufficiently large to enable a harvest of one ton of maize grain, the estimated long term average maize yield local farmers were harvesting from 2 ha of rainfed land. Cash cropping on the food plots during winter would enable farmers to recover the operating costs of both summer and winter plantings, and allow for a small cash profit to be made.. At the time when the schemes were designed, planners found that local farmers involved in crop production aimed their agriculture mainly at subsistence. Food plots were introduced to enable the land right holders to continue with this type of farming. The evolution of food plot holders from subsistence farmers to market oriented farmers within the context of a scheme was never considered or catered for by scheme planners. Food plots, therefore, were designed to be a trap, because the possibility of a shift in the production objectives of food plot holders was not integrated into the design.

6.4.2 Factors of production in small scale irrigation: the current status at food plots schemes

Faced with the need to produce most of what the household consumes, subsistence oriented irrigated food plot producers have attempted to maximise the utilisation of allotted plots ranging from 0,16-0,25ha. Most of the factors of production, namely land, labour, capital (and management) were not considered major constraints by farmers, although there were serious considerations in several aspects of these factors.

Whereas land was not identified as a major constraint, plot size was in most cases perceived by farmers to be too small, and the great majority desired to acquire additional land. Willingness by farmers to pay rent for additional plots was proof of an internally motivated desire towards a higher degree of commercialisation of their farming activities. The current land tenure system, whereby land is *de jure* owned by the state in most cases, and *de facto* the property of local tribal leadership in the case of communally held land, was generally found not to encourage scale enlargement through land acquisition. The expressed desire to obtain title deed to their plots indicated that farmers identified a need for more secure tenure.

Labour was also not considered a major constraint in irrigated food plot production. It appeared that the available labour within the households, which consisted on average of 5,5 members, was generally adequate to farm plots of 0,25ha or smaller. As a result, little use was made of hired labour, the mean number of labour days hired by plot holders being 1,2. The need for hired labour is expected to increase when plots size is increased and crops acquire more commercial value. More labour will be needed to prepare the land, plant the crops, control weeds and to harvest the produce. Furthermore, a new demand for labour may be created as a result of the need to market a larger proportion of the yield. At present, marketing of produce at schemes with small plots is done mainly locally, the demand for produce appearing to exceed the supply. An increase in commercialisation is expected to result in an increase in produce supply, creating a need to access markets further afield. When these markets are distant and organised transport is scarce or expensive, considerably more time may have to be spent on marketing activities than is the case at present.

In food plot production capital was not a major constraint either. The majority of farmers appeared not to actively seek capital through loans or by obtaining credit. This condition may partly be the result of the lending policy adopted by the traditional parastatal lending agency - Ciskei Agricultural Bank. This policy was adopted in response to the high number of defaulters in the past, and does not provide small scale farmers with easy access to finance. The importance of capital needed for the expansion of activities will increase when plot size and the degree of commercialisation increase. It would be important for small scale farmers to develop an appreciation for the financial climate and associated cost of money and plan effectively in order to manage repayment of loans, whilst maintaining earnings.

The study showed that decision making in irrigated food plot production in central eastern Cape was done mainly by old people with little formal education. This had implications on the decisions that were made. Farmers who followed scheme management recommendations and adhered to the cropping programme proposed by management benefited in a number of ways, for example by obtaining land preparation free of charge or at a subsidised rate. Although this saved farmers money, which could be spent on other plot activities, it also increased the dependence of farmers on scheme management. When production was subsistence oriented mainly, this was not necessarily a disadvantage. However, a shift to commercialisation of production is expected to bring about a need for farmers to become more independent decision makers. The role of government or its representative needs to be examined in this regard. Farmers need to understand the role of government and the limits of the state's engagement in farming. One of the policy guidelines of the Eastern Cape Department of Agriculture adopted in 1996 was that government would not be involved in active farming, which was to be left to farmers. Defining its role as essentially supportive and facilitative, Provincial government is challenging farmers to become more independent. One of the consequences of this change in government policy is that farmers may be held responsible for paying for services, which historically were provided free of charge, water supply being but one example.

6.4.3 Irrigated food plot production: can it progress from a social to an economic development factor?

Transition from a social subsistence farming orientation to an economic and market related process of commercialisation may be a consequence of markets in irrigated food plot production. Here markets refer to different sets of exchange possibilities such as land, inputs, produce, services and others, which could have direct bearing on the ability to make the transition to commercialisation possible. As of now, small holder farming in irrigable lands pursue a social objective. When examined closely irrigated food plot farming does not encourage economic freedom, given the limited size of plots, outputs and other factors. At present, irrigated food plot production only generates income that supplements overall household income. Although, social investment of this kind helps household food security (Arnon,1987), it cannot continue as the subsidised cost is of great expense to a nation.

When during the late 1980s centrally managed estate production on irrigation schemes became problematic for a number of reasons, parastatals responsible for the management of many irrigation schemes in former Ciskei and Transkei decided to withdraw from active farming and focus on farmer support. This decision resulted in centrally managed land becoming available for redistribution. At some schemes (e.g. Shiloh) this land has not been reallocated yet, but at Tyefu the local communities asked Ulimocor to transform this land into food plots, enabling a larger number of households obtaining access to a plot. Various other models, involving larger scale plots and mini-farms were proposed, but the local people decided that food plots was what they desired most. Over time, the number of food plots at Tyefu Irrigation Scheme increased from an initial 273 plots to the present total of 1492. Yet the demand for additional food plots at Tyefu has not been satisfied yet. At Ndlambe, for example, the community has requested the conversion of all remaining estate land into food plots, despite having been told by many advisors, including the Standing Committee on Agriculture in Senate, that food plot farming is "farming for poverty". It would appear, therefore, that the food plot concept is attractive to many rural households. Part of its attraction is the high degree of equity provided by food plots developments, because so many people are able to benefit from it. It appears that in local rural society a lot of importance is given to the sharing of a newly introduced asset developed by external agents. Everyone getting a small share appears to be preferred over some getting a large share and others nothing. In this social context, a food plot appears to be an ideal first step in the introduction of rural people to irrigated agriculture.

Can food plot developments progress from a social to an economic development factor, in spite of their "trap design"? In financial terms the production potential of a food plot is insufficient to provide a household with adequate income from crop production alone, because the plot is just too small. On the other hand, a number of plot holding households may attach little importance to irrigated cropping when packaging their livelihood. Potentially, this would allow for land exchanges. Some households opting to increase the contribution agriculture makes to their livelihood could acquire additional plots from households with little or no interest in or time for agriculture. The present study demonstrated that this type of land exchanges are not common at most schemes, perhaps with the exception of Shiloh Irrigation Scheme. From the responses obtained it appears that the security of tenure by which land right holders hold their plots is insufficient to encourage exchanges of land amongst plot holders. Thomson and Lyne (1995) recommended that this constraint should be addressed by extending the breadth, duration and assurance of the rights plot holders have over their land. Once plot holders are convinced that the rights over their plots are secure, they may be more willing to enter into land transactions. When preservation of equity is considered important, these transactions would have to be in the form of land rentals. Part of the institutional interventions needed to bring about adequate security of tenure would also need to address the rights of lessees. New arrangements would need to provide for the enforcement of land transaction agreements lessee and lessor have entered into. All too often a farmer entering into an agreement with a land right holder on a long-term lease of land, is forced to return the land to the "owner" after one or two seasons, losing out on the investments made into improving the productivity of that land. The required institutional changes with regard to tenure security do not necessarily have to await national legislation. Land right holders could be encouraged to develop rules and regulations catering for the needs of farmers at their scheme only, and a suitable mechanism to enforce these rules.

Once opportunities for farmers to increase their land holding are created, it is expected that selected farmers will shift their production objective from mainly subsistence to mainly market oriented production. These farmers will be faced with a number of challenges new to them.

Increasing land area increases labour demands. From the experience at Horseshoe Irrigation Scheme, it appeared that many households respond to this increase in labour demand by mobilising family labour, whereby both husband and wife become actively involved in agriculture on the plot, and by hiring labour during critical periods. The process of farmers increasing their land holding by acquiring additional land is expected to increase the demand for hired labour in a modest way only.

Weeding was shown to be the most labour demanding of all food plot activities. As plot size increased, the amount of weeding required increases concomitantly. From the findings at Horseshoe Irrigation Scheme it appeared that the use of chemical weed control methods complemented by hand hoeing is preferred over weed control by hand only. This is one of the reasons why the demand for hired labour at Horseshoe Irrigation Scheme was limited.

Market oriented production is highly reliant on access to essential support services such as a reliable water supply, timely and good quality land preparation services, easy access to all the required inputs and expert extension advice. Without all these support factors in place, market oriented production may just be too risky to draw potential participants into this type of enterprise. The experiences at HACOP Irrigation Scheme demonstrated that a well organised farmers co-operative is able to provide most of these services to its members, with the exception of extension advice. Interestingly, local extension staff appeared to perform much better in a specialised market oriented environment than under subsistence oriented farming conditions, and were able to provide services to the satisfaction of their clients. It appeared that the training programmes of extension staff prepared officers quite adequately for the task of providing support and advice to market oriented farming.

From the assessment of HACOP and Horseshoe Irrigation Schemes it was evident that access to large plots (1ha or more) was an important factor in shifting production objectives away from subsistence into the direction of market-oriented production, and that this shift was responsible for an increase in the contribution of agriculture to household income to the extent that at Horseshoe Irrigation Scheme, where plots are 2ha in size, irrigated crop production was the main source of income. When livelihood becomes dependent on the sale of agricultural products, adequate access to markets becomes crucial. The favourable location of Horseshoe Irrigation Scheme close to a major urban centre ensured that access to markets is almost un-limited. However, not all schemes share this advantage. Access to markets was found to be a major constraint at HACOP Irrigation Scheme, which is located in a sparsely populated and impoverished part of the central Eastern Cape, far removed from urban centres. The high transport and transaction costs of marketing common vegetables such as cabbage and potatoes in urban centres were found to make crop production no longer economically viable, threatening the future of farming at the scheme. Similar constraints may affect future market oriented production at some of the other schemes (e.g. Tyefu Irrigation Scheme). There is a need for the development of appropriate marketing systems for small scale irrigation farmers and a need for alternative crops and cropping patterns. Marketing systems may include contract marketing to whole-salers, retailers and hawkers, where transportation costs form part of the contract; or house-to-house delivery contracts, where for example a scheme member is made responsible for retail and delivers on a weekly or monthly basis a predetermined vegetable basket to households in the region, using animal draft for transportation. Where economically viable, road stalls could be built aimed at selling produce to passing motorists. The current crop selection and cropping patterns used at the schemes are not always appropriate to ensure favourable marketing conditions. Simultaneous planting of cabbage and potatoes by many farmers results in a very narrow window of marketing opportunities. All farmers have the same crop ready for marketing at the same time, causing a local glut, a drop in prices and parts of the crop being spoilt. Sequential planting of small areas to a wider range of crops would extend the time during which fresh produce can be marketed. Introducing crops which can be processed on site (e.g. by drying) or crops where the marketable component is not bulky (e.g. essential oil crops) may remove the constraint of high transportation costs.

Market oriented farming is a business. It may require accessing loans for production or capital investment and it definitely requires farmers to maintain a reasonable level of financial management. Access to finance was shown to be available to farmers through Ciskei Agricultural Bank. The study showed that many market oriented producers experience difficulties in repaying production loans at one or other stage. At Horseshoe Irrigation Scheme farmer's loan facility was suspended as a result of their poor repayment record. Subsequent financing by the scheme, combined with assistance in management of their finances, evolved quite rapidly into a service supply system based on cash on delivery. It follows that access to production loans is not necessarily needed when production practices ensure a steady cash flow. However, the development of such a financial system does require farmers to be assisted in managing their finances. The need for financial management assistance is partly explained by the low educational level among farmers at the schemes.

Food plots schemes were designed to be a trap by failing to incorporate the progression of farmers from subsistence oriented to market oriented producers into the scheme design. Socially, food plot schemes were found to suit the aspirations of local rural people when the introduction of an irrigation scheme on land to which they had a prior right was considered, because of the high degree of equity it provided. It has been argued that institutional change with respect to tenure security may lead to conditions which favour selected farmers to shift their production objective from mainly subsistence to mainly market oriented production, by accessing additional land through land transactions between plot holders. This shift will expose farmers to a number of new challenges, of which production practices, marketing and financial management are the most important. The shift will also create new demands in terms of scheme organisation and the supply of support services. Factors such as ready access to inputs, good quality land preparation, a reliable water supply and expert extension co-determine success. Well organised farmers organisations were found to be able to handle many of these new challenges and their development needs to be encouraged and supported.

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CHAPTER SEVEN

RECOMMENDATIONS

7.1 RECOMMENDATIONS FOR EXISTING IRRIGATION SCHEMES

7.1.1 Financial viability

Three of the four schemes at which standard food plots of 0,16-0,25ha are found, are managed by a parastatal (Ulimocor). In 1991 this parastatal redefined its mission, making farmer support its core business and withdrawing from active agricultural production. However the staff structure of the parastatal was never adapted in function of this new mission, causing an excess number of staff to remain on its books. Parastatal staff are deployed mainly at the schemes. The impact of most of these staff on farming activities at the schemes is minimal. The high staff cost causes the subsidy requirement of the schemes to be artificially high. In some cases the annual subsidy exceeds the total monetary value of crops produced by farmers at the scheme.

It is recommended that farmer support services at the schemes are restructured. The new structure must be geared towards addressing the essential needs of farming at the schemes,. These essential needs include access to a reliable supply of irrigation water, timely access to good quality land preparation services and access to information and training. The proposed restructure of farmer support services is expected to reduce the subsidy requirements of the schemes to a fraction of their current level.

There is potential to reduce the subsidy requirement of irrigated food plot production further by encouraging farmers to adopt responsibility for mechanised land preparation, as is already the case at some schemes. A conversion from mechanised land preparation to a system based on animal draught could also be considered as this may be financially advantageous to farmers. However, the current level of dependency on mechanised land preparation prevents this conversion to be realised in the short term. Irrigation schemes or sections of schemes with standard food plots have little potential to ever become financially self-sustainable, because they will continue to rely on state subsidies for water supply. However, they are considered a potentially suitable instrument for the state in its endeavour to alleviate rural poverty, whereby an annually recurrent subsidy by the state is multiplied through productive activity by food plot holders.

7.1.2 Plot size and land tenure

Results of the current study suggest that an increase in plot size from 0,16-0,25ha, which is the size of a standard food plot, to plot of 1 or 2ha, encourages a more commercial approach to agriculture and increases the potential of schemes to become more financially self-sustainable. Generally, the lay-out and land distribution at schemes with standard food plots do not favour an increase in plot size. However, institutional reform with respect to tenure security may open a market for land rentals, enabling farmers to increase their land holding. There was already evidence of land transactions through rentals at one of the six schemes, and these appeared to have a positive effect on allocative efficiency and land use intensity. Increases in the size of plots appeared to encourage commercial orientation of production.

This brought about a new set of farmers' needs, of which access to markets and expert advice on production practices and financial management were the most important.

It is recommended that the development of conditions suitable for land transactions to take place is encouraged by engaging land right holders at the schemes in a process aimed at farmers acquiring adequate security of tenure over their plots. This process must pay special attention to the set of rights and their duration and assurance pertaining to land leases. The rights of both lessor and lessees need to be sufficiently secure, and mechanisms enabling their enforcement need to be developed and put in place. Where equity is important, as is the case on schemes developed on land held under communal tenure, land leases are the preferred way in which land transaction should occur, because equity is preserved.

The tenure system at most of the schemes was found insufficiently secure to provide land right holders with the freedom to make the full range of possible decisions about their land, such as the renting out or selling of their land. The large majority of plot holders favoured title deed to their plots. In other countries, such as Mexico communal land tenure systems have been transformed successfully, and there was no evidence of factors preventing a similar reform from being implemented on irrigation schemes in central Eastern Cape.

It is recommended that the constraint of plot size being too small to afford farming households with an opportunity of making agriculture their main source of income is addressed indirectly by providing plot holders with greater security of tenure over their plots. This can be achieved by extending title deed, or by means of other suitable ways of providing plot holders with a maximum possible or socially most desirable degree of freedom of decision over the use of their land.

7.1.3 Water supply and irrigation infrastructure

The results of the study clearly demonstrated that food plot holders rely heavily on the state for the supply of irrigation water, including the maintenance of the supply system.. The economics of standard irrigated food plot production, the socio-economic profile of food plot holders at the schemes and experiences in other African countries make it highly unlikely that this condition can be turned around fundamentally.

It is important that farmers realise that water is an economic good , and therefore costs money. It is equally important that they realise that harnessing and conveying water from rivers to farmer fields also has a cost attached to it.

It is, therefore, recommended that the level of dependency is reduced at least partly. This can be achieved by:

- Transferring responsibility of maintaining in-field irrigation equipment to farmers;
- Making farmers realise that there is a cost attached to supplying water, by demanding farmers to pay a token charge for water supply services, a measure which is also expected to encourage a land market and productive use of the land;

- Encouraging farmers where possible, to make use of more than one sprinkler, which could reduce intervals between applications and frequency of changing sprinkler positions.

- Involving farmers in water management decisions at scheme or section level, through the development of water user associations, whereby the supplier of water supply services becomes responsible to the group of end-users, with a view of improving the standard of this service.

7.1.4 Farming systems

At most schemes irrigated food plot production was planned to make use of modern technology to be sourced by farmers from central unit, thus demanding a radical break-away from traditional rainfed based systems, which relied mainly on on-farm resources. Choice of crops, on the other hand, was not affected much by this change, farmers continuing to grow crops which feature prominently in the diet of local people. At the schemes under investigation, 90-95% of land was planted to three crops only, namely maize, cabbage and potatoes. When plots were small, marketing of these crops by farmers appeared not to be a limiting factor, because a lot of produce was sold locally. Once the size of plots and the quantities that were being produced increased, marketing of crops became more difficult to achieve and was found to depend on factors such as seasonal demand and supply and distance to major markets. As a result, there is a general need for the identification of suitable crops that can be grown profitably, without being as sensitive to market conditions and distance to markets as the current range of crops grown. At this stage such crops have not yet been identified. There is also scope to reduce operating costs of irrigated agriculture by adopting more sustainable technologies. Animal traction is a prime example of an option that needs to be investigated urgently in the context of irrigated agriculture.

It is recommended that a major research effort is launched to develop alternative cropping systems and production technologies for use by small scale irrigators and to test potentially suitable interventions under on-farm conditions. The proposed research effort should be aimed primarily at increasing the profitability of small scale commercially oriented irrigated agriculture.

7.1.5 Extension

The present extension system supporting irrigated crop production at schemes with standard food plots was found to be ineffective. Invariably, extension staff at these schemes appeared to fail to effectively address the advisory needs of farmers, whose objectives combined subsistence and sales oriented production. At schemes where plots were large and production mainly market oriented the extension service appeared more appropriate and consequently more appreciated by farmers. It appeared, therefore, that the training programmes offered to aspirant extension officers failed to impart an understanding and appreciation of subsistence oriented production . This may be the root cause of the high degree of observed alienation between extension staff and farmers at the schemes.

It is recommended that specialised training is offered to aspirant or serving extension officers deployed on small scale irrigation schemes. This training should cover the various conventional aspects of irrigated agriculture, preparing trainees for service in a commercially oriented production system. It should also pay attention to the social, economic and institutional aspects of subsistence farming and its importance in the livelihood package of impoverished rural households.

7.2 RECOMMENDATIONS AND SUGGESTIONS FOR FUTURE SCHEMES

Considering the experiences gained on existing schemes, it is not recommended that the concept of an irrigated food plot scheme, involving small sized plots of a fraction of a hectare, is replicated where ownership of the land allows for farmer settlement . All indications are that the economic returns from production on small plots do not allow participants to re-pay the cost of infrastructural development and also appear to depend on a recurrent state subsidy towards paying the cost of water supply and access to information (extension).

Whereas development of schemes consisting of small plots are not recommended, irrigation schemes consisting of larger plots should be considered seriously as a way of providing rural households with a livelihood option. Irrigated plots of one or more hectares appear to have the potential to provide farmers with a reasonable income, which, when added to other sources of income, can provide for a reasonable quality of life. The study showed that plots of 2ha were large enough to make agriculture the main source of household income of farmers. When plots are sufficiently large to encourage households to make agriculture their main economic activity, the need for a recurrent subsidy from the state was found to be much less. Under such conditions financial self sustainability of small scale irrigation farming may be achievable. This would require farmers to adopt farming systems which suit small scale agriculture, whilst still generating adequate profits. Use of animal traction, on-farm resources in nutrient cycling, appropriate marketing systems and other practices, will need to be developed and tested under on-farm conditions. The impression was gained that at this stage of South Africa's development practices tailored to suit small scale irrigation have not received the attention they deserve.

Where the introduction of irrigation on land held under communal tenure is considered, the development of standard food plot schemes may still be the best way to do so. Experience at Tyefu Irrigation Scheme showed that the high degree of equity inherent to food plot scheme development is socially particularly attractive under such conditions. By providing secure tenure to land, separating land rights from the right to water, and attaching a cost to the use of water, it is expected that over time a market for land and for water rights could develop. This, in turn, is expected to result in selected plot holders expanding their land holding and shifting their production objectives from mainly subsistence to predominantly market oriented. The supply of land is expected to come from plot holding households who wish to package their livelihood differently and prefer to derive benefits from making available their land and water rights for use by others, rather than through active farming.

It is recommended that future planning of food plot schemes on land held under communal tenure considers security of tenure over irrigation plots as part of the planning process.

Lessons learnt from existing schemes show the importance of assigning co-ownership and co-responsibility over scheme infrastructure to farmers. When this is ignored, farmers develop dependency and expect the state to service and maintain the available infrastructure.

It is recommended that any new irrigation development should address the issues of ownership of and responsibility towards scheme infrastructure at the stage of planning.

Lastly, it is recommended that the development of future irrigation schemes should follow the guidelines for local economic development and should be the result of an informed decision by participating communities to become engaged in irrigated crop production. The example of HAIS suggests that initiatives based on local economic development processes can rely on a large degree of ownership and commitment, attributes which are much less expressed at schemes developed as a result of a government initiative.

7.3 RECOMMENDATIONS FOR FURTHER RESEARCH

The current study raises a number of questions and identifies a need for more detailed work, using methodologies suitable for this purpose. There is a need to conduct an in-depth analysis of the existing data set with a view of identifying in-scheme variability among farmers. This type of analysis is expected to provide useful information about ways in which different types of households make use of their irrigated plots in packaging their livelihood. From the data collected on gross household income derived from food plot production, it was evident that this variability did exist.

Generally, the study identified a need for research aimed at developing a set of practices and production systems that suit small scale irrigated agriculture. These should enable farmers to reduce operating costs whilst maintaining a high level of profitability. It is suggested that this research considers possibilities of replacing capital with labour, and external or purchased inputs and services with on-farm resources.

A need was identified for alternative crops that are less perishable than those grown on the schemes at present. Marketing of fresh produce was at times a serious constraint in small scale irrigated agriculture. Research into alternative marketing strategies which suit the conditions of small scale farmers was also identified as a need..

There is also a need to investigate the economics and other aspects of overhead versus surface irrigation in the context of small scale irrigation. Whereas at this stage farmers appear to prefer overhead irrigation, because of its ease of use and relatively low labour requirements, it is possible that when presented with the real costs of these systems farmers may prefer surface irrigation.

Little is known about the irrigation efficiency that is being achieved by farmers on small scale irrigation schemes. From the responses it appeared that farmers are over-irrigating, but field observations suggested the opposite in many cases. Considering that water is increasingly becoming a scarce resource in South Africa, studies directed at improving water use efficiency in small scale irrigation are urgently required.

There is also a need for research work to be conducted into the processes that may lead to enhanced security of tenure by which land is held by farmers at schemes is governed by common property institutions, and for the documentation of the impact of these processes on the productivity and allocative efficiency of irrigated land. It is recommended that such