Gender-Sensitive Irrigation Design

An assessment of the implications of pump breakdown and community participation in irrigation schemes, Masvingo Province, Zimbabwe

E Berejena
J Ellis-Jones
N Hasnip

Report OD 143 (Part 5)
December 1999

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DFID Department for International Development

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Executive Summary

Gender-Sensitive Irrigation Design

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The Gender Sensitive Irrigation Design project, in Zimbabwe, has been undertaken in two phases.

- Phase I, (October 1997 to February 1998) identified and prioritised design issues which have important gender implications.
- Phase II commenced in July 1998 with focus group discussions at eight irrigation schemes in Masvingo Province to investigate the three major issues identified in Phase I, namely access to resources, equipment and land preparation and marketing.

The overall issues of farmer participation and gender implications were continued in Phase II. However, in considering equipment in Phase I there was also significant evidence to suggest that the inclusion of pumps in scheme design gave particular problems. It was clear that women were vulnerable and poorly situated to deal with these problems as highlighted in the focus group studies in Phase I.

Conclusions and recommendations from the focus groups highlighted the need for further investigation to:

- Link the level of participation at design stage and the general support found in schemes to the subsequent level of female involvement, particularly in decision-making, use of water, land, labour and productivity.
- Quantify the implications of pump unreliability and its effect on farmers' incomes and livelihoods.

This study provides further insight into these two components.

At the design stage, support tends to be provided in different ways by Government, NGOs and private sector with different policies being applied by donors. This results in different farming and operation practices and different levels of subsequent involvement by men and women in operation, maintenance, and decision-making. The study recommends that before new schemes are introduced the technical and cost implications must be fully discussed with potential users to facilitate informed decision-making and avoid non viable schemes that become a financial drain on both government and community resources. In existing schemes, women's roles in operation and management should, and can be, increased through on site and flexible training programmes with timetables that take into account women's domestic responsibilities.

The study has highlighted that wherever possible pumps, especially diesel pumps, should be avoided through the use of well-designed gravity fed schemes. Where there is no other alternative to diesel pumping, the farmers need to be aware of the operating risks and the full implications of the costs (direct and indirect), so they are able to make an informed choice. The study has shown that where farmers are given responsibility for pump use and maintenance, it is men that tend to assume this responsibility even when women are the main users of water. As a result women are not trained and in the absence of trained pump minders are unable to ensure water availability. This often places an additional work burden on women to cart water to ensure domestic food/vegetable requirements are met. Women should be included in training courses on pump care and operation, which should be supported by clear illustrated guidelines and instructions their local language.

Acronyms

AGRITEX	Department of Agricultural and Technical Services
CARE	CARE - a Non Government Organisation
COTCO	Cotton Company of Zimbabwe
DAP	Draught animal power
DWD	Department for Water Development

Acknowledgements

We would like to acknowledge the support provided in this study by AGRITEX, DWD and CARE staff as well as farmers at each of the schemes for providing so freely of their time and giving the information on which this report is largely based. We would also like to thank the staff at Irrigation Supplies and Stewart and Lloyds, in Masvingo, for providing costs for engines, pumps and other irrigation equipment.

Currency

The currency used throughout is Zimbabwe dollars (Z$). At the time of the survey, the exchange rate was Z$60 to £1 Sterling.

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1. BACKGROUND, SUMMARY AND RECOMMENDATIONS

1.1 Background and purpose

The Gender Sensitive Irrigation Design project, in Zimbabwe, has been undertaken in two phases.

- Phase I, (October 1997 to February 1998) identified and prioritized design issues which have important gender implications.
- Phase II commenced in July 1998 with focus group discussions at eight irrigation schemes in Masvingo Province to investigate the three major issues identified in Phase I, namely access to resources, equipment and land preparation and marketing.

The overall issues of farmer participation and gender implications were continued in Phase II. However, in considering equipment in Phase I there was also significant evidence to suggest that the inclusion of pumps in scheme design gave particular problems. It was clear that women were vulnerable and poorly situated to deal with these problems as highlighted in the focus group studies in Phase I.

Conclusions and recommendations from the focus groups highlighted the need for further investigation to:

- Link the level of participation at design stage and the general support found in schemes to the subsequent level of female involvement, particularly in decision-making, use of water, land, labour and productivity. *This has concentrated on Rupike and Mushandike irrigation schemes.*
- Quantify the implications of pump unreliability and its effect on farmers' incomes and livelihoods. *This has concentrated on Chemombe, Chinyamatumwa and Rupike irrigation schemes*

This study resulting from visits to these schemes and discussions with key stakeholders provides further insight in to these two components.

1.2 Irrigation scheme comparisons

Each scheme differs in size, plots per farmer and irrigation methods, but also the development of each has varied with provision of capital and operating costs. These being provided in different ways by Government, NGOs and private sector with different policies being applied by donors. This has resulted in some schemes being farmed largely by women (Chemombe and Rupike), although men still play a key role in operational management and decision making. Some such as Mushandike are farmed and operated largely by men whilst others such as Chinyamatumwa are largely operated by women. However, in all schemes women farmers dominate the smaller areas growing predominantly food crops. A detailed profile of each scheme is shown in Appendix 1.

Little variation in the land area allocated per farmer for irrigation occurs at Rupike (0.5 ha), Mushandike, (1.5 ha) and Chemombe (0.02 ha). At Chinyamatumwa, however, there is much greater variation in land sizes (Table 1).

Table 1 Plot size and number at Chinyamatumwa Irrigation Scheme

Area (ha)	No of plots	Total (ha)
1	8	8
0.7	12	8.4
0.6	6	3.6
0.4	12	4.8
0.1	95	9.5
Total	***133***	***34.3***
Average		*0.26*

Number of farmers = 128 (58 men, 70 women)

1.3 Farmer participation

Work priorities
Women undertake most domestic work and decision-making determining priorities related to this work. Women are responsible for determining work priorities and decision-making on vegetables, groundnuts and other food crops for household consumption. The women retain income from sales from these crops. Men and women share decision making on irrigated and dryland farming, although there is clear gender differentiation in work duties. Men are largely responsible for determining work priorities for livestock and cash crops, particularly cotton, retaining the income from sales.

Crop resource decisions
At Rupike, women make most decisions with regard to irrigated farming with considerable input from extension workers and men are largely responsible for dryland operations. At Mushandike, men dominate decisions, apart from non cash crop vegetable production. On both schemes, men have greater access to, control over and use of resources.

Control of access to resources
Men generally have greater control over access to resources, other than on the smaller irrigation plots (Rupike) and for crops where women have greater control (vegetables, primarily for household consumption).

Role in scheme management
At both schemes men dominate the decision making in farmer committees, although ordinary men and women feel they are able to influence how the schemes operate.

Profitability
Margins of cash income over expenditure from the case studies show that low achievers obtain negative cash returns in both summer and winter. Average achievers at Mushandike obtain negative cash returns in winter and at Rupike cash returns are low but positive in both summer and winter.

Table 2 Margins of cash income over expenditure (Z$) by different categories of farmers.

Farmer achievement	Summer 97/98	Winter 98	Total
	Mushandike 1.5ha)		
Low	-5300.00	-5350.00	-10, 650.00
Average	11137.00	-72.00	11, 065.00
High	82120.00	2010.00	84, 130.00
	Rupike (0.5ha)		
Low	-1215.00	-2430.00	-3, 645.00
Average	865.00	1479.00	2, 344.00
High	3102.00	4328.00	7, 430.00

The greatest proportion of expenditure was incurred on fertiliser (55%) and electricity (20%) at Rupike. At Mushandike, the proportion of expenditure on fertiliser was 37%, chemicals 20% and water 17%. At both Mushandike (and Chinyamatumwa) farmers are struggling to pay their water bills and think that they are too high. Water is the third highest category of cash expenditure on average but the highest category for low achievers.

Marketing decisions
Women are largely responsible for decisions regards marketing of vegetables, while men are responsible for the marketing of all other crops. Marketing committees play an important supporting role in most crops that are not sold locally.

Views on irrigation
All those interviewed see very positive benefits from having access to irrigation, notably food security, reliable harvests, higher incomes to pay for children's' education and provide a higher standard of living. However there are some concerns, notably, the high cost of water and electricity, increases in the prices of other inputs and a lack of transport.

Differences between the schemes
There are major differences between the development of the four schemes, which have affected the level of support provided to farmers and the roles of men and women in their farming and scheme management as set out in Appendix I. In summary:

- Chemombe is a small garden scheme developed as a small dam rehabilitation scheme with 63 farmers, initially supported by CARE Zimbabwe, but now by Agritex. Mainly women work in the garden as the men concentrate on their dryland plots, although they rely on the male chairman to operate their small diesel pump.

- The government, with JICA support built Chinyamatumwa, just after the 1992 drought. There are 128 farmers who receive support from Agritex and the Department for Water Development (DWD). Many households lost their dryland farming areas due to the scheme and the dam, but these have larger areas of irrigated land than those who still have dryland plots. Women tend to do most of the work on the irrigated plots but often experience problems due to pump failure.

- Mushandike was part of a large resettlement scheme, built in the 1980s supported by Agritex and the Department for Water Development. There are now 250 farmers who have no dryland plots and therefore both men and women work on the land.

- Rupike was originally initiated and supported by Rio Tinto but was handed over to the government in 1996. The farmers now manage the scheme with some support from Agritex and DWD. There are 200 farmers on this scheme, who are predominantly women as the men tend to concentrate on their dryland plots.

1.4 Implications of pump breakdowns

Loss of productivity on the four schemes due to pump breakdown has been summarised and is very considerable.

Table 3 Productivity loss for each scheme as a result of pump breakdowns (Z$ per year)

Scheme	Loss per farmer	Loss for whole scheme
Chemombe	1 900	120 160
Chinyamatumwa	26 000	3 352 000
Rupike	1 700	340 000

The main lesson coming from this analysis is that pumps, especially diesel pumps should be avoided wherever possible through the use of well-designed gravity fed schemes. This would have been possible at Chemombe through better siting of the area to be irrigated, even though the irrigated land would have been in 2-3 separate blocks. It may also have been possible at Chinyamatumwa, although irrigated lands would have been considerable distance from the dam wall itself. In both cases the capital cost of the irrigation may have been more expensive as a result of longer distances of buried line or open canal, but the savings in operating costs and loss of productivity resulting from pump failure would have been considerable. The alternative of bringing electricity to the pump site would require a relatively simple cost-benefit investment appraisal.

Where there is no other alternative to diesel pumping, the beneficiaries need to be aware of the operating risks and the full implications of the costs (direct and indirect), so they are able to make an informed choice. In the case of Chinyamatumwa, the beneficiaries were unaware so that pump failure along side the introduction of water charges has meant that they had to subsidise their irrigation from other revenue sources. As a result the scheme has made some households worse off than they were with no irrigation.

Farmers in Masvingo Province will increasingly find it difficult to pay the full costs of irrigation as schemes (such as Chinyamatumwa) are effectively handed over to the farmers and they become fully responsible for all operating and maintenance costs. Flood schemes such as Mushandike will have considerable advantage over pumped schemes as they will only have to pay for water and not for any fuel consumption.

As farmers are given responsibility for pump use and maintenance, it is men that assume this responsibility even when women are the main users. As a result women are not trained and in the absence of trained pump minders are unable to ensure water availability. This often places an additional work burden on women to cart water to ensure domestic food/vegetable requirements are met. Pump breakdowns have also led to reduced or lost incomes.

With regard to the schemes that have formed part of this study, the following specific conclusions are made:

Chemombe

- Training or Retraining of irrigatiors, including women, in pump care and operation is required. Reliance on one individual as a pump minder and operator is likely to lead to future problems.
- No pump manuals have been provided. A straightforward illustrated manual written in Shona is

required for the farmers.

Chinyamatumwa

- Conflicts between pump attendants, farmers and extension staff need to be resolved.
- Farmers need to be trained in routine maintenance, and take over the role of pump attendants.
- Farmers should be allowed to purchase their own diesel and the costs deducted from the water charges
- Where DWD does not have the resources to undertake the necessary maintenance and repairs, private contractors should be used to provide the necessary support.

Rupike

- On this scheme relationships between farmers and DWD pump attendants (who live locally and are also farmers) are good.
- Provision needs to be made for the replacement of capital assets, which have been handed over to farmers by Rio Tinto. This includes in-field irrigation equipment, tractors and implements, workshop and storage facilities. Particularly important is the in-field irrigation equipment, which is in poor condition.
- Other schemes could benefit from the initial and follow up training that was provided in irrigation methods and scheme management as it has proved to be very successful at this scheme.

Mushandike

- The major issue of payment for water requires more sympathetic treatment if costs are to be recovered.
- There is opportunity for increasing women's' roles within the scheme. An example would be a women extension worker to facilitate improvements to production and marketing of horticultural produce.

1.5 Policy implications associated with funding pump maintenance and replacement

The main policy considerations in ensuring future scheme viability are associated with:

- *Who is responsible for pump maintenance?*
- *What criteria are needed to assess appropriateness of pump adoption?*
- *Who pays for maintenance, repair and replacement?*
- *What skills development is required to facilitate maintenance and long term planning?*

Clearly it is Government policy for water users to pay an economic cost for water. This includes all recurrent costs of operating and maintenance as well as an element for the capital cost. The productivity potential of the schemes could allow these costs to be levied and paid. However it is incumbent on Government to ensure efficient water delivery and to put in place appropriate institutional arrangements and training to provide for the skills development to allow each scheme's potential to be achieved. This requires that farmers (men and women) are given the management and technical skills for pump operations and routine maintenance with support from skilled mechanics, spares and diesel/electric suppliers. This support will only emerge from the private sector provided there is demand for their services and payment is forthcoming.

At the same time other major constraints to increased productivity (tillage, soil fertility, input supplies, pests and marketing) need to be effectively addressed. Imposition of water charges without addressing these issues intensify problems on schemes. Chinyamatumwa is clearly in this situation at present. Low achievers on both Mushandike and Rupike are already faced with greater cash outflows than inflows and are not in a position to pay water charges. Low achievers are generally the poorest and totally dependant

on the scheme for their livelihoods and will become totally dependant on social relief for survival if they are unable to continue subsistence farming on the scheme. Government is therefore faced with a dilemma:

How to effectively impose economic water charges without increasing poverty within the most vulnerable section of the population?

This could be addressed by providing a small area of land and a small quantity of water, at no or low cost, sufficient for say 0.01ha to all users regardless of ability. All additional water would attract an economic cost. This would provide some measure of security to low achievers (subsistence farmers and other vulnerable groups-particularly women) and at the same time encourage increasing efficiency of use of water resources.

1.6 Recommendations

1.6.1 Farmer participation

(i) There is opportunity to increase women's' roles within the operation and management of schemes. An example would be a women extension worker to facilitate improvements to production and marketing of horticultural produce.

(ii) Training of women in all aspects of irrigation is vital. Training programmes should be on-site and flexible to meet the needs of women with timetables taking into account domestic work.

(iii) Before new schemes are introduced, the technical and cost implications must be fully discussed with potential users to facilitate informed decision making and avoid non viable schemes that become a financial drain on both Government and community resources.

1.6.2 Pump operation

(iv) Training of irrigators, including women, in pump care and operation is required. This needs to be supported by clear illustrated guidelines and instructions in Shona.

(v) Farmers should be encouraged and allowed to purchase their own diesel and pay directly for operating and maintenance costs. These could be obtained from private contractors if necessary and such costs could be deducted from the water charges made by DWD.

(vi) Farmers need to think about saving money for the replacement of capital assets[1]. This includes in-field irrigation, as well as pumps.

(vii) Although it is Government policy for water service provision to be run on commercial lines, the issue of payment of water costs require fair and sympathetic treatment if costs are to be recovered, farmers livelihoods sustained and poverty reduced. Consideration should be given to providing a small area of land and a small quantity of water, sufficient for say 0.05ha to all users regardless of ability. All additional water could then attract an economic cost.

[1] At present no provision is made for replacement of capital assets. This is likely to become a problem at Rupike as tractors, implements, workshops and storage facilities, all donated by Rio Tinto, require repair or replacement

2. METHODOLOGY

2.1 Participation and support

A mini-survey was undertaken at *Mushandike* (village 21) and *Rupike* irrigation schemes to link the levels of support and participation to incomes and production levels. The results from Rupike, initially identified as having higher levels of support (especially in the early stages of the project) and as a result higher levels of farmer participation, were compared with Mushandike perceived as having lower levels of support and therefore lower farmer participation in management.Men and women farmers of various levels of achievement were interviewed at Rupike and Mushandike about:

- Work priorities and duties,
- Crop resource decisions,
- Scheme management,
- Profitability of irrigation,
- Marketing,
- Their views on irrigation.

The stratified sample included high, medium and low achievers.

2.2 The cost of pump unreliability

In order to determine the costs of pump unreliability three schemes were compared.

- *Rupike*, which uses electric powered pumps, draglines with overhead, sprinklers.
- *Chinyamatumwa*, which uses large diesel pumps and flood irrigation with water applied by siphons from concrete in-field canals.
- *Chemombe*, which uses a small diesel pump and flood irrigation with water applied by buckets from troughs within the garden.

Discussions were held at each scheme with scheme users, AGRITEX and NGO extension staff and pump attendants. DWD officials in Masvingo were also consulted to establish the reasons for:

- The frequency and direct costs of breakdown, and
- The productivity consequences of breakdown.

3. FARMER PARTICIPATION IN THE SCHEMES

3.1 Profile of interviewed farmers

Features such as age, gender and marital status all shape and have significant impact on activities in irrigation. (Table 4).

Table 4 Profile of farmers interviewed

In total 17 farmers were interviewed - 9 men and 8 women. Three of the women interviewed are household heads (**FHH**). The other fourteen households are headed by men (**MHH**).

RUPIKE					MUSHANDIKE				
Interviewees	*Male*	**4**	**4 MHH**		**Interviewees**	Male	**5**	**5 MHH**	
	Female	**4**	**3 MHH**	**1 FHH**		*Female*	**4**	**2 MHH**	**2 FHH**
			M	**F**				**M**	*F*
Achievers	*High*	**0**	**0**	**0**	**Achievers**	*High*	**5**	**4**	**1**
	Medium	**6**	**5**	**1**		*Medium*	**2**	**2**	**0**
	Low	**2**	**2**	**0**		*Low*	**2**	**1**	**1**
Irrigated land area	*0.5ha*	**8**	**7**	**1**	**Irrigated land area**	*1.0ha*	**1**[4]	**1**	**0**
						1.5ha	**8**	**6**	**2**
Dryland areas farmed	*Small plot*	**1**	**0**	**1**	**Dryland areas farmed**	*Small plot*	**1**	**1**	**0**
	<0.5ha	**0**	**0**	**0**		*<0.5ha*	**6**	**4**	**2**
	0.5-1ha	**2**[5]	**2**	**0**		*0.5-1ha*	**2**	**2**	**0**
	1-1.9ha	**2**	**2**	**0**		*1-1.9ha*	**0**	**0**	**0**
	2-3.9ha	**3**	**3**	**0**		*2-3.9ha*	**0**	**0**	**0**
	>4ha	**0**	**0**	**0**		*>4ha*	**0**	**0**	**0**
Household size	*Average*	**8**			**Household size**	*Average*	**9**		
	Max	**13**				*Max*	**12**		
	Min	**4**				*Min*	**6**		
Draught cattle owned	*None*	**2**	**2**	**0**	**Draught cattle owned**	*None*	**2**	**1**	**1**
	1-3	**1**	**1**	**0**		*1-3*	**2**	**2**	**0**
	4-7	**2**	**1**	**1**		*4-7*	**3**	**3**	**0**
	>8	**3**	**3**	**0**		*>8*	**2**	**1**	**1**
Donkeys owned	*None*	**7**	**6**	**1**	**Donkeys owned**	*None*	**3**	**1**	**2**
	1-3	**0**	**0**	**0**		*1-3*	**3**	**3**	**0**
	4-7	**1**	**1**	**0**		*4-7*	**3**	**3**	**0**
	>8	**0**	**0**	**0**		*>8*	**0**	**0**	**0**
Implements owned (Each interviewee can own more than one implement)	*Plough*	**6**	**6**	**0**	**Implements owned**	*Plough*	**8**	**7**	**1**
	Cultivator	**1**	**1**	**0**		*Cultivator*	**1**	**1**	**0**
	Oxcart	**3**	**3**	**0**		*Oxcart*	**7**	**6**	**1**
	Ox-planter	**0**	**0**	**0**		*Ox-planter*	**0**	**0**	**0**
	None	**2**	**1**	**1**		*None*	**1**	**0**	**1**

4 At Mushandike one farmer interviewed had 1ha of irrigated land. This is because one of the blocks is not currently being irrigated. The fields in this block are higher than the night storage dam and a booster pump is required to get water to flow down to the fields. The village did not receive this pump at completion of construction, however the pump has since been supplied and installed and it is hoped that the effected farmers will be able to commence irrigating their 0.5ha plots that have been farmed under dryland conditions. Generally farmers at Mushandike practice full time irrigation and therefore do not have dryland.

5 Rupike farmers practice supplementary or part-time irrigation on 0.5ha irrigated plots. Some have dryland plots as big as 3.9ha. Farmers with dryland plots less than 1.0ha are those whose land fell within the irrigation area and the land they hold was only compensated to them by those farmers within the vicinity of the scheme who were invited to join the irrigation project.

Other survey work in Masvingo Province6 showed that most households have access to either an irrigated (from a small dam or borehole) or vlei garden (usually a few beds). Women carry out most decisions and most work, strongly supported by children in these areas. The main crops grown are rape/spinach, tomatoes, cabbage and onions. Most households have a surplus that is sold (91%) or given away (10%). 10% of households grow for home consumption only. Cash incomes from vegetable sales although small are very important for women.

Work priorities and duties

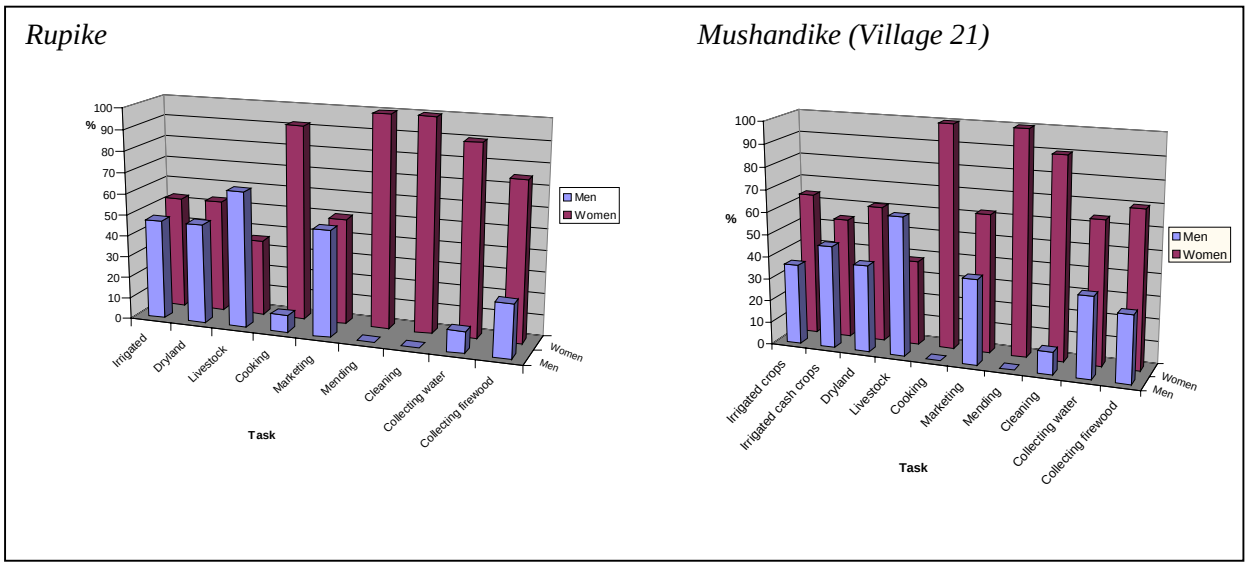

Figure 1 Decisions on work priorities

At household level women make most decisions regarding work priorities. Women dominate decisions regarding domestic work, especially cooking, mending and cleaning. Both men and women are involved in decision making about work priorities relating to irrigated and dryland areas and also marketing. The only task where men are more involved in decision making than women are is regarding livestock (Figure 1).

6 Ellis-Jones J., 1999. Small dams and community resources project. Baseline socio-economic survey. Descriptive statistics. Survey undertaken for CARE in October 1998. IDG/99/12. Silsoe Research Institute.

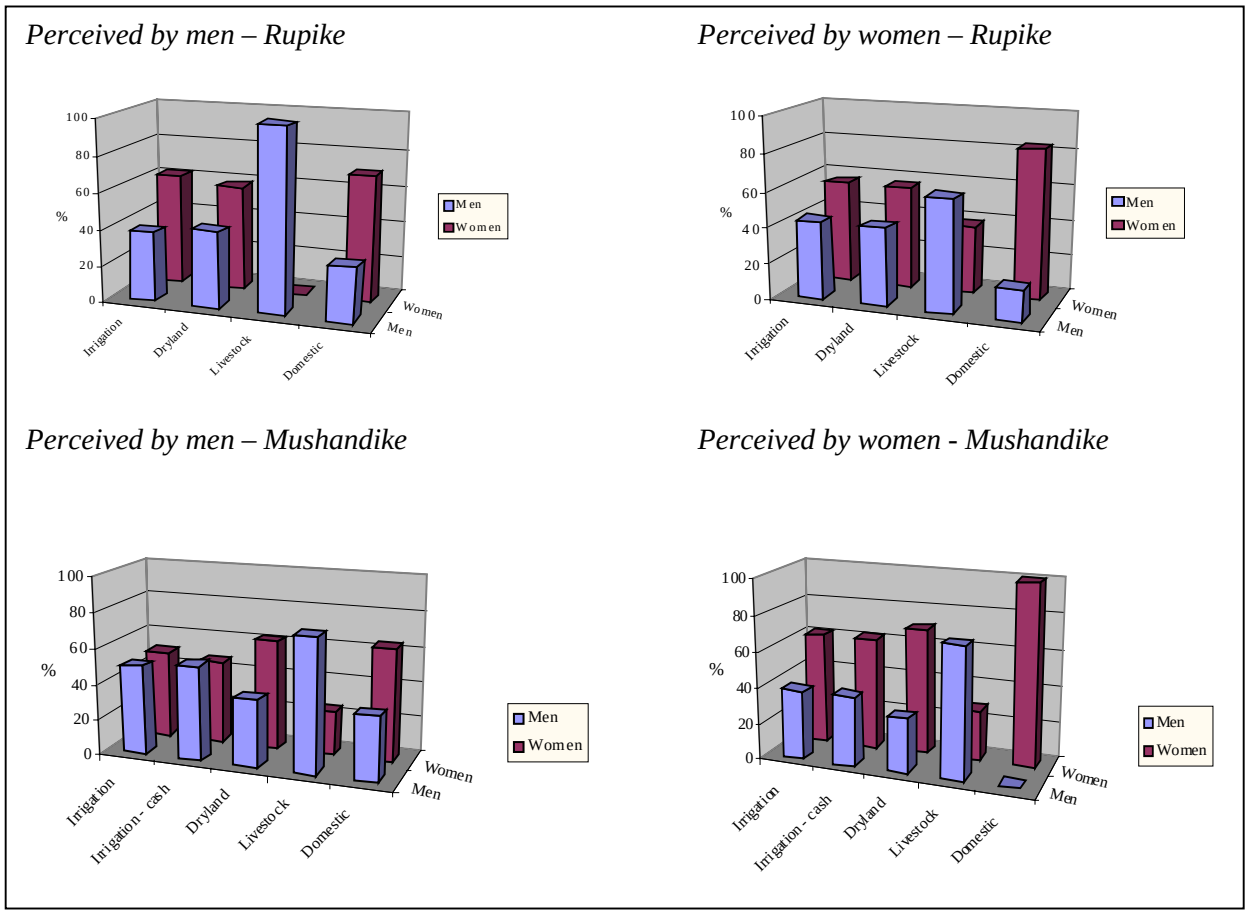

Figure 2 Sharing out the workload

Men at Mushandike think that males and females have a similar workload. They do however think that women perform more of the domestic tasks and work more in the dryland areas, whilst they concentrate more on the livestock. Women at Mushandike however think that they have a greater workload in all tasks apart from livestock. Women perceive that they do over 60% of work on both irrigated and dryland areas, whilst men only do about 35%.

At Rupike men and women are almost in agreement on how the work is shared with the exception of domestic work and livestock They agree that women do a greater share of the work on the irrigated and dryland areas. Where households have a larger area of dryland and a smaller area of irrigation, the men tend to be more involved on the dryland (Figure 2).

At both schemes it is the women in the 21-40-age group whom are perceived to do most of the work. Males (10-20 years) do much of the work with the livestock. A breakdown of age groups perceived to do most of the work at household level is shown in Table 5.

Table 5 Age group and gender of those perceived to do the most work

Men's views – Rupike		Women' views – Rupike	
Irrigation	F 21-40 & F41-60	Irrigation	F21-40
Dryland	F21-40	Dryland	F21-40
Livestock	M<10-20	Livestock	M10-40
Domestic	F21-40	Domestic	F21-40
Men's views – Mushandike		**Women's views – Mushandike**	
Irrigation	M41-60 & F21-40	Irrigation	F21-60
Dryland	F41-60	Dryland	F41-60
Livestock	M10-20	Livestock	M21-40
Domestic	F10-20	Domestic	F21-60

3.2 Crop resource decisions

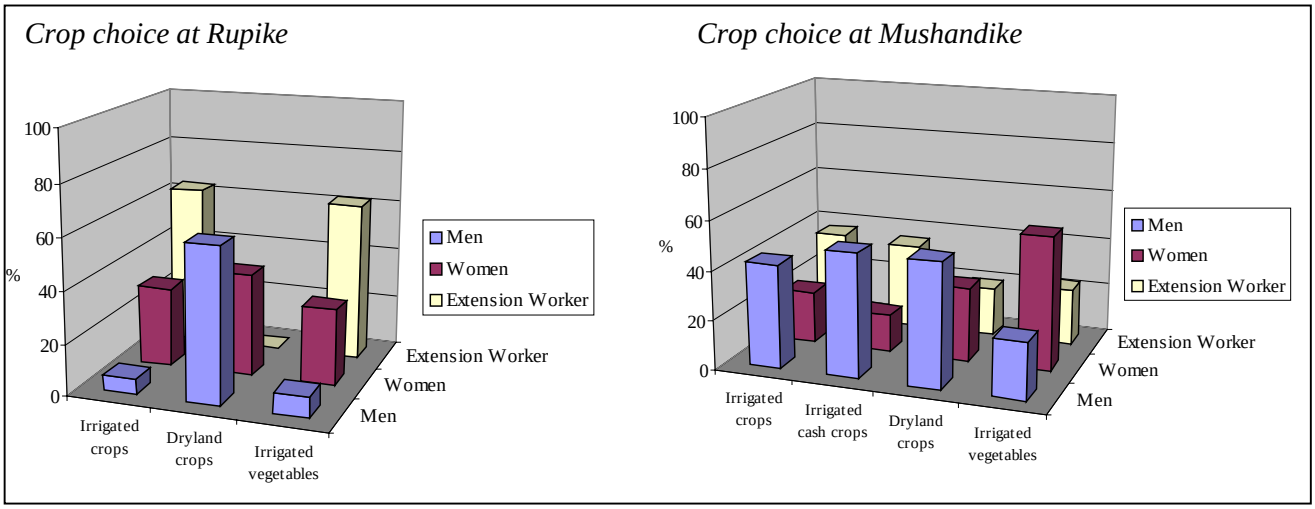

Figure 3 Crop choice decisions

At Mushandike extension staff are the main source of technical advice on cropping programmes. In the households it is male farmers who dominate in choosing the crops apart from irrigated vegetables. This is considered to be due to men mainly attending Agritex meetings and training programmes. As pointed out earlier, the women at Mushandike do more work than the men, but the men make more decisions.

At Rupike women make decisions with guidance from extension staff about which crops to grow. At this scheme, because women tend to be the registered plot holders they are encouraged to make decisions and attend meetings. The men however, make more decisions regarding the dryland areas – probably as they perceive the dryland as belonging to them and the irrigated areas to their wives (Figure 3).

3.3 Control of access to resources

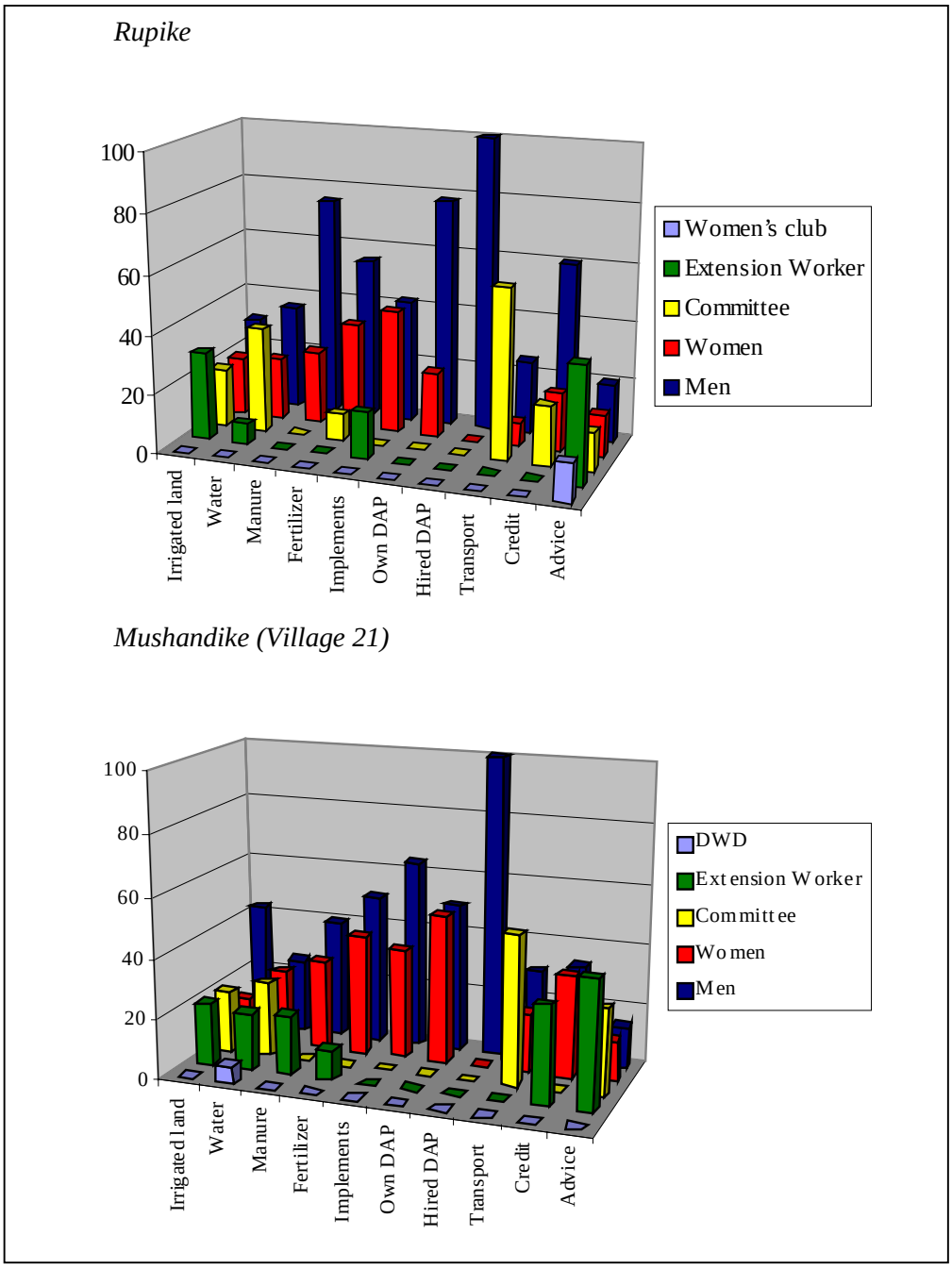

Figure 4 Control of access and use

Although at both schemes, men have more control over access and use of resources than women, the women at Rupike have more control than the women at Mushandike. This links back to the fact that women at Rupike have been encouraged to take an active role in scheme management since the scheme was initiated. At both schemes the committee is perceived to have control over access and use of transport. The extension workers at both schemes give advice and play a role in dictating how the farmers use their land, the water and how much fertiliser and manure to apply. Women's clubs seem to be important in the lives of widows and female headed households in terms of advice (Figure 4).

3.4 Role in scheme management

Of the eight farmers interviewed at Rupike, four have a family member belonging to a committee, whereas at Mushandike, only three out of nine have a committee member in their family. Of the four-committee members at Rupike, two are men aged 21-40, and the other two are men over 41. At Mushandike, two of the three-committee members are males aged 21 to 40 and one is a male aged 41 to 60. At both schemes all interviewees thought that they knew what their family member did at the committee meetings with most giving resolving conflicts, problem solving, fining farmers and scheme management as their reply.

At both schemes older men dominate the decisions of the farmer committees, followed by males and females aged 21-40. At Rupike it was indicated that females aged 10-20 and the extension worker also have say, whereas at Mushandike it is thought that the older females (41-60) have more influence than the younger females. This may be a direct result of the demography at the two schemes – Mushandike has been going for longer than Rupike and therefore the older women may have more prominence at Mushandike.

At both schemes ordinary men and women feel able to influence the way that the scheme operates and develops. The main reason given was the fact that at both schemes there are meetings of all farmers were views can be given and often taken into consideration. However, one female at Mushandike (who is illiterate) thinks that she is taken advantage of by the committee and that they do not explain things to her adequately, especially about the water costs. One person at Rupike thinks that the Block committees get more say and have more influence than farmers who are not committee members.

3.5 Indicative profitability of irrigation

3.5.1 Incomes from crop production

Information was obtained only on the value of crop sales[7] and not crop retention, largely because of the difficulty in obtaining such information. Although it was assumed that most farmers would retain sufficient food crops for their households' subsistence requirements, this was clearly not the case for the poorest households. However, all households do retain some food crops for home consumption and often for sale after the next season yield potential has been assessed.

At Mushandike, most households retained sufficient basic grain for subsistence requirements (ranging from 8 bags to over 40 bags- with surplus over household needs), although some households did not sell any produce. At Rupike, although every household sold maize, sufficient was retained to meet household needs at least until the next season. However, the poorest households often sell to meet immediate cash requirements even though they do not produce sufficient to meet annual domestic requirements. In such cases, the household becomes dependent on food donations either from the community or as part of a Government feeding scheme. Notwithstanding, only one household claimed to have any other source of income outside of farming, indicating that income from crop sales (and possibly livestock) are essential for the purchase of crop inputs. Credit was generally not available.

Mushandike Irrigation Scheme. With the case studies analysed, tomatoes provided the highest proportion of gross income (47% on average). However, excluding one grower who achieved a very high income (over Z$ 80 000) from tomatoes (grown under contract), gross income from tomatoes dropped to 8% of the total, indicating the potential but high risk nature of tomato production. With the bias towards tomatoes excluded, cotton (54%) and maize (19%) including green maize were the most important cash crops (Figure 5).

7 These figures exclude the value of crops kept for domestic consumption and are likely to underestimate the value of vegetable crops, especially when reported by men. The growing, and sales of vegetables is largely a women's' responsibility with men often indifferent to or ignorant of the use of that income

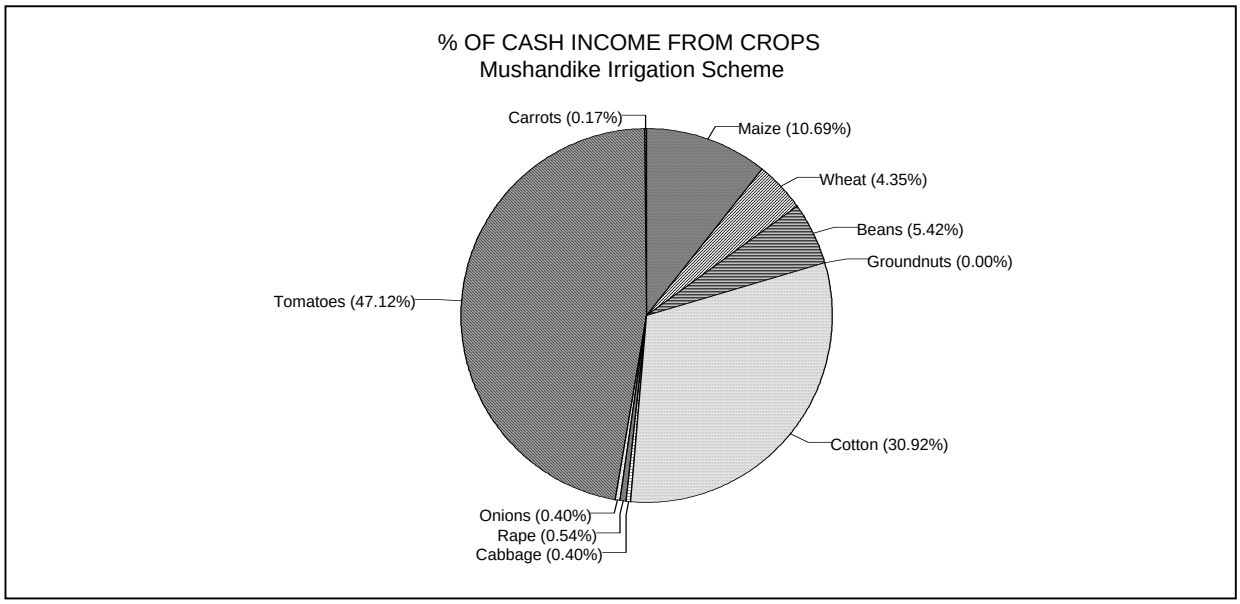

Figure 5 Percentage of cash income form crops – Mushandike Irrigation scheme

The total income from each is shown in Figure 6.

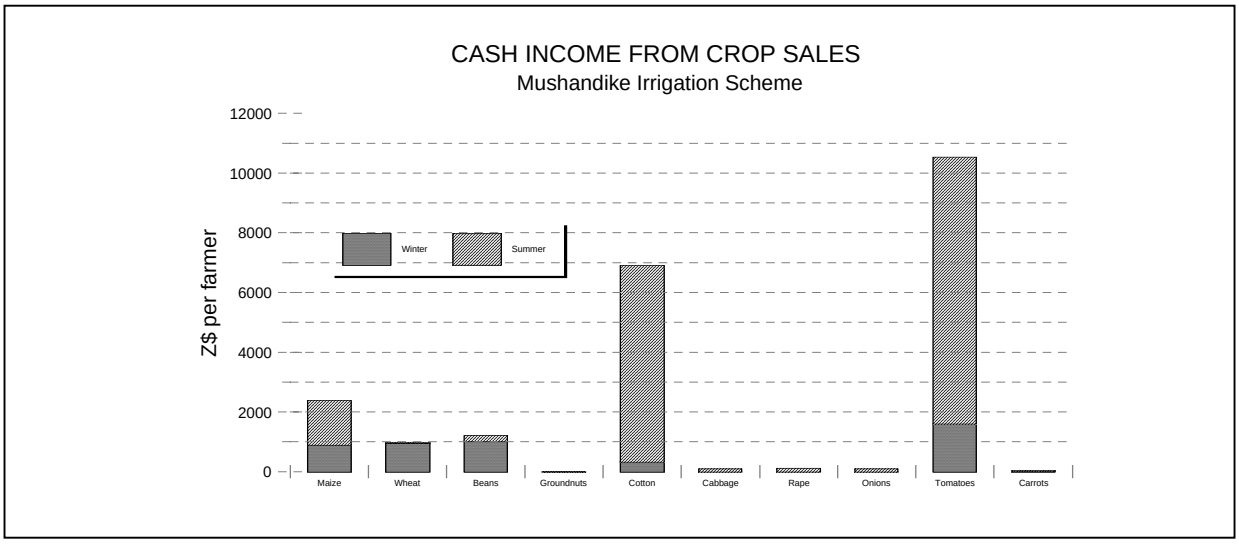

Figure 6 Cash income for crop sales – Mushandike Irrigation Scheme

This emphasises the importance of tomatoes and cotton, as the major cash crops grown on the scheme. It also demonstrates the importance of crops grown in summer for providing cash incomes.

Rupike Irrigation Scheme. Highest incomes came from Maize (37%) and Beans (33%) with vegetables (including tomatoes) comprising 26% of total income (Figure 7).

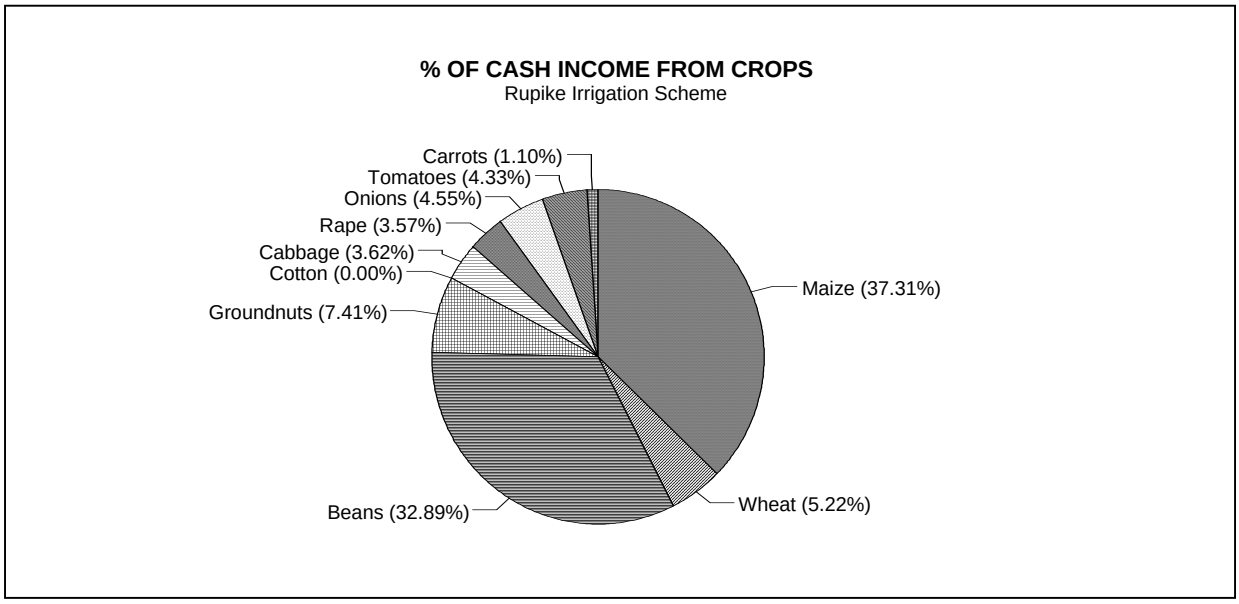

Figure 7 Percentage of cash income for crops – Rupike Irrigation Scheme

This demonstrates the importance of maize for summer income and beans and vegetables for winter income (Figure 8).

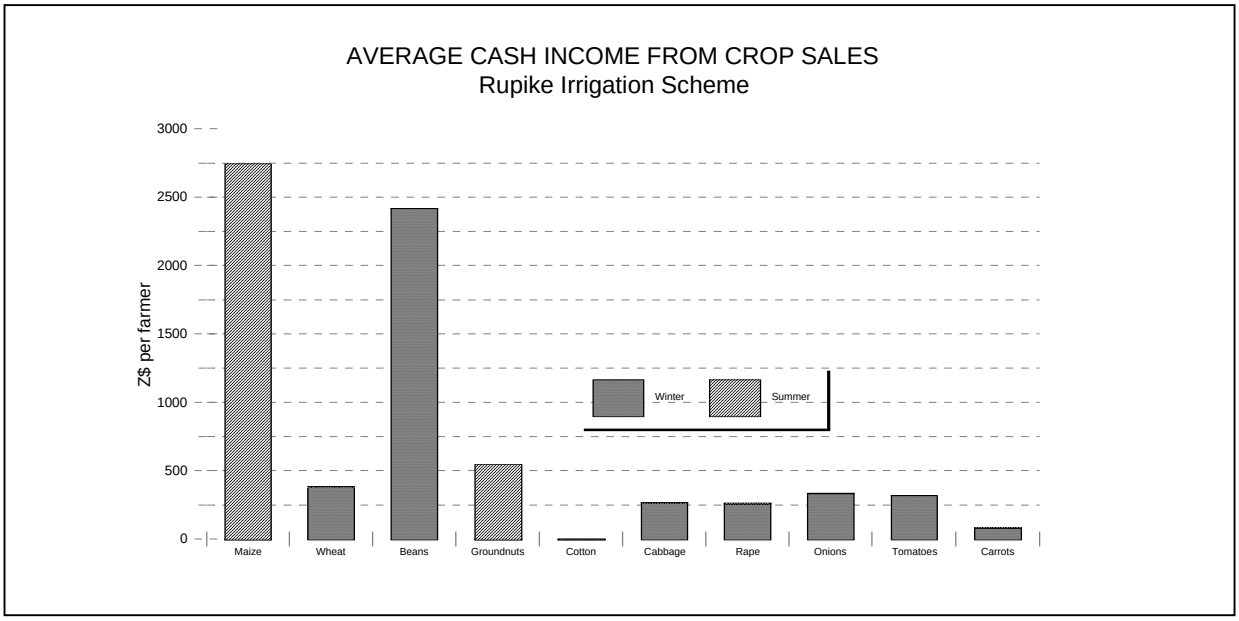

Figure 8 Average cash income for crop sales – Rupike irrigation Scheme

The difference between Rupike and Mushandike can be explained by differences between the two schemes.

- The larger irrigated areas at Mushandike (1.5 ha vs. 0.5 ha) and the very limited dryland farming areas.
- The fact that most farmers at Mushandike are men and at Rupike most are women.
- The greater areas of dryland at Rupike, where men place much of their effort.
- The much sandier soils at Rupike, which are unsuitable for cotton production.

On both schemes there was considerable variation around the average as demonstrated in Tables 6a and 6b.

Table 6a Mushandike: Average incomes and ranges from crop production (Z$)

Summer	n=	Average	Zero	0-1000	1000-2000	2-5000	5-10000	10-15000	>15000
Maize	9	1500	44%	-	22%	22%	11%	-	-
Beans	8	178	88%	-	13%	-	-	-	-
Groundnuts	8	0	100%	-	-	-	-	-	-
Cotton	9	6578	22%	-	-	-	33%	33%	11%
Cabbages	8	89	75%	25%	-	-	-	-	-
Rape/spinach	7	111	71%	29%	-	-	-	-	-
Onions	8	89	63%	38%	-	-	-	-	-
Tomatoes	8	8933	63%	13%	-	-	13%	-	13%
Carrots	7	0	100%	-	-	-	-	-	-
Winter									
Maize	9	889	56%	11%	22%	11%	-	-	-
Wheat	8	972	38%	25%	25%	13%	-	-	-
Beans	8	1033	63%	13%	13%	13%	-	-	-
Groundnuts	7	0	100%	-	-	-	-	-	-
Cotton	7	0	100%	-	-	-	-	-	-
Cabbages	7	8	86%	-	-	14%	-	-	-
Rape/spinach	8	9	88%	13%	-	-	-	-	-
Onions	7	0	100%	-	-	-	-	-	-
Tomatoes	9	1600	44%	44%	-	-	-	11%	-
Carrots	7	89	86%	14%	-	-	-	-	-

Table 6b Rupike: Average incomes and ranges from crop production (Z$)

Summer	n=	Average	Zero	0-1000	1000-2000	2-5000	5-10000	10-15000	>15000
Maize	8	2744	-	13%	25%	63%	-	-	-
Beans	8	0	100%	-	-	-	-	-	-
Groundnuts	8	545	38%	38%	25%	-	-	-	-
Cotton	8	0	100%	-	-	-	-	-	-
Cabbages	8	0	100%	-	-	-	-	-	-
Rape/spinach	8	0	100%	-	-	-	-	-	-
Onions	8	0	100%	-	-	-	-	-	-
Tomatoes	8	0	100%	-	-	-	-	-	-
Carrots	7	0	100%	-	-	-	-	-	-
Other	4	0	100%	-	-	-	-	-	-
Specify	-		-	-	-	-	-	-	-
Winter									
Maize	8	0	100%	-	-	-	-	-	-
Wheat	8	384	38%	63%	-	-	-	-	-
Beans	8	2419	25%	-	-	75%	-	-	-
Groundnuts	8	0	100%	-	-	-	-	-	-
Cotton	8	0	100%	-	-	-	-	-	-
Cabbages	8	266	50%	38%	13%	-	-	-	-
Rape/spinach	8	263	75%	25%	-	-	-	-	-
Onions	7	334	29%	71%	-	-	-	-	-
Tomatoes	8	319	63%	25%	13%	-	-	-	-
Carrots	8	81	75%	25%	-	-	-	-	-

Costs of Crop Production

On both schemes, the cash costs of crop production reflect the high proportion spent on seed, fertiliser and chemicals. The amounts for water and electricity are substantial, especially as charges for these have been recently introduced or increased. The value of household supplied resources, specifically labour and draught animals have not been identified.

Mushandike Irrigation Scheme. Fertiliser, seed and chemicals (for pest control on cotton) comprise nearly 70% of total costs with water adding to this by another 17% (Figure 9).

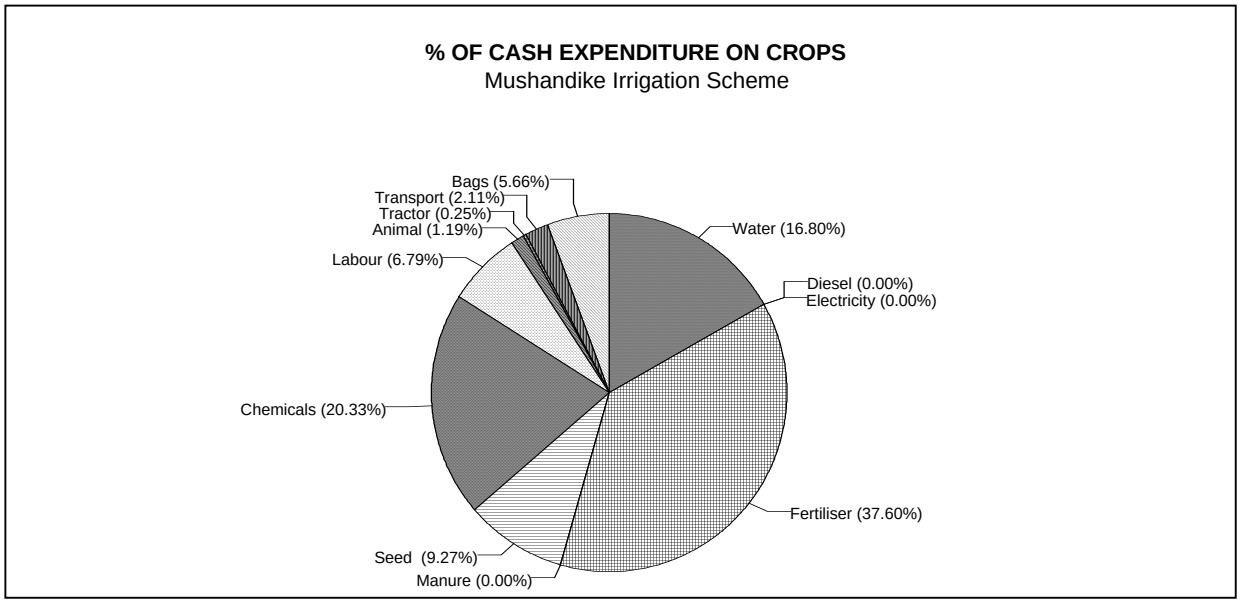

Figure 9 Percentage of cash expenditure on crops – Mushandike Irrigation Scheme

The amounts of cash spent on hiring labour and draft power are relatively insignificant compared to the total costs, as these are mostly supplied from household resources. The actual amounts spent on each item are shown in Figure 10, showing the split between summer and winter cash expenditure.

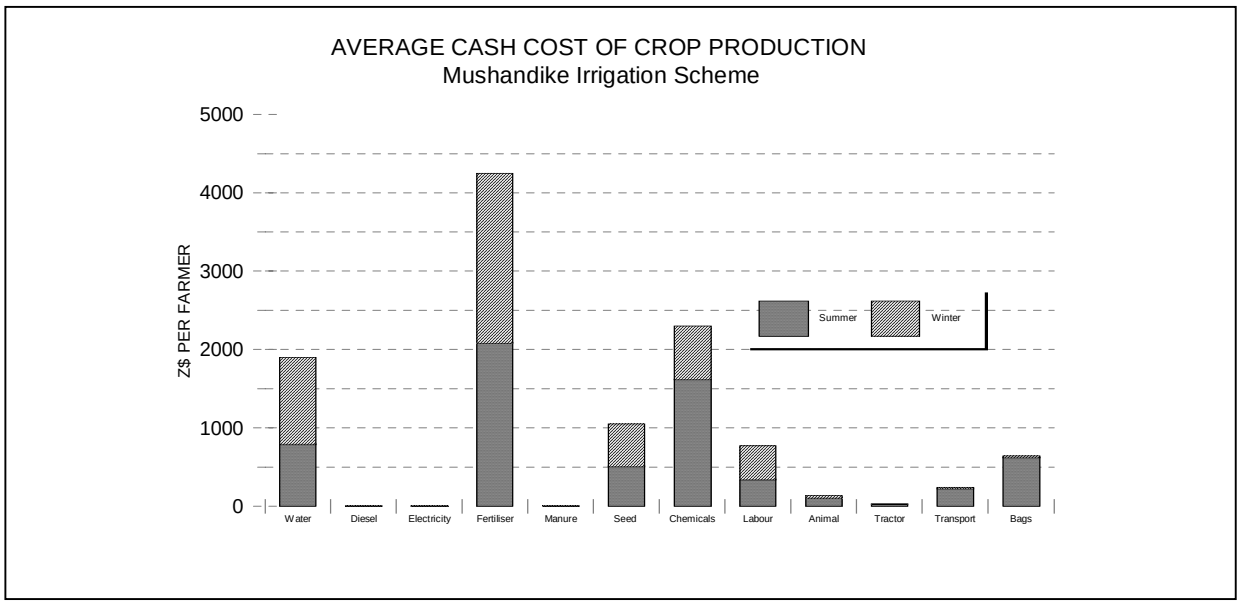

Figure 10 Average cash cost of crop production – Mushandike Irrigation Scheme

Rupike Irrigation Scheme. Fertiliser costs make up some 55% of total costs; with electricity costs (which include maintenance of pumps) comprising another 20% (Figure 11).

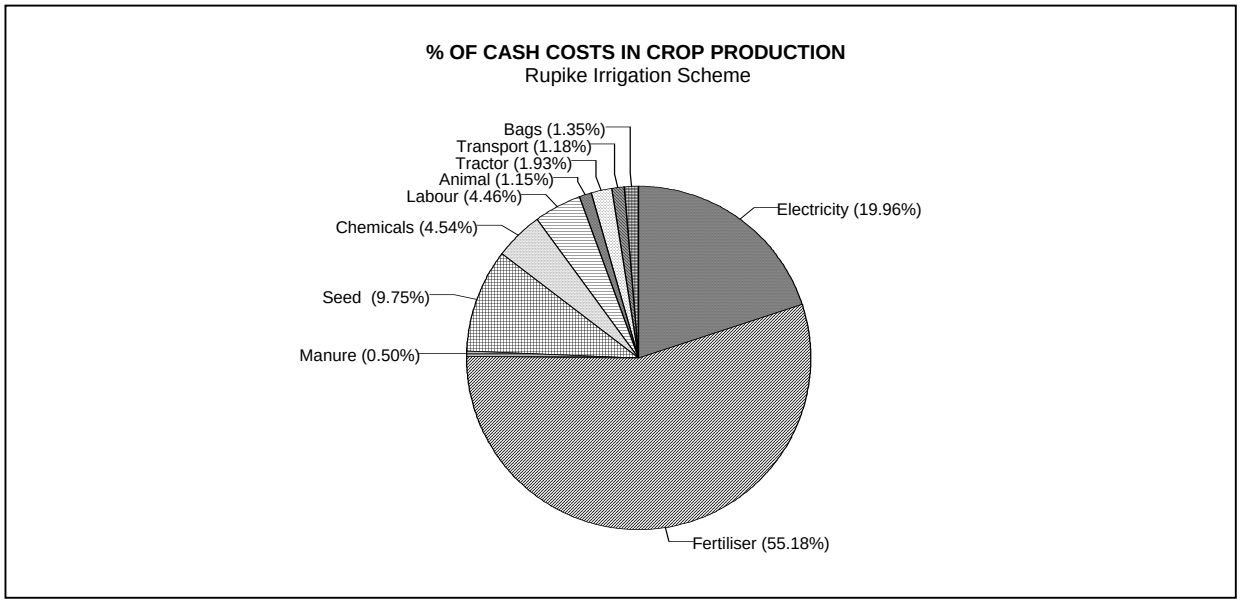

Figure 11 Percentage of cash costs from crops – Rupike Irrigation Scheme

The actual amounts spent for summer and winter crops are shown in Figure 12.

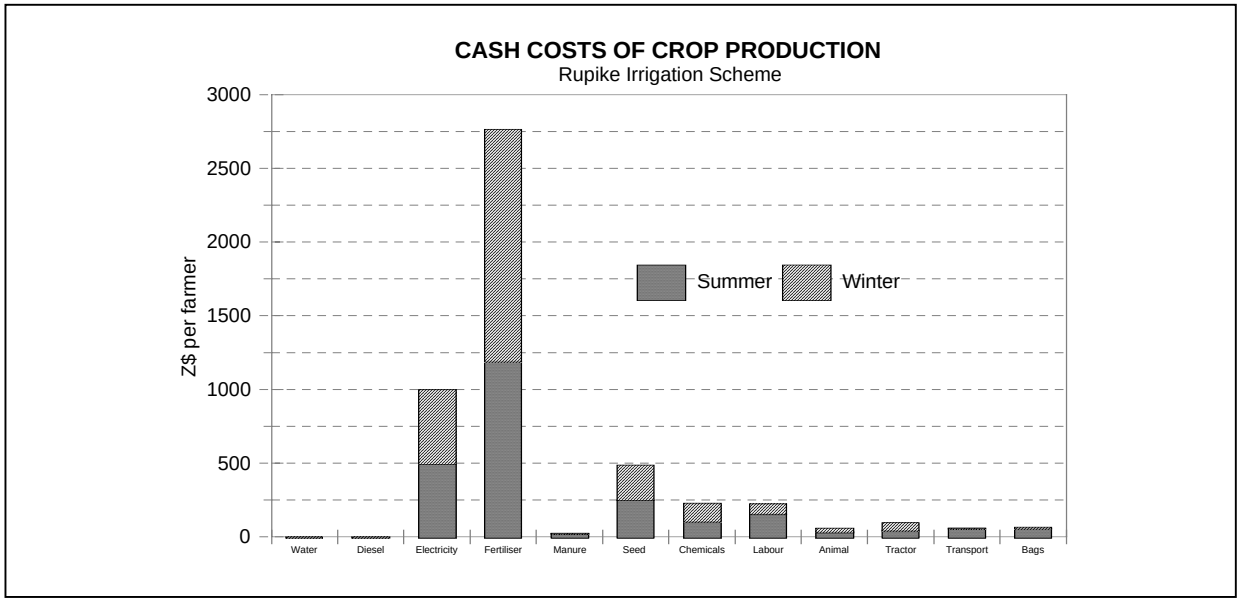

Figure 12 Cash costs of crop production – Rupike Irrigation Scheme

Net cash incomes

The net cash returns for each case study demonstrate the wide differences between farmers on both schemes.

Mushandike Irrigation scheme. Average income from the two seasons crops is in excess of Z$ 11 000, although is biased by the large income from a successful tomato farmer (case 2, excluded from Figure 13). When he is excluded average cash income drops to almost Z$500 with over 50% of farmers showing a negative return in winter and 20% in summer. Two of the nine cases showed negative returns in both summer and winter.

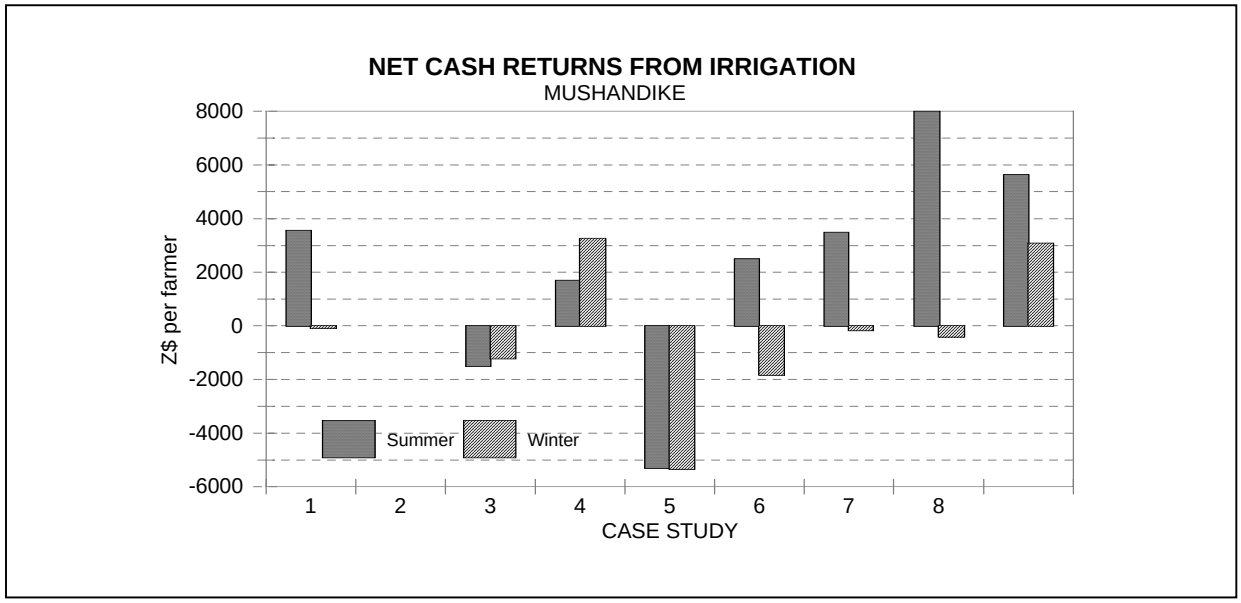

Figure 13 Net cash returns from irrigation – Mushandike Irrigation Scheme

Rupike irrigation scheme. Despite the smaller areas income levels tend to be very much greater with most farmers achieving a cash surplus. Apart from cases 5, 6 and 8 who achieved negative returns in at least one season all other cases made a cash surplus in both seasons (Figure 14). This could be due to the very good marketing strategies employed by the farmers at Rupike.

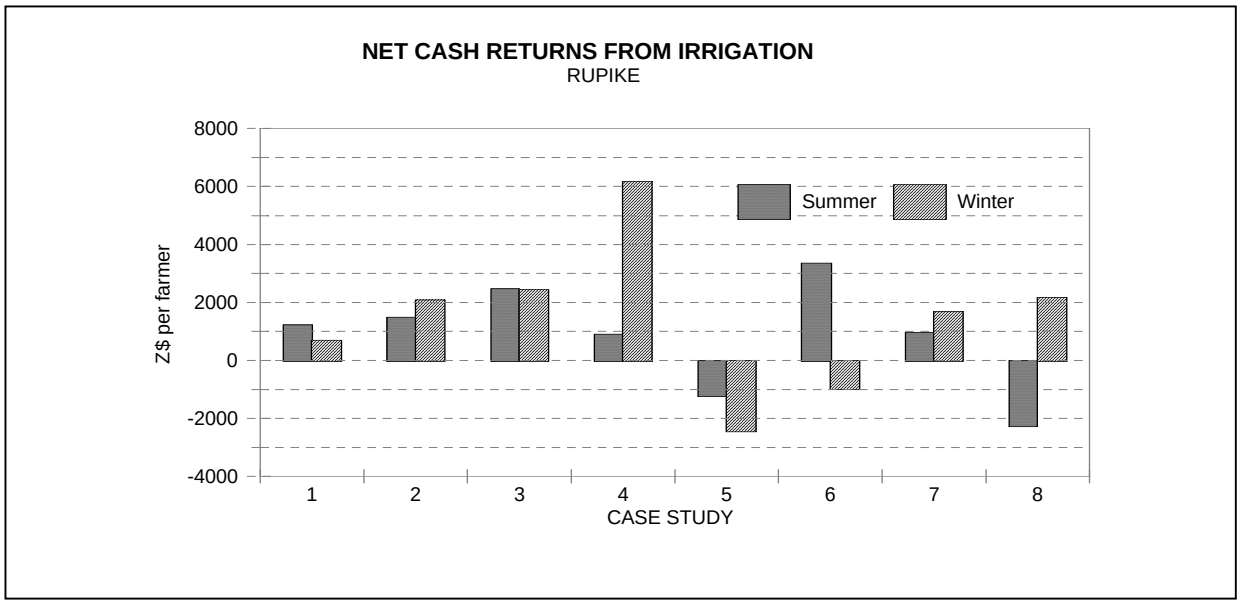

Figure 14 Net cash returns from irrigation – Rupike Irrigation Scheme

3.6 Marketing decisions

Rupike and Mushandike differ with regard to how marketing decisions are made. At Rupike the women make most decisions, (especially those aged between 20 and 40) guided by the committee, whilst the men only get involved in decisions concerning maize, wheat and beans. At Mushandike, although the women make decisions regarding vegetables, the scheme marketing committee dominates the decisions regarding tomatoes, as there are contractual arrangements for tomatoes. Men have more involvement in decisions about marketing maize and wheat than the men at Rupike (Figure 15).

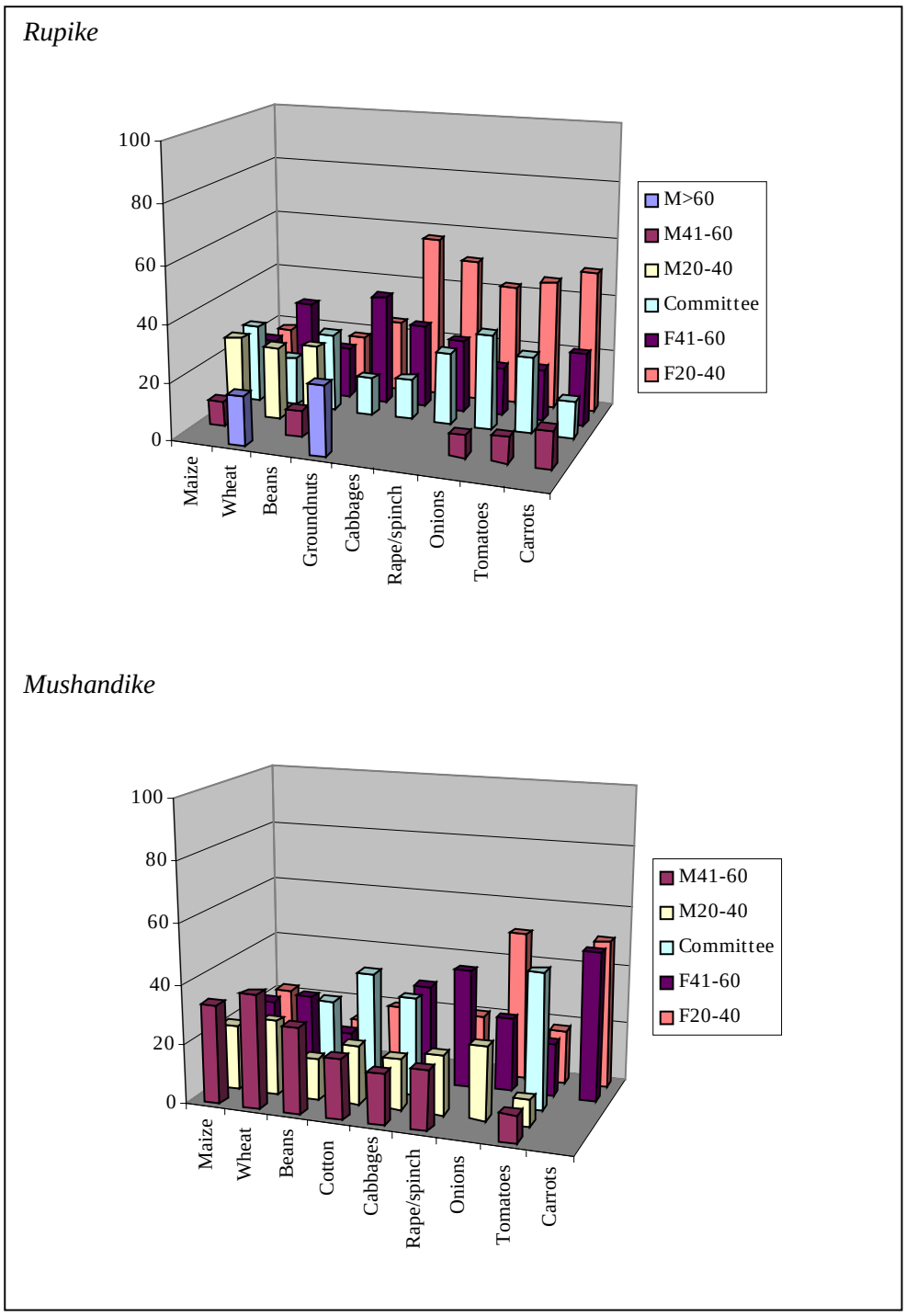

Figure 15 Marketing decisions

Main factors taken into account
At both schemes the main factors that are taken into account when making marketing decisions are the price offered taking into consideration transport costs. For example, one farmer at Mushandike, would rather pay higher transport costs to Mutare instead of Masvingo as the prices offered in Mutare are higher. The marketing committee undertakes market surveys.

3.7 Views on the future of irrigation

At present all farmers indicate that their families will carry on irrigating at Rupike and Mushandike. There are however factors that farmers feel make their lives more difficult such as high electricity bills, high water bills, high increases in input costs, transport problems (especially at Rupike). On the other hand the farmers feel that they benefit through increased food security for their families, reliable harvests, higher incomes so that cash is available for draught animals and children's education.

4. IMPLICATIONS OF PUMP FAILURE

4.1 Reasons for, frequency of and direct costs of pump failure

The main reasons for pump failure have been lack of spare parts, insufficient farmer knowledge and training on routine maintenance and minor repair needs, lack of skilled mechanics for more problematic repairs and non-availability of diesel fuel either through supply problems or failure by Government to pay diesel suppliers. Unfortunately relatively minor problems that could have been resolved in a short time remain unresolved for long periods leading to major crop losses.

At Chemombe (1.5 ha irrigation), which has been operational for two years. A small mobile 5 HP Kingfisher diesel pump was supplied by local dealers with training provided by the supplier to two local residents, both men, despite the fact that all the users are women. One of the men has subsequently left the area and no follow-up training has been provided, since pump delivery two years previously. The pump minder is a well-respected elderly man, who keeps the pump at his homestead, when not in use. He has ultimate responsibility for pump operation, including diesel purchase and maintenance, although he does this in conjunction with irrigation users. He is also responsible for transport to and from the dam, some 2 kilometres from its point of use. Although oil changes have been regularly carried out, the air filter has not been changed since new and no other maintenance undertaken. As a result the pump is unlikely to last its 10-15 year projected lifespan. To date the only problem has been the breakage of an aluminium water manifold inlet pipe as a result of the pump falling from a scotch-cart during transport. This resulted in non-function of the pump for a critical two-month period during the winter months. A simple low cost (Z$200) weld, which could have been undertaken in Masvingo would have resolved the problem in less than a day. However local welders (who do not have facilities for aluminium welding) indicated that no repair was possible. It was only as a result of our visit that local irrigators became aware of repair facilities in Masvingo. As a result of this breakdown, irrigators reduced the area irrigated by half, carting water by wheelbarrow and bucket from the dam to the irrigated garden, a distance of some 200 metres.

The Chinyamatumwa scheme (34 ha under irrigation), which has been operational since 1995 is designed to have two pumps operational during peak water requirements. One or other of the pumps has been non-operational since scheme initiation due to non-availability of parts, even from Japan. Pump attendants are responsible for operating pumps and routine maintenance (cleaning, air filter changes etc.). Farmers are not permitted to operate or undertake any work on the pumps. Pumps were initially serviced on a monthly basis by DWD mechanics from Masvingo, but due to budgetary constraints such visits have become increasingly irregular. Water charges levied by DWD contribute towards maintenance, repair and operational costs and although these have risen rapidly over the last two years from Z$45 to Z$185 per

10^3m^3 of water, in real terms the rise has been insignificant due to the present high inflation rate, currently over 50%[8]. As a result, farmers are in arrears with their water payments, unable to see their way to making payments and in dispute with DWD as to how their invoices are actually calculated. These problems have been compounded by DWD's inability to supply diesel to the scheme at certain periods, both due to budgetary problems and failure by central Government to settle outstanding invoices with diesel suppliers. This has further compounded farmers problems who have been unable to plant irrigated crops and therefore unable to generate an income to pay for water charges.

At Rupike, the electrically powered pumps have only broken down once since 1993, for a period of three weeks during October/November, as new parts were ordered. This resulted in delayed planting of summer crops, but farmers were not concerned and generally felt that this had not resulted in any crop losses. However delay in planting does have serious yield penalties and lost opportunity to market early crops, in this case green maize. A loss of at least 10% of productivity was therefore probable.

It should be noted that although farmers are responsible for the costs of maintenance of pumps, they have access to skilled mechanics from the Rio Tinto Mine some 30 kms away, who order buy and deliver parts on site and provide the skilled labour at no cost for repairs. So long as this relationship continues, farmers are unlikely to be faced with major crop losses as a result of pumps not operating. This contrasts with other schemes who are reliant on DWD who have on the one hand a policy of ultimately achieving full cost recovery and secondly budgetary constraints which prevent the provision of a cost-effective service. Although the alternative of using the private sector means that full cost recovery will immediately be faced.

4.2 Productivity consequences of pump failure

On all schemes a number of factors besides pump failure seriously affect farmers' ability to derive maximum productivity from their irrigation resources. These include:

- Poor land preparation and tillage practices. *(Especially Mushandike and Rupike)*
- Low fertility of soils, inadequate manure or cash to purchase fertilisers. *(All schemes)*
- Input supply problems. *(All schemes)*
- Disease and pest problems. *(Especially Rupike and Mushandike)*
- Marketing problems. *(Especially Rupike and Mushandike)*
- Pump breakdowns. *(Especially Chemombe and Chinyamatumwa*
- Poor distribution of water, resulting from the poor condition of in-field irrigation equipment *(Especially Rupike)*

No attempt has been made to quantify the productivity losses resulting from each of these factors either separately or jointly. Each on its own is likely to have a major impact on scheme and individual farmer productivity. We have however compared estimated farmer productivity with and without pump breakdowns, largely based on farmers estimates of actual yields with breakdowns compared with their estimates of what they would have obtained without breakdowns.

At Chemombe, the consequences of reducing the area under irrigation by half and reducing water applied has been a dramatic decrease in productivity (Table 7).

8 It should be noted that although water costs for the last season year were Z$29840, the wage costs of a single pump attendant are Z$23000, indicating the ongoing high subsidisation by Government of pump costs. (DWD-Masvingo, Personal communication

Table 7 Loss of income as a result of pump failure at Chemombe Irrigation Scheme (figures rounded)

	Loss in cash income -Z$
	Scheme (1.5ha)
Loss of crop due to breakdown (Winter vegetables only)	
- as a result of reduction in area	120164
Total loss	120164
Savings in costs as a result of breakdown	
- Cash inputs (other than water or diesel) saved	1000
Net loss	**119164**

Details are shown in Appendix VI.

This clearly demonstrates the large loss incurred as a result of the winter breakdown, which would have more than paid for a new pump, let alone the cost of the repair. The loss of productivity to both individual farmers and the scheme is large.

This has not taken into account any further productivity loss that may have occurred due to delayed planting of maize and loss of the green maize crop. If only half the maize area was planted and yield losses result, a further loss could result.

At Chinyamatumwa, where pump breakdowns have had the most serious consequences for farmers, loss in productivity has been substantial both for the summer and winter crops. (Table 8.)

Table 8 Loss of income as a result of pump failure at Chinyamatumwa Irrigation Scheme (figures rounded)

	Loss in cash income -Z$
	Scheme (34ha)
Loss of crop due to pump breakdown	
- summer crops	860000
- winter crops	2570000
Total loss	*3430000*
Savings in costs as a result of breakdown	
- Cash inputs (other than pump costs) saved	78000
Net loss	**3352000**

Details are shown in Appendix VII

Yields and inputs have been based on information provided by farmers and adjusted when necessary through use of information in a baseline survey report (1997). More detail is shown in Appendix VII.

At Rupike, a 10% productivity decline caused by pump failure is likely to have occurred resulting in a loss of some Z$1700 per farmer or Z$ 340 000 for the whole scheme (Appendix VIII). This high opportunity cost again demonstrates the importance of the need to ensure that pump breakdowns are quickly and effectively dealt with.

4.3 Gender implications

The key gender implications resulting from pump failure are:

- As farmers are given responsibility for pump use and maintenance, it is men that assume this responsibility even when women are the main users.
- As a result women are not trained in the use or maintenance of pumps and in the absence of trained pump minders (men) are unable to ensure water availability.
- Pump breakdown often places additional work burden on women to carry water by hand to ensure plant requirements are met. On bigger plots this may not be possible and crop losses occur.
- On those schemes where women are the major users, pump breakdown means that women's incomes are significantly reduced or lost.
- Women's lack of control over the operation and maintenance of pumps means that their substantial investment of labour may go unrewarded. As women's remuneration and share of profits tends to be extremely low already, further reductions can erode livelihoods and increase poverty. If pump failure occurs late in the growing season there is no time to pursue other income generating options.
- Women headed households tend to be relatively more dependant on irrigation, lacking the extra labour needed for livestock and dryland farming and thus more vulnerable to loss of irrigated crops.

Appendices

Appendix I

Comparative summary of Chemombe, Chinyamatumwa, Mushandike and Rupike Irrigation Schemes, Masvingo Province

Comparative summary of Chemombe, Chinyamatumwa, Mushandike and Rupike Irrigation schemes, Masvingo Province

	Chemombe	**Chinyamatumwa**	**Mushandike**	**Rupike**
Natural Region	V	IV	IV	IV
Area under irrigation	1.5 ha	34 ha	400 ha	100 ha
Date constructed	1996	Initiated in 1992, first irrigation in 1996	1980s	Initiated in 1990, completed in 1993
Cost of scheme borne by	50% subsidy by CARE (through DFID support)	Government (through JICA support)	Government (as part of the resettlement programme)	Rio Tinto (private sector)
Approximate replacement cost per ha (excluding dam)[2]	Z$ 45 000 (Z$ 65 000 per 1.5 ha)	Z$ 135 000	Z$ 100 000	Z$ 100 000
History	Developed as part of a DFID-funded small dam rehabilitation scheme. This involved repairing the spillway and fencing a	Dam built on good site just after the 1992 drought, irrigation subsequently developed on dryland communal farming area	Originally large scale commercial farms, resettled in the early 1980s	All costs (dam, water delivery and infield irrigation) provided by Rio Tinto. Scheme handed over to Govt. in 1996
Scheme supported by	CARE initially, now AGRITEX	AGRITEX and DWD	AGRITEX and DWD	Rio Tinto initially, now AGRITEX and DWD
Other farming activities of farmers/plotholders	Part of a resettlement scheme, where resettled farmers (mostly men) have 5 ha dryland arable with communal grazing.	Most households, other than those who lost land under water have additional dryland farming areas.	No dryland cropping, but most have livestock	Most have dryland cropping areas outside scheme. Most have livestock

[2] Cost estimates based on present pump prices and Government of Zimbabwe (1996), Feasibility report. Mondi-Montaga small scale irrigation scheme. AGRITEX, Irrigation Branch, Midlands.

	Most have livestock	Some have livestock		
Number of farmers with irrigation	63	128	250	200
Ratio of men to women farmers	All women	Men on larger areas, women on smaller areas	Predominantly men	Predominantly women
Plot/land size	0.02 ha	0.1 up to 1 ha (mean 0.25 ha)	1.5 ha	0.5 ha
Soil type	Sandy loams	Sands to sandy loams	Sandy loams-clays	Sands-sandy loams
Water source	Small dam	Medium sized dam (3200 000m3)	Large dam	Large dam
Irrigation type	Buckets from open troughs	Siphoned from in-field concrete canals	Siphoned from in-field concrete canals	Drag line sprinklers from buried mainlines
Power source	5 HP Kingfisher diesel pump	2 60 kW diesel pumps	Gravity, no pumps	4 Electric 60 kW motors
Main crops	Green maize, vegetables	Maize, beans, vegetables	Maize, cotton, tomatoes, vegetables	Maize, beans, vegetables
Costs levied to cover water costs	Nil	Z$ 185 per 103m3	Z$ 185 per 103m3	Nil at present but being considered
Costs levied to cover pump costs	Z$ 60 per annum per farmer (Z$ 5 per month)	Diesel costs and all repair costs paid by DWD	No pumps	Z$ 1020 per year (Z$ 510 per season) Rio Tinto presently provide skilled labour for repairs at no cost to farmers
Pump controlled by	Farmers	DWD (pump attendants on site)	No pumps	DWD (pump attendants on site)

Assets owned jointly by farmers	Pump, pipes,	Nil	Nil	- Tractor, trailer and implements (hired out with small surplus to cover operating costs, not replacement) - Workshop, storage shed (all donated by Rio Tinto)
Assets owned individually by farmers	Watering cans, Cultivation implements	Siphons, Cultivation implements	Siphons, Cultivation implements	In-field drag lines and sprinklers (3 per plot) Cultivation implements
Farmer organisations	Scheme fully managed by farmers through a committee. Pump controlled by a well-respected elder (male).	Farmers' committee with marketing and financial subcommittees. Strong support from AGRITEX.	-Village irrigation committees responsible for finance - Central committee with marketing sub-committee	- 5 Block committees -! Central committee with marketing and financial subcommittees
Main issues of concern to farmers with regards to irrigation	- Pump maintenance problems - Pump operation	- High water fees - Marketing, lack of cash for input purchase - Reliable water	- Newly introduced water fee - Marketing	- Marketing vegetables - Payment of fee for electricity and pump maintenance

Appendix II

Scheme descriptions

Mushandike Irrigation Scheme
Mushandike is an Agritex scheme that was built in the early1980s as a smallholder commercial irrigation scheme. It is approximately 20km from Masvingo and utilises water from Mushandike dam to irrigate some 400ha. Water is distributed in surface channels and applied to the fields using siphons. The farmers are responsible for organising their turns along the channel and for maintaining the channels. There are around 250 plotholders and the average plot size is around 1.5ha. Originally intended to grow cotton, maize and wheat there has been considerable diversification in response to changes in market prices. Although these crops are still grown there is considerable commitment to growing vegetables. Tomatoes are grown under contract with Cairns of Mutare. Cotton is grown for Cotton Company of Zimbabwe (COTCO). Both crops are collected from the site, as road access is good. The scheme is managed by AGRITEX with the help of an irrigation management committee. The farmer management committee reports to the irrigation management committee. The scheme is divided into three blocks each serving a number of villages. The study concentrated on Village 21 that consists of 52 households each with an average of 1.5ha of land under irrigation.

Rupike Irrigation Scheme
Rupike irrigation scheme was initially established and managed by Rio Tinto but is now managed by farmers with support from AGRITEX. The scheme is 100ha in area, subdivided into 5 blocks with 200 plots, each 0.5ha in size. At present there are three extension workers, and two pump attendants employed by DWD.

The scheme has a pump house, which contains four Ecanorm 80-250 pumps connected to 60hp motors. On maximum demand three pumps are used delivering 128l/second to 600 overhead sprays. One pump is kept in reserve. Water is taken from Tugwane dam, which has an earth embankment 460m high. The capacity of the dam is $3200m^3$ 10^3. The depth is 14m. The scheme has a pipeline system consisting of a 17km main pipe and 10km of PVC pipes to laterally feed water to the plots. Each plot has three water outlets which connect to a 1" rubber hose supplying a moveable overhead spray. There is a total of 23km of 1" rubber hoses. Infrastructure at the schemes includes an office block, two lecture theatres, a workshop, a tools/spares store, storage space for grain and produce and nine houses. The total cost up until June 1994 was Z$ 6000, 000. The scheme is in natural region IV. In 1990 there were only 20 farmers on the scheme, but this rose to 200 by 1993. Rio Tinto initially paid the bills, until the farmers could afford to start paying themselves. Each block has a block committee with 7 members. The Block Chairman for each Block attends meetings of the main Scheme management committee to report any problems that have arisen at Block committee meetings, which are held once a week. Problems that tend to arise are theft, waterlogging and not abiding the by-laws. At present there are three extension workers, two employees of the Ministry of Water Development, one full time treasurer paid by the farmers, one welder and a tractor driver.

Since hand over by Rio Tinto, farmers have had to pay for servicing and maintenance of the pumps. The farmers pay Z$510/season for each 0.5 ha to the scheme committee for services such as electricity, the welder, tractor driver and for maintenance of the pumps. The treasurer is in charge of banking this money.

Chinyamatumwa
The Chinyamatumwa irrigation scheme is located in Bikita District in Masvingo Province. It was initiated in 1992 on completion of Chinyamatumwa dam. Families displaces from their fields and homes by the dam and irrigation lands no longer have dryland plots and practice full time irrigation on larger plots (1.2ha), while others who participate in the project have smaller plots. The scheme is approximately 34ha of irrigated land and comprises two blocks with plots ranging in size from 0.1 to 1.2ha. There are 128 participants who have lifelong tenancy of the plots. Water is pumped from the dam to the night storage dam and distributed through a lined canal to the fields by gravity.

There are two agencies involved. The Department of Water Development is responsible for the dam, the pump and the pump attendants, and AGRITEX is responsible for the distribution system within the fields and agricultural extension. Generally the irrigated land is prepared as long furrows. Water is applied to the furrows through syphons and the crops are planted on the ridges. All lands are ploughed by oxen or by donkeys. Farmers are unable to obtain loans for inputs and therefore fertiliser application rates remain low. Nonetheless, farmers can grow up to three crops in a year, alternating between maize, wheat, beans, tomatoes and other vegetables. The farmers committee consists of five men and two women. There is also a marketing sub-committee of three women and four men.

Chemombe (CARE Garden scheme)

Chemombe is a small garden scheme with 1.5ha under irrigation provided by CARE under their small dam rehabilitation project. 63 households have plots in the garden. Water is pumped from the dam into troughs using a 5HP Kingfisher pump. The women then use buckets to take water from the trough to the garden. Although women largely use the scheme, the chairman keeps the pump at his homestead for safety reasons. When the women need water for their gardens, he has to transport the pump to the dam on the back of a scotch cart and then is responsible for starting the pump. As the chairman is the only person who can operate the pump, when he is unavailable the women have to take water from the dam in wheelbarrows. The farmers pay Z$5/month to cover cost of fuel for the pump. The farmers have never received a manual for the pump. Each individual has 18 beds in the garden (each 1m x 5m). Agritex provides guidance on crop choice. The women mainly grow green maize in the summer season and then rape, cabbages and tomatoes in the winter. They have no problems selling the crops as communal farmers from the area come to the garden and place their orders.

Appendix III

Cropping patterns on each scheme

Cropping patterns on each scheme

Chemombe	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**Average area per farmer (ha)** [9]	**% of scheme**
Green maize	X	X						X	X	X	X	X	0.02	50%
Vegetables			X	X	X	X	X	X	X				0.02	50%
Total													***0.04***	100%
Chinyamatumwa	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**		
Green maize							X	X	X	X	X	X	0.10	20%
Maize	X	X	X	X						X	X	X	0.10	20%
Sugar beans		X	X	X	X								0.10	20%
Tomatoes (S)									X	X	X	X	0.05	10%
Tomatoes (W)				X	X	X	X						0.05	10%
Wheat					X	X	X	X	X				0.05	10%
Vegetables				X	X	X	X	X	X				0.05	10%
Total													***0.50***	100%
Mushandike	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**		
Green maize						X	X	X	X	X	X		0.30	12%
Maize	X	X	X	X						X	X	X	0.50	20%
Cotton	X	X	X	X	X	X				X	X	X	0.50	20%
Sugar beans		X	X	X	X								0.50	20%
Tomatoes (S)									X	X	X	X	0.20	8%
Tomatoes (W)				X	X	X	X						0.20	8%
Wheat					X	X	X	X	X				0.20	8%
Vegetables				X	X	X	X	X	X				0.10	4%
Total													***2.50***	100%
Rupike	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**		
Green maize							X	X	X	X	X	X	0.20	18%
Maize	X	X	X	X						X	X	X	0.30	27%
Sugar beans		X	X	X	X								0.30	27%
Groundnuts	X	X								X	X	X	0.10	9%
Wheat					X	X	X	X	X				0.15	14%
Vegetables				X	X	X	X	X	X				0.05	5%
Total													***1.10***	100%

9 On each scheme most land is cropped twice a year (given no pump breakdowns) and some cropped three times. On average, however, double cropping predominates

Appendix IV

Margin of crop incomes over costs – Rupike Irrigation Scheme

GROSS MARGIN BUDGET

Case Number	Average				
Achiever					
SCHEME	Rupike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***0.5***	***0.5***	***0.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	2744	0	2744	5488	37%
Wheat	0	384	384	768	5%
Beans	0	2419	2419	4838	33%
Groundnuts	545	0	545	1090	7%
Cotton	0	0	0	0	0%
Cabbage	0	266	266	533	4%
Rape	0	263	263	525	4%
Onions	0	334	334	669	5%
Tomatoes	0	319	319	638	4%
Carrots	0	81	81	163	1%
Other	0	0	0	0	0%
Total	**3289**	**4066**	**7354**	**14709**	**100%**
CASH COSTS					
Purchased inputs					
Water	0	0	0	0	0%
Diesel	0	0	0	0	0%
Electricity	500	500	1000	2000	20%
Fertiliser	1188	1578	2765	5530	55%
Manure	25	0	25	50	0%
Seed	250	239	489	977	10%
Chemicals	109	119	228	455	5%
Labour	155	69	223	447	4%
Animal	35	23	58	115	1%
Tractor	47	50	97	194	2%
Transport	59	0	59	119	1%
Bags	57	11	68	135	1%
Sub-total	**2424**	**2587**	**5011**	**10021**	**100%**
MARGIN OVER PURCHASED INPUTS	***865***	***1479***	***2344***	***4688***	
Return on cash investment	***0.36***	***0.57***	***0.47***	***0.47***	

GROSS MARGIN BUDGET

Case Number	10				
Achiever					
SCHEME	Rupike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***0.5***	***0.5***	***0.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	2000		2000	4000	35%
Wheat		600	600	1200	11%
Beans			0	0	0%
Groundnuts	1100		1100	2200	19%
Cotton			0	0	0%
Cabbage		1300	1300	2600	23%
Rape/spinach			0	0	0%
Onions		405	405	810	7%
Tomatoes		250	250	500	4%
Carrots			0	0	0%
Other			0	0	0%
Total	**3100**	**2555**	**5655**	**11310**	**100%**
CASH COSTS					
Purchased inputs					
Water		0	0	0	0%
Diesel			0	0	0%
Electricity	500	500	1000	2000	27%
Fertiliser	1000	1250	2250	4500	60%
Manure			0	0	0%
Seed	120	50	170	340	5%
Chemicals	150	60	210	420	6%
Hired labour			0	0	0%
Hired draft animals			0	0	0%
Hired tractor			0	0	0%
Transport			0	0	0%
Packing material	100		100	200	3%
Sub-total	**1870**	**1860**	**3730**	**7460**	**100%**
MARGIN OVER PURCHASED INPUTS	***1230***	***695***	***1925***	***3850***	
Return on cash investment	***0.66***	***0.37***	***0.52***	***0.52***	

GROSS MARGIN BUDGET

Case Number	11				
Achiever					
SCHEME	Rupike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***0.5***	***0.5***	***0.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	3000		3000	6000	37%
Wheat		300	300	600	4%
Beans		4500	4500	9000	55%
Groundnuts	400		400	800	5%
Cotton			0	0	0%
Cabbage			0	0	0%
Rape/spinach			0	0	0%
Onions			0	0	0%
Tomatoes			0	0	0%
Carrots			0	0	0%
Other			0	0	0%
Total	**3400**	**4800**	**8200**	**16400**	**100%**
CASH COSTS					
Purchased inputs					
Water			0	0	0%
Diesel			0	0	0%
Electricity	500	500	1000	2000	22%
Fertiliser	870	1600	2470	4940	53%
Manure			0	0	0%
Seed	434	370	804	1608	17%
Chemicals	70	250	320	640	7%
Hired labour			0	0	0%
Hired draft animals			0	0	0%
Hired tractor			0	0	0%
Transport			0	0	0%
Packing material	40		40	80	1%
Sub-total	**1914**	**2720**	**4634**	**9268**	**100%**
MARGIN OVER PURCHASED INPUTS	***1486***	***2080***	***3566***	***7132***	
Return on cash investment	***0.78***	***0.76***	***0.77***	***0.77***	

GROSS MARGIN BUDGET

Case Number	12				
Achiever	High				
SCHEME	Rupike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***0.5***	***0.5***	***0.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	4000		4000	8000	42%
Wheat			0	0	0%
Beans		3850	3850	7700	41%
Groundnuts	800		800	1600	8%
Cotton			0	0	0%
Cabbage			0	0	0%
Rape/spinach			0	0	0%
Onions		800	800	1600	8%
Tomatoes			0	0	0%
Carrots			0	0	0%
Other			0	0	0%
Total	**4800**	**4650**	**9450**	**18900**	**100%**
CASH COSTS					
Purchased inputs					
Water			0	0	0%
Diesel			0	0	0%
Electricity	500	500	1000	2000	22%
Fertiliser	1330	1625	2955	5910	65%
Manure			0	0	0%
Seed	130	50	180	360	4%
Chemicals	50	5	55	110	1%
Hired labour	200		200	400	4%
Hired draft animals			0	0	0%
Hired tractor	25		25	50	1%
Transport			0	0	0%
Packing material	100	36	136	272	3%
Sub-total	**2335**	**2216**	**4551**	**9102**	**100%**
MARGIN OVER PURCHASED INPUTS	***2465***	***2434***	***4899***	***9798***	
Return on cash investment	***1.06***	***1.10***	***1.08***	***1.08***	

GROSS MARGIN BUDGET

Case Number	13				
Achiever					
SCHEME	Rupike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***0.5***	***0.5***	***0.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	2500		2500	5000	17%
Wheat		800	800	1600	6%
Beans		5000	5000	10000	34%
Groundnuts	1500		1500	3000	10%
Cotton			0	0	0%
Cabbage		800	800	1600	6%
Rape/spinach		400	400	800	3%
Onions		1000	1000	2000	7%
Tomatoes		2000	2000	4000	14%
Carrots		500	500	1000	3%
Other			0	0	0%
Total	**4000**	**10500**	**14500**	**29000**	**100%**
CASH COSTS					
Purchased inputs					
Water			0	0	0%
Diesel			0	0	0%
Electricity	500	500	1000	2000	13%
Fertiliser	1050	2320	3370	6740	45%
Manure	200		200	400	3%
Seed	485	440	925	1850	12%
Chemicals	60	530	590	1180	8%
Hired labour	288	288	576	1152	8%
Hired draft animals	100		100	200	1%
Hired tractor	150	200	350	700	5%
Transport	225		225	450	3%
Packing material	44	50	94	188	1%
Sub-total	**3102**	**4328**	**7430**	**14860**	**100%**
MARGIN OVER PURCHASED INPUTS	***898***	***6172***	***7070***	***14140***	
Return on cash investment	***0.29***	***1.43***	***0.95***	***0.95***	

GROSS MARGIN BUDGET

Case Number	14				
Achiever	High				
SCHEME	Rupike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***0.5***	***0.5***	***0.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	1500		1500	3000	86%
Wheat		250	250	500	14%
Beans			0	0	0%
Groundnuts			0	0	0%
Cotton			0	0	0%
Cabbage			0	0	0%
Rape/spinach			0	0	0%
Onions			0	0	0%
Tomatoes			0	0	0%
Carrots			0	0	0%
Other			0	0	0%
Total	**1500**	**250**	**1750**	**3500**	**100%**
CASH COSTS					
Purchased inputs					
Water			0	0	0%
Diesel			0	0	0%
Electricity	500	500	1000	2000	19%
Fertiliser	1500	1500	3000	6000	56%
Manure			0	0	0%
Seed	200	300	500	1000	9%
Chemicals	85		85	170	2%
Hired labour	150		150	300	3%
Hired draft animals	180	180	360	720	7%
Hired tractor		200	200	400	4%
Transport			0	0	0%
Packing material	100		100	200	2%
Sub-total	**2715**	**2680**	**5395**	**10790**	**100%**
MARGIN OVER PURCHASED INPUTS	***-1215***	***-2430***	***-3645***	***-7290***	
Return on cash investment	***-0.45***	***-0.91***	***-0.68***	***-0.68***	

GROSS MARGIN BUDGET

Case Number	15				
Achiever	Medium				
SCHEME	Rupike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***0.5***	***0.5***	***0.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	4700		4700	9400	71%
Wheat		120	120	240	2%
Beans			0	0	0%
Groundnuts	560		560	1120	8%
Cotton			0	0	0%
Cabbage		30	30	60	0%
Rape/spinach		300	300	600	5%
Onions		470	470	940	7%
Tomatoes		300	300	600	5%
Carrots		150	150	300	2%
Other			0	0	0%
Total	**5260**	**1370**	**6630**	**13260**	**100%**
CASH COSTS					
Purchased inputs					
Water			0	0	0%
Diesel			0	0	0%
Electricity	500	500	1000	2000	24%
Fertiliser	750	1500	2250	4500	53%
Manure			0	0	0%
Seed	250	250	500	1000	12%
Chemicals	85	35	120	240	3%
Hired labour	300	60	360	720	8%
Hired draft animals			0	0	0%
Hired tractor			0	0	0%
Transport	25		25	50	1%
Packing material			0	0	0%
Sub-total	**1910**	**2345**	**4255**	**8510**	**100%**
MARGIN OVER PURCHASED INPUTS	***3350***	***-975***	***2375***	***4750***	
Return on cash investment	***1.75***	***-0.42***	***0.56***	***0.56***	

GROSS MARGIN BUDGET

Case Number	16				
Achiever	Medium				
SCHEME	Rupike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***0.5***	***0.5***	***0.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	3500		3500	7000	47%
Wheat			0	0	0%
Beans		3000	3000	6000	41%
Groundnuts			0	0	0%
Cotton			0	0	0%
Cabbage			0	0	0%
Rape/spinach		900	900	1800	12%
Onions			0	0	0%
Tomatoes			0	0	0%
Carrots			0	0	0%
Other			0	0	0%
Total	**3500**	**3900**	**7400**	**14800**	**100%**
CASH COSTS					
Purchased inputs					
Water			0	0	0%
Diesel			0	0	0%
Electricity	500	500	1000	2000	21%
Fertiliser	1500	1500	3000	6000	63%
Manure			0	0	0%
Seed	150	200	350	700	7%
Chemicals	170	20	190	380	4%
Hired labour			0	0	0%
Hired draft animals			0	0	0%
Hired tractor	200		200	400	4%
Transport			0	0	0%
Packing material	20		20	40	0%
Sub-total	**2540**	**2220**	**4760**	**9520**	**100%**
MARGIN OVER PURCHASED INPUTS	***960***	***1680***	***2640***	***5280***	
Return on cash investment	***0.38***	***0.76***	***0.55***	***0.55***	

GROSS MARGIN BUDGET

Case Number	17				
Achiever	Medium				
SCHEME	Rupike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***0.5***	***0.5***	***0.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	750		750	1500	14%
Wheat		1000	1000	2000	19%
Beans		3000	3000	6000	57%
Groundnuts			0	0	0%
Cotton			0	0	0%
Cabbage			0	0	0%
Rape/spinach		500	500	1000	10%
Onions			0	0	0%
Tomatoes			0	0	0%
Carrots			0	0	0%
Other			0	0	0%
Total	**750**	**4500**	**5250**	**10500**	**100%**
CASH COSTS					
Purchased Inputs					
Water			0	0	0%
Diesel			0	0	0%
Electricity	500	500	1000	2000	19%
Fertiliser	1500	1325	2825	5650	53%
Manure			0	0	0%
Seed	230	250	480	960	9%
Chemicals	200	50	250	500	5%
Hired labour	300	200	500	1000	9%
Hired draft animals			0	0	0%
Hired tractor			0	0	0%
Transport	225		225	450	4%
Packing material	50		50	100	1%
Sub-total	**3005**	**2325**	**5330**	**10660**	**100%**
MARGIN OVER PURCHASED INPUTS	***-2255***	***2175***	***-80***	***-160***	
Return on cash investment	***-0.75***	***0.94***	***-0.02***	***-0.02***	

Appendix V

Margin of crop incomes over costs – Mushandike Irrigation Scheme

GROSS MARGIN BUDGET

Case Number	Average				
Achiever					
SCHEME	Mushandike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***1.5***	***1.5***	***1.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	1500	889	2389	1593	11%
Wheat	0	972	972	648	4%
Beans	178	1033	1211	807	5%
Groundnuts	0	0	0	0	0%
Cotton	6578	333	6911	4607	31%
Cabbage	89	0	89	59	0%
Rape	111	9	120	80	1%
Onions	89	0	89	59	0%
Tomatoes	8933	1600	10533	7022	47%
Carrots	0	39	39	26	0%
Other	0	0	0	0	0%
Total	**17478**	**4876**	**22353**	**14902**	**100%**
CASH COSTS					
Purchased inputs					
Water	796	1100	1896	1264	17%
Diesel	0	0	0	0	0%
Electricity	0	0	0	0	0%
Fertiliser	2088	2157	4244	2830	38%
Manure	0	0	0	0	0%
Seed	515	531	1046	697	9%
Chemicals	1620	675	2295	1530	20%
Labour	344	422	767	511	7%
Animal	106	29	134	90	1%
Tractor	28	0	28	19	0%
Transport	222	17	239	159	2%
Bags	622	17	639	426	6%
Sub-total	**6341**	**4947**	**11288**	**7525**	**100%**
MARGIN OVER PURCHASED INPUTS	***11137***	***-72***	***11065***	***7377***	
Return on cash investment	***1.76***	***-0.01***	***0.98***	***0.98***	

GROSS MARGIN BUDGET

Case Number	1				
Achiever	High				
SCHEME	Mushandike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***1.5***	***1.5***	***1.5***	***per ha***	
CASH INCOME	**Total Z$**	**Total Z$**	**Total Z$**	**Total Z$ per ha**	
Maize			0	0	0%
Wheat			0	0	0%
Beans		2200	2200	1467	17%
Groundnuts			0	0	0%
Cotton	10000		10000	6667	77%
Cabbage			0	0	0%
Rape/spinach			0	0	0%
Onions			0	0	0%
Tomatoes		800	800	533	6%
Carrots			0	0	0%
Other			0	0	0%
Total	**10000**	**3000**	**13000**	**8667**	**100%**
CASH COSTS					
Purchased inputs					
Water	1000	1050	2050	1367	22%
Diesel			0	0	0%
Electricity			0	0	0%
Fertiliser	2000	1600	3600	2400	38%
Manure			0	0	0%
Seed	485	130	615	410	6%
Chemicals	900	300	1200	800	13%
Hired labour			0	0	0%
Hired draft animals		10	10	7	0%
Hired tractor			0	0	0%
Transport	98		98	65	1%
Packing material	1950		1950	1300	20%
Sub-total	**6433**	**3090**	**9523**	**6349**	**100%**
MARGIN OVER PURCHASED INPUTS	***3567***	***-90***	***3477***	***2318***	
Return on cash investment	***0.55***	***-0.03***	***0.37***	***0.37***	

GROSS MARGIN BUDGET

Case Number	2				
Achiever	High				
SCHEME	Mushandike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***1.5***	***1.5***	***1.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	3000		3000	2000	3%
Wheat		400	400	267	0%
Beans		5600	5600	3733	5%
Groundnuts			0	0	0%
Cotton	8000		8000	5333	8%
Cabbage	300		300	200	0%
Rape/spinach	600		600	400	1%
Onions	600		600	400	1%
Tomatoes	75000	10000	85000	56667	82%
Carrots			0	0	0%
Other			0	0	0%
Total	**87500**	**16000**	**103500**	**69000**	**100%**
CASH COSTS					
Purchased inputs					
Water	750	1350	2100	1400	11%
Diesel			0	0	0%
Electricity			0	0	0%
Fertiliser		5550	5550	3700	29%
Manure			0	0	0%
Seed	250	1700	1950	1300	10%
Chemicals	2530	3840	6370	4247	33%
Hired labour	1350	1400	2750	1833	14%
Hired draft animals			0	0	0%
Hired tractor	250		250	167	1%
Transport	250		250	167	1%
Packing material		150	150	100	1%
Sub-total	**5380**	**13990**	**19370**	**12913**	**100%**
MARGIN OVER PURCHASED INPUTS	***82120***	***2010***	***84130***	***56087***	
Return on cash investment	***15.26***	***0.14***	***4.34***	***4.34***	

GROSS MARGIN BUDGET

Case Number	3				
Achiever	Low				
SCHEME	Mushandike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***1.5***	***1.5***	***1.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize			0	0	0%
Wheat			0	0	0%
Beans			0	0	0%
Groundnuts			0	0	0%
Cotton			0	0	0%
Cabbage			0	0	0%
Rape/spinach			0	0	0%
Onions			0	0	0%
Tomatoes		800	800	533	100%
Carrots			0	0	0%
Other			0	0	0%
Total	**0**	**800**	**800**	**533**	**100%**
CASH COSTS					
Purchased inputs					
Water	250	750	1000	667	29%
Diesel			0	0	0%
Electricity			0	0	0%
Fertiliser	250	750	1000	667	29%
Manure			0	0	0%
Seed	250	250	500	333	14%
Chemicals	250	250	500	333	14%
Hired labour	250		250	167	7%
Hired draft animals	250		250	167	7%
Hired tractor			0	0	0%
Transport	0		0	0	0%
Packing material	0		0	0	0%
Sub-total	**1500**	**2000**	**3500**	**2333**	**100%**
MARGIN OVER PURCHASED INPUTS	***-1500***	***-1200***	***-2700***	***-1800***	
Return on cash investment	***-1.00***	***-0.60***	***-0.77***	***-0.77***	

GROSS MARGIN BUDGET

Case Number	4				
Achiever	Low				
SCHEME	Mushandike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***1.5***	***1.5***	***1.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	5000	3700	8700	5800	55%
Wheat		4000	4000	2667	25%
Beans			0	0	0%
Groundnuts			0	0	0%
Cotton	2200		2200	1467	14%
Cabbage			0	0	0%
Rape/spinach			0	0	0%
Onions			0	0	0%
Tomatoes		900	900	600	6%
Carrots			0	0	0%
Other			0	0	0%
Total	**7200**	**8600**	**15800**	**10533**	**100%**
CASH COSTS					
Purchased inputs					
Water	300	500	800	533	7%
Diesel			0	0	0%
Electricity			0	0	0%
Fertiliser	3000	3000	6000	4000	55%
Manure			0	0	0%
Seed	400	600	1000	667	9%
Chemicals	1500	32	1532	1021	14%
Hired labour	300	1200	1500	1000	14%
Hired draft animals			0	0	0%
Hired tractor			0	0	0%
Transport			0	0	0%
Packing material			0	0	0%
Sub-total	**5500**	**5332**	**10832**	**7221**	**100%**
MARGIN OVER PURCHASED INPUTS	***1700***	***3268***	***4968***	***3312***	
Return on cash investment	***0.31***	***0.61***	***0.46***	***0.46***	

GROSS MARGIN BUDGET

Case Number	5				
Achiever	High				
SCHEME	Mushandike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***1.5***	***1.5***	***1.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize			0	0	0%
Wheat			0	0	0%
Beans	1600	1500	3100	2067	69%
Groundnuts			0	0	0%
Cotton			0	0	0%
Cabbage			0	0	0%
Rape/spinach			0	0	0%
Onions			0	0	0%
Tomatoes	400	1000	1400	933	31%
Carrots			0	0	0%
Other			0	0	0%
Total	**2000**	**2500**	**4500**	**3000**	**100%**
CASH COSTS					
Purchased inputs					
Water	500	1500	2000	1333	13%
Diesel			0	0	0%
Electricity			0	0	0%
Fertiliser	3300	4500	7800	5200	51%
Manure			0	0	0%
Seed	1000	700	1700	1133	11%
Chemicals	2000	1000	3000	2000	20%
Hired labour	500	150	650	433	4%
Hired draft animals			0	0	0%
Hired tractor			0	0	0%
Transport			0	0	0%
Packing material			0	0	0%
Sub-total	**7300**	**7850**	**15150**	**10100**	**100%**
MARGIN OVER PURCHASED INPUTS	***-5300***	***-5350***	***-10650***	***-7100***	
Return on cash investment	***-0.73***	***-0.68***	***-0.70***	***-0.70***	

GROSS MARGIN BUDGET

Case Number	6				
Achiever	Medium				
SCHEME	Mushandike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***1.5***	***1.5***	***1.5***	***per ha***	
CASH INCOME	**Total Z$**	**Total Z$**	**Total Z$**	**Total Z$ per ha**	
Maize	2000	1500	3500	2333	32%
Wheat		600	600	400	5%
Beans			0	0	0%
Groundnuts			0	0	0%
Cotton	7000		7000	4667	63%
Cabbage			0	0	0%
Rape/spinach			0	0	0%
Onions			0	0	0%
Tomatoes			0	0	0%
Carrots			0	0	0%
Other			0	0	0%
Total	**9000**	**2100**	**11100**	**7400**	**100%**
CASH COSTS					
Purchased inputs					
Water	1000	2000	3000	2000	29%
Diesel			0	0	0%
Electricity			0	0	0%
Fertiliser	3000	1200	4200	2800	40%
Manure			0	0	0%
Seed	600	500	1100	733	11%
Chemicals	1200	54	1254	836	12%
Hired labour		150	150	100	1%
Hired draft animals	300		300	200	3%
Hired tractor			0	0	0%
Transport			0	0	0%
Packing material	400		400	267	4%
Sub-total	**6500**	**3904**	**10404**	**6936**	**100%**
MARGIN OVER PURCHASED INPUTS	***2500***	***-1804***	***696***	***464***	
Return on cash investment	***0.38***	***-0.46***	***0.07***	***0.07***	

GROSS MARGIN BUDGET

Case Number	7				
Achiever	Medium				
SCHEME	Mushandike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***1.5***	***1.5***	***1.5***	***per ha***	
CASH INCOME	**Total Z$**	**Total Z$**	**Total Z$**	**Total Z$ per ha**	
Maize		1000	1000	667	8%
Wheat			0	0	0%
Beans			0	0	0%
Groundnuts			0	0	0%
Cotton	10000		10000	6667	84%
Cabbage			0	0	0%
Rape/spinach			0	0	0%
Onions			0	0	0%
Tomatoes		900	900	600	8%
Carrots			0	0	0%
Other			0	0	0%
Total	**10000**	**1900**	**11900**	**7933**	**100%**
CASH COSTS					
Purchased inputs					
Water	1000	1200	2200	1467	26%
Diesel			0	0	0%
Electricity			0	0	0%
Fertiliser	2500	600	3100	2067	36%
Manure			0	0	0%
Seed	400	250	650	433	8%
Chemicals	1200		1200	800	14%
Hired labour	400		400	267	5%
Hired draft animals			0	0	0%
Hired tractor			0	0	0%
Transport			0	0	0%
Packing material	1000		1000	667	12%
Sub-total	**6500**	**2050**	**8550**	**5700**	**100%**
MARGIN OVER PURCHASED INPUTS	***3500***	***-150***	***3350***	***2233***	
Return on cash investment	***0.54***	***-0.07***	***0.39***	***0.39***	

GROSS MARGIN BUDGET

Case Number	8				
Achiever	Medium				
SCHEME	Mushandike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***1.5***	***1.5***	***1.5***	***per ha***	
CASH INCOME	**Total Z$**	**Total Z$**	**Total Z$**	**Total Z$ per ha**	
Maize	2000	1800	3800	2533	20%
Wheat		1750	1750	1167	9%
Beans			0	0	0%
Groundnuts			0	0	0%
Cotton	7000		7000	4667	37%
Cabbage	500		500	333	3%
Rape/spinach	400	80	480	320	3%
Onions	200		200	133	1%
Tomatoes	5000		5000	3333	27%
Carrots			0	0	0%
Other			0	0	0%
Total	**15100**	**3630**	**18730**	**12487**	**100%**
CASH COSTS					
Purchased inputs					
Water	1865	1150	3015	2010	27%
Diesel			0	0	0%
Electricity			0	0	0%
Fertiliser	1740	1250	2990	1993	27%
Manure			0	0	0%
Seed	500	350	850	567	8%
Chemicals	1000	600	1600	1067	14%
Hired labour	300	700	1000	667	9%
Hired draft animals			0	0	0%
Hired tractor			0	0	0%
Transport	950		950	633	9%
Packing material	750		750	500	7%
Sub-total	**7105**	**4050**	**11155**	**7437**	**100%**
MARGIN OVER PURCHASED INPUTS	***7995***	***-420***	***7575***	***5050***	
Return on cash investment	***1.13***	***-0.10***	***0.68***	***0.68***	

GROSS MARGIN BUDGET

Case Number	9				
Achiever	Medium				
SCHEME	Mushandike				
Season	**Summer**	**Winter**	**Both**	**Average**	
AREA (ha)	***1.5***	***1.5***	***1.5***	***per ha***	
	Total	**Total**	**Total**	**Total**	
CASH INCOME	**Z$**	**Z$**	**Z$**	**Z$ per ha**	
Maize	1500		1500	1000	7%
Wheat		2000	2000	1333	9%
Beans			0	0	0%
Groundnuts			0	0	0%
Cotton	15000	3000	18000	12000	82%
Cabbage			0	0	0%
Rape/spinach			0	0	0%
Onions			0	0	0%
Tomatoes			0	0	0%
Carrots		350	350	233	2%
Other			0	0	0%
Total	**16500**	**5350**	**21850**	**14567**	**100%**
CASH COSTS					
Purchased inputs					
Water	500	400	900	600	7%
Diesel			0	0	0%
Electricity			0	0	0%
Fertiliser	3000	960	3960	2640	30%
Manure			0	0	0%
Seed	750	300	1050	700	8%
Chemicals	4000		4000	2667	31%
Hired labour		200	200	133	2%
Hired draft animals	400	250	650	433	5%
Hired tractor			0	0	0%
Transport	700	150	850	567	6%
Packing material	1500		1500	1000	11%
Sub-total	**10850**	**2260**	**13110**	**8740**	**100%**
MARGIN OVER PURCHASED INPUTS	***5650***	***3090***	***8740***	***5827***	
Return on cash investment	***0.52***	***1.37***	***0.67***	***0.67***	

Appendix VI

Budgets comparing crop productivity with and without pump breakdown – Chemombe

Chemombe Irrigation Scheme - 1.5 ha

With no pump breakdowns

Summer crops (maize)					Value per area (ha)	
Income	*Area (ha)*	*Yield*	*Units*	*Price*	*1.5*	*0.02*
Grain maize	1	5	tonnes	3200	16000	
Green maize	0.5	15000	cobs	2	30000	
Gross income					***46000***	***920***

Costs	*Units*	*Amount per ha*	*Cost*	*per ha*	per 1.5 ha	
Seed	kg	25	15	375	562.5	
Fertliser	50 kg	6	350	2100	3150	
Diesel					1500	
Chemicals						
Thiodan	kg	2	60	120	180	
Total cash cost					***5393***	***108***
Net income					***40608***	***812***

Winter crops	***(vegetables)***			
Income	*0.02*	*per ha*	*1.5 ha*	
Rape	1000	50000	75000	
Cabbage	1100	55000	82500	
Tomato	300	15000	22500	
Gross income	***2400***	***120000***	***180000***	***3600***

Costs	*Units*	*Amount per ha*	*Cost*	*per ha*	per 1.5 ha	
Seed	100g	5	400	2000	3000	
Fertliser	50 kg	6	350	2100	3150	
Diesel					2000	
Chemicals						
Dithane	2kg	2	400	800	1200	
Carbaryl	kg	2	580	1160	1740	
Marshall	2 litres	1	200	200	300	
Mitac	2 litres	1	200	200	300	
Thiomex	4 kg	1	450	450	675	
Total cash cost				***6910***	***12365***	***247***
Net income					**167635**	***3353***
TOTAL INCOME					**208243**	**4165**

Chemombe Irrigation Scheme - 0.75 ha
With pumpbreakdowns

Summer crops (maize)					Value per area (ha)	
Income	*Area (ha)*	*Yield*	*Units*	*Price*	*0.75*	*0.01*
Grain maize	0.75	3	tonnes	3200	9600	
Green maize	0	0	cobs	2	0	
Gross income	***0.75***				***9600***	***96***

Costs	*Units*	*Amount per ha*	*Cost*	*per ha*	*per 0.75ha*	
Seed	kg	25	15	375	281.25	
Fertliser	50 kg	6	350	2100	1575	
Diesel					0	
Chemicals						
Thiodan	kg	2	60	120	90	
Total cash cost					***1946***	***26***
Net income					***7654***	***77***

Winter crops	***(vegetables)***			
Income	*0.01*	*per ha*	*0.75 ha*	
Rape	250	25000	18750	
Cabbage	275	27500	20625	
Tomato	75	7500	5625	
Gross income	***600***	***60000***	***45000***	***600***

Costs	*Units*	*Amount per ha*	*Cost*	*per ha*	*0.75 ha*	
Seed	100g	5	400	2000	1500	
Fertliser	50 kg	6	350	2100	1575	
Diesel					0	
Chemicals						
Dithane	2kg	2	400	800	600	
Carbaryl	kg	2	580	1160	870	
Marshall	2 litres	1	200	200	150	
Mitac	2 litres	1	200	200	150	
Thiomex	4 kg	1	450	450	338	
Total cash cost				***6910***	***5183***	***69***
Net income					**39818**	***398***
TOTAL INCOME					**47471**	**475**

Chemombe Irrigation Scheme -
Difference

Summer crops (maize)	**Value per area (ha)**		
	Scheme	*Per farmer*	per ha
Gross income	-36400	-824	-24267
Total cash cost	-3446	-82	-2298
Net income	-32954	-742	-21969
Winter crops			
Gross income	-135000	-3000	-90000
Total cash cost	-7183	-178	-4788
Net income	***-127818***	***-2822***	***-85212***
TOTAL INCOME	***-160771***	***-3564***	***-107181***

Appendix VII

Budgets comparing crop productivity with and without pump breakdown – Chinyamatumwa

Chinyamatumwa Irrigation Scheme - 34 ha

With no pump breakdowns

Summer crops (maize)					Irrigation area owned			
Income	*Area (ha)*	*Yield per ha*	*Units*	*Price*	*0.25*	*0.5*	*1*	*34*
Grain maize	0.1	5	tonnes	3200	1600			
Green maize	0.1	30000	cobs	2	6000			
Total income	***0.2***				***7600***	***15200***	***30400***	***1033600***
Costs	*Units*	*Amount per ha*	*Cost*	*per ha*				
Seed	kg	25	15	375	75			
Fertliser-D	50 kg	6	350	2100	420			
Fertliser-AN	50 kg	4	360	1440	288			
Water	103m3	5	185	925	185			
Chemicals								
Thiodan	kg	2	60	120	24			
Total cash cost					***992***	***1984***	***3968***	***134912***
Net income					***6608***	***13216***	***26432***	***898688***

Winter crops	***(vegetables)***							
Income	*Area (ha)*	*Yield per ha*	*Units*	*Price*				
Sugar beans	0.1	30	50kg bags	6000	18000			
Wheat	0.05	30	50kg bags	750	1125			
Vegetables	0.05	1	various	3600	180			
Tomato	0.1	1800	kg	12	2160			
Gross income	***0.3***				***21465***	***42930***	***85860***	***2919240***
Variable costs		*Amount per ha*	*Cost per area*					
Sugar beans		7308	730.8					
Wheat		4573	228.65					
Vegetables		6910	345.5					
Tomato		6870	687					
Water		750	225					
Total cash cost			***2217***		***2217***	***4434***	***8868***	***301505***
Net income					**19248**	**38496**	**76992**	**2617735**
TOTAL INCOME					**25856**	**51712**	**103424**	**3516423**

Chinyamatumwa Irrigation Scheme - 34 ha

With pump breakdowns

Summer crops (maize)						**Irrigation area owned**			
Income	*Area (ha)*	*Yield per ha*	*Units*	*Price*		*0.2*	*0.5*	*1*	*34*
Grain maize	0.2	2	tonnes	3200		1280			
Green maize	0	0	cobs	2		0			
Total income	***0.2***					***1280***	***2560***	***5120***	***174080***
Costs	*Units*	*Amount per ha*	*Cost*	*per ha*					
Seed	kg	25	15	375		75			
Fertliser-D	50 kg	6	350	2100		420			
Fertliser-AN	50 kg	0	360	0		0			
Water	103m3	1	185	185		37			
Chemicals									
Thiodan	kg	2	60	120		24			
Total cash cost						***556***	***1112***	***2224***	***75616***
Net income						***724***	***1448***	***2896***	***98464***
Winter crops	***(vegetables)***								
Income	*Area (ha)*	*Yield per ha*	*Units*	*Price*					
Sugar beans	0.05	8	50kg bags	6000		2400			
Wheat	0.02	8	50kg bags	750		120			
Vegetables	0.02	1	various	1800		36			
Tomato	0.05	0.9	kg	12		0.54			
Gross income	***0.14***					***2557***	***5113***	***10226***	***347689***
Variable costs		*Amount per ha*	*Cost per area*						
Sugar beans		7308	365.4						
Wheat		4573	91.46						
Vegetables		6910	138.2						
Tomato		6870	343.5						
Water		30	4.2						
Total cash cost			***942.76***			***943***	***1886***	***3771***	***128215***
Net income						**1614**	**3228**	**6455**	**219474**
TOTAL INCOME						**2338**	**4676**	**9351**	**317938**

Chinyamatumwa Irrigation Scheme -
Difference

Summer crops (maize)	**Irrigation area owned**			
Income	0.2	*0.5*	*1*	*34*
Total income	***-6320***	***-12640***	***-25280***	***-859520***
Total cash cost	***-580***	***-1160***	***-2320***	***-78880***
Net income	***-5740***	***-11480***	***-22960***	***-780640***
Winter crops				
Gross income	***-18908***	***-37817***	***-75634***	***-2571551***
Total cash cost	***-1274***	***-2548***	***-5097***	***-173290***
Net income	**-17634**	**-35269**	**-70537**	**-2398261**
TOTAL INCOME	**-23374**	**-46749**	**-93497**	**-3178901**

Appendix VIII

Implications of productivity loss- Rupike

Rupike irrigation scheme		**Yield reductions as a result of breakdowns**				
		1	**2**	**3**	**4**	**5**
Reduction in income as a result of pump breakdown		*0%*	*10%*	*30%*	*50%*	*100%*
Expected income without breakdown		7354	7354	7354	7354	7354
Income as a result of breakdown		7354	6619	5148	3677	0
Cash income lost		***0***	***735***	***2206***	***3677***	***7354***
Reduction in costs as a result of pump breakdown						
Savings in water costs		0	0	0	0	0
Savings in pump costs (electricity or diesel)		0	50	150	500	1000
Savings in inputs applied		0	451	1353	2087	4011
Total cost savings		***0***	***501***	***1503***	***2587***	***5011***
Net cash income lost		**0**	**234**	**703**	**1090**	**2344**
Estimate of value of crop retained for home consumption	15000					
Value lost as a result of breakdown		0	1500	4500	7500	15000
Net productivity lost per farmer (0.5ha)		**0**	**1734**	**5203**	**8590**	**17344**
Net productivity lost for the scheme (100ha)		**0**	**346875**	**1040625**	**1718088**	**3468750**

Appendix IX

AGRITEX crop budgets for irrigation schemes (1998)

GROSS MARGIN BUDGET (AGRITEX)

CROP	Maize				
AREA	1 ha				
GROSS OUTPUT	**Type**	**Units**	**Quantity**	**Price**	**Total Z$**
Grain		kg	6000	3.2	19200
Stover		kg			0
Total					**19200**
VARIABLE COSTS					
Purchased inputs					
Seed	R201	kg	25	15	375
Fertiliser	Compound D	50 kg bags	6	340	2040
	Urea	50 kg bags	6	360	2160
Chemicals	Thiodan	kg	2.0	58	116
Water		000 m3	5.0	185	925
Bags			50	20	1000
Hired labour	days		0	12	0
Hired draft power for land preparation		per ha	1	500	500
Marketing costs	% of income		1%		192
Sub-total					**7308**
MARGIN OVER PURCHASED INPUTS					***11892***
Return on cash investment					***1.63***
Family labour days	days		100.5		
Gross margin per labour day					***118***

GROSS MARGIN BUDGET (AGRITEX)

CROP	Beans
Season	Summer and winter
AREA	1.0 ha

GROSS OUTPUT	**Type**	**Units**	**Quantity**	**Price**	**Total Z$**
Beans		kg	2000	15	30000
					0
Total					**30000**
VARIABLE COSTS					
Purchased inputs					
Seed		50kg	2	50	100
Fertiliser	Compound D	50 kg bags	12	340	4080
	Urea	50 kg bags	2	360	720
Mancozeb	Mancozeb	300g	2.0	67	134
	Carbaryl	1kg	2.0	580	1160
	Dicofol	200g	2.0	66	132
Hired labour					0
Water		000 m3	6.0	185	1110
Bags			0	20	0
Hired labour			0	12	0
Hired draft power for land preparation		per ha	0	500	0
Marketing costs	% of income		1%		300
Sub-total					**7736**
MARGIN OVER PURCHASED INPUTS					***22264***
Return on cash investment					***2.88***
Family labour days	days		93.5		
Gross margin per labour day					***238***

GROSS MARGIN BUDGET (AGRITEX)

CROP	Wheat				
AREA	1 ha				
GROSS OUTPUT	**Type**	**Units**	**Quantity**	**Price**	**Total Z$**
Grain		kg	6000	2.2	13200
Total					**13200**
VARIABLE COSTS					
Purchased inputs					
Seed	R201	kg	125	2.2	275
Fertiliser	Compoun(	50 kg bag:	12	340	4080
	Urea	50 kg bag:	6	360	2160
Chemicals	Thiodan	kg	0.0	58	0
Water		000 m3	8.0	185	1480
Bags			0	20	0
Hired labour			0	12	0
Hired draft power for land preparation		per ha	1	500	500
Marketing costs	% of income		1%		132
Sub-total					**8627**
MARGIN OVER PURCHASED INPUTS					***4573***
Return on cash investment					***0.53***
Family labour days	days		66.5		
Gross margin per labour day					***69***

GROSS MARGIN BUDGET (AGRITEX)

CROP	Tomatoes				
Season	Winter				
AREA	1.0	ha			
GROSS OUTPUT	**Type**	**Units**	**Quantity**	**Price**	**Total Z$**
Tomatoes		kg	2800	12	33600
					0
Total					**33600**
VARIABLE COSTS					
Purchased inputs					
Seed		25g	1	345	345
Fertiliser	Compound L	50 kg bags	6	340	2040
	Urea	50 kg bags	2	360	720
Chemicals	Thiomex	4	1.0	444	444
	Carbaryl	1kg	2.0	580	1160
	Marshall	2l	1.0	198	198
	Mitac	2l	1.0	198	198
Water		000 m3	6.0	185	1110
Bags			20	20	400
Hired labour			0	12	0
Hired draft power for land preparation		per ha	0	500	0
Marketing costs	% of income		1%		336
Sub-total					**6951**
MARGIN OVER PURCHASED INPUTS					***26649***
Return on cash investment					***3.83***
Family labour days	days		125.5		
Gross margin per labour day					***212***

GROSS MARGIN BUDGET (AGRITEX)

CROP	Tomatoes	
Season	Summer	
AREA	1.0	ha

GROSS OUTPUT	**Type**	**Units**	**Quantity**	**Price**	**Total Z$**
Tomatoes		tonnes	30	1000	30000
					0
Total					**30000**
VARIABLE COSTS					
Purchased inputs					
Seed		100g	2	345	690
Fertiliser	Compoun(	50 kg bag:	20	340	6800
	Urea	50 kg bag:	2	360	720
Chemicals	Dithane	2kg	2.0	444	888
	Carbaryl	1kg	2.0	580	1160
	CuOx	2kg	2.0	124	248
Hired draft					0
Water		000 m3	6.0	185	1110
Bags			0	20	0
Hired labour			0	12	0
Hired draft power for land preparation		per ha	0	500	0
Marketing costs	% of income		1%		300
Sub-total					**11916**
MARGIN OVER PURCHASED INPUTS					***18084***
Return on cash investment					***1.52***
Family labour days	days		125.5		
Gross margin per labour day					***144***

LABOUR REQUIREMENTS

	Maize	G-nuts	Beans	Cabbage	G maize	Tomatoes	Wheat
Manure application	12		12		12		
Land preparation	1.5	1.5	1.5	2	1.5	1.5	1.5
Planting	6	8	8	30	6	6	6
Cultivating	22	90	32	16	26	40	10
Fertilising	2	4	2	8	4	4	4
Irrigation	22	21	6	8	18	20	14
Pest control	4	0	2	3	4	12	1
Harvesting	28	54	28	8	28	40	28
Transport	3	3	2	3	2	2	2
Total	**101**	**182**	**94**	**78**	**102**	**126**	**67**

Prices - Feb 1999

Seed	*Unit*	
Maize seed	kg	15
Cotton seed	kg	11
Wheat seed	kg	2.2
Bean seed	kg	50
Rape seed	gm	2.5
Tomato seed	gm	345
Cabbage seed	gm	23

Fertiliser		
Compound D	50 kg bag	340
Compound L	50 kg bag	350
Compound S	50 kg bag	356
Ammonium nitrate	50 kg bag	360

Chemicals		
Dithane M45	250g	54
Cosan	375g	62
Dimethoate	100ml	29
Dicofol	100ml	40
Marshall	100ml	198
Karate	500ml	411
Thionex	500ml	221
Thiodan	1 kg	58

Land Preparation	per ha	500
Labour	per day	12

Crop prices		
Maize grain	kg	3.2
Maize cobs	cob	2
Cotton	kg	12
Wheat	kg	2.2
Beans	kg	15
Tomato	kg	10

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