Gender-Sensitive Irrigation Design

Guidance for smallholder irrigation development

F Chancellor
N Hasnip
D O'Neill

Report OD 143 (Part 1)
December 1999

HR Wallingford

DFID Department for International Development

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Address and Registered Office: HR Wallingford Ltd. **Howbery Park, Wallingford, OXON OX10 8BA**
Tel: +44 (0) 1491 835381 Fax: +44 (0) 1491 832233

Contract

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(name)

SOCIO-ECONOMIST

(Title)

Approved by .....

(name)

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(Title)

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Executive Summary

Gender-sensitive irrigation design

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Future development of smallholder irrigation in southern Africa will depend on improved returns to investment in irrigation. Subsidy is likely to decrease. It is therefore important that the users of irrigation have the capacity to make profits and to improve livelihoods by choosing the systems best suited to their situations. Women are key actors in irrigation in the region but have not in the past been considered closely in design, nor been included among participants in choice or decision-making.

The objective of this research is to improve southern African smallholder irrigation through greater gender-sensitivity in design and operation. For the purposes of this study the term 'design' has been used in a broad sense including various aspects of planning.

The approach employed was to identify the gender-based constraints and opportunities in existing irrigation developments, investigate their origins and formulate strategies to reduce negative impacts and increase positive ones. This Guidance synthesises the lessons learned from irrigators and agencies, who assisted the study (Part 1). The associated reports (Parts 2-6) give an account of the work undertaken and are the basis on which the Guidance stands. The Guidance is organised in conventional sections for ease of presentation and to allow readers to dip into sections of particular interest. However, a devoted reader will find that there is overlap between sections: Repetition serves to emphasise key messages. Posters also have been produced for translation to local southern African languages, to help bring to the attention of farmers important design issues highlighted by the study.

The study consists of two Phases. Phase I, which took place in Zimbabwe and identified a representative sample of smallholder irrigation projects and investigated gender roles in these projects, through surveys and focus groups to identify potential research issues. A regional workshop was organised in which regional irrigation professionals prioritised the gender issues that had emerged. The process resulted in the following priority list:

- **Marketing**
- **Access to resources**
- **Equipment and land preparation**

Phase II investigated these priority issues in a variety of situations in the region. In Zimbabwe, the focus was on group-based communal irrigation schemes, in South Africa the emphasis was on the rehabilitation and remodelling of former homeland communal irrigation schemes and, finally, in Zambia, where communal irrigation is less used, the study concentrated on individual, low-cost treadle pump adoption.

It was clear from the Phase I study that some design features constrain, while others empower men and women to build their own capacity for development. The examples that came to light should help future designers to adopt a more gender-sensitive and participatory approach.

In smallholder agriculture generally, women provide the majority of human labour, and their labour on irrigated holdings is increased.

Women's labour is particularly increased by irrigation because of;

- **the year round nature of cultivation**
- **the extra weed growth resulting from applying water**
- **the extra burden of land preparation and levelling**

Also, because irrigation often involves use of technology, women are excluded from choice, decision-making and control because of their own and other people's perceptions of their role as assistants to men farmers. Women tend to benefit less than would be expected as a result of social and institutional arrangements such as land tenure, credit and training arrangements that were established in the past.

A central concept is that sustainable livelihoods can be supported by irrigation development rather than that irrigation development is an end in itself. The study highlighted numerous measures that can ameliorate disadvantages and improve designs for all users. The main recommendations for design for sustainable livelihoods, ie gender-sensitive design are summarised below:

Participation

- ***Before design begins, ensure that the various subgroups of stakeholders, particularly women's groups, have reached consensus on their objectives in investing in irrigation and understand real market opportunities***
- ***Recognise that mass meetings have a role but cannot be relied upon to differentiate the valid needs of the different subgroups ,particularly women.***
- ***Use participation to link design features of irrigation infrastructure and equipment to the different tasks that men and women are obliged to do. This means that designers have to learn about who does what and what resources and constraints are present. Men and women farmers have to learn about routine maintenance and repair and the level and frequency of recurrent costs for different options.***
- ***Prepare checklists to help structure participation so that designers and farmers can use the process more effectively and women's needs are included in a more systematic way.***

- ***Use existing women's groups and meeting points effectively to ensure that women understand the potential constraints and opportunities and can give their views in a comfortable unrestricted environment.***
- ***Recognise that most communities need help to sort out their long and medium term priorities and emphasise that explicit attention to women's needs benefits all users.***

Scheme Layout

- ***Encourage stakeholders, always including women, to visit the site, organise visits to other working sites, provide interactive demonstrations and take their comments into account.***
- ***Assist farmers to link the proposed layout to the routine work that the layout would involve.***
- ***Address the equipment requirements implicit in different layouts and discuss availability and sustainability.***
- ***Address the maintenance implications of layout, emphasising the costs, the schedules and the need to budget for maintenance.***

Land preparation

- ***Take account of the key importance of land preparation in irrigated agriculture by always considering the resources and capacity of the people who will have responsibility for ploughing.***
- ***Link layout issues such as plot size to land preparation constraints.***
- ***Appreciate that designs that rely on effective land levelling for the distribution of water, in the field, place a heavy burden of labour on women.***
- ***Investigate how well traditional land preparation equipment is being used.***

Water distribution and application

- ***Identify the people who will take day to day responsibility for water application and investigate their concerns.***
- ***Link the system to be used to the land preparation requirements, the cost and technical requirements of maintenance, the risk of breakdown and flexibility of the system.***
- ***Ensure that the operation and maintenance is well understood and within the capacity of day to day users.***
- ***Do not neglect the large numbers of women who need special consideration due to their lack of technical confidence.***

Institutions and management

- ***Be aware of the differences between types of management and the consequences for men and women smallholders.***

- ***Arrange the institutional inputs to be complementary and in the interest of both men and women smallholders.***
- ***Ensure that stakeholders who influence the performance of schemes also benefit from success and underwrite failure.***
- ***Appreciate that attention to external linkages is a key factor in reducing the risk of increasing physical capital at the expense of the other capitals.***

Pumps and modern technology

- ***Considering inclusion of pumps very carefully, discussing fully the costs and risks involved and considering alternative options, paying particular attention to the availability of support and services locally.***
- ***Where pumps are included, establish workable arrangements, viable financing and links to suppliers of spares and service, ensuring that women are included in all aspects of training and communication relating to pumps.***
- ***Emphasise the pitfalls users have experienced in the use of imported pumps.***
- ***Illustrate the gender disparity that can arise from pump use.***
- ***Ensure that a reliable corps of men and women are trained and confident to operate, maintain and trouble-shoot pumps and engines and that they are available on a day to day basis.***
- ***Involve men and women in evaluating tools and small equipment, building their capacity and confidence to select appropriate models for their circumstances, thus promoting interest in design and further participation.***

Marketing

- ***Assist farmers to appreciate the importance of marketing as opposed to selling and ensure the involvement of women in marketing committees.***
- ***Appreciate that poor men and women require different cash flows to people who have more resources, and may require to market to meet these requirements.***
- ***Appreciate that women have different cash needs to men.***

Financing

- ***Ensure that design includes all the necessary linkages for men and women to make effective use of irrigation infrastructure and equipment, particularly relating to micro credit.***
- ***Promote women's role in handling group finances.***
- ***Links operational practices to the budgets for maintenance, particularly for modern equipment such as pumps and tractors.***
- ***Encourage informal savings groups and women's savings clubs.***
- ***Facilitate training in budgeting and planning.***

Health and environment

- ***Consider how layout and design affect human health by changing working practices and duration.***
- ***Investigate opportunities for introduction of labour saving techniques and equipment***
- ***Appreciate that the different objectives and resources available to men and women suggest that provision of a range of options is more gender-sensitive than design that prioritises equity.***
- ***Ensuring that the range of options is accessible to both men and women and that the institutional arrangements allow for people to move between options as their requirements, capacities and health change.***

Training

- ***Involve both men and women in establishing training priorities and ensure that the training is specific and demand-led in terms of content, venue and style.***
- ***Consider if training should be provided separately for men and women.***
- ***Make training enjoyable and issue worthwhile certificates that have a future value.***
- ***Ensure interactive courses and encourage broad content.***
- ***Don't force women to take up training that conflicts with community views in the name of empowerment.***

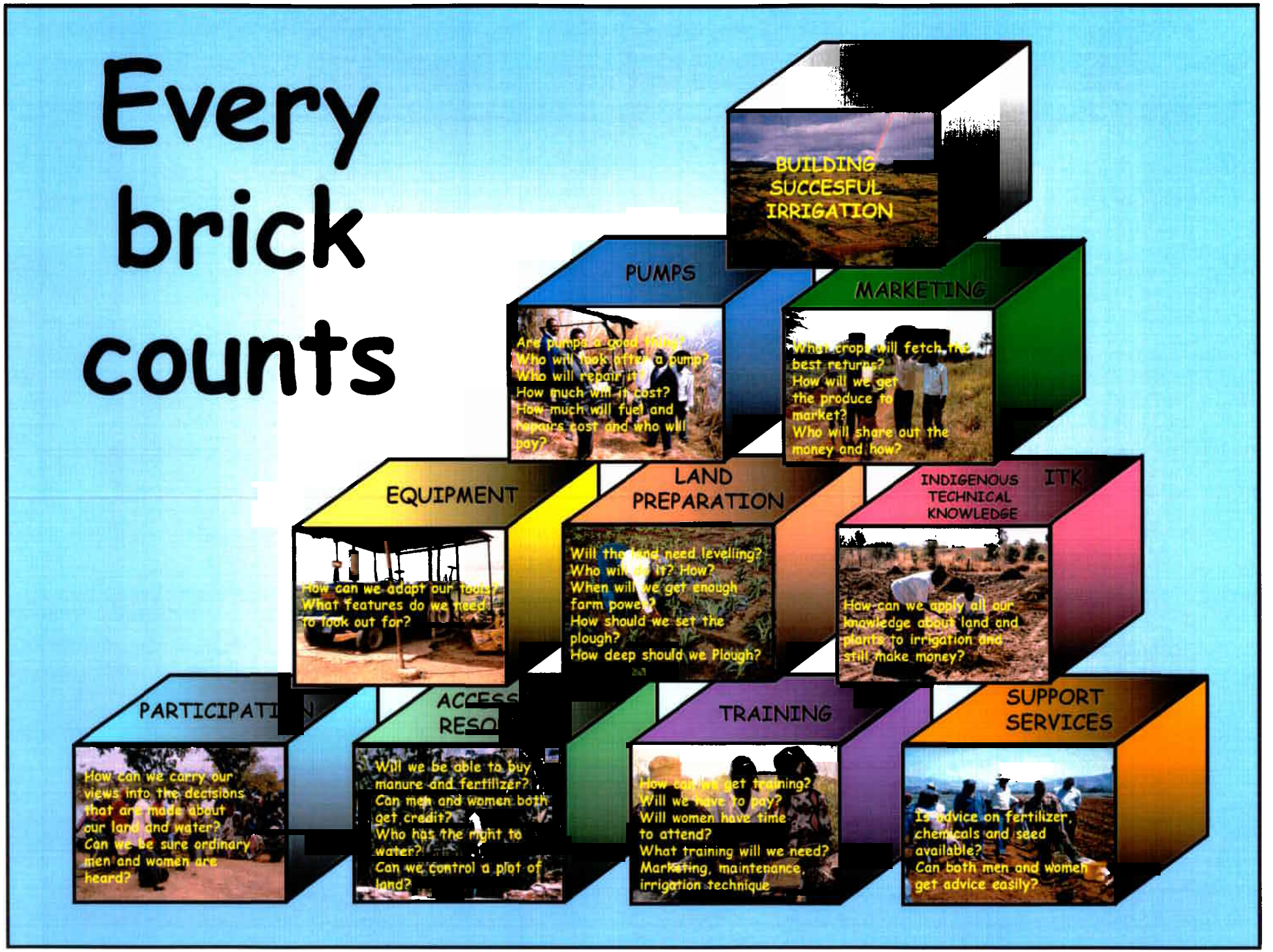
Gender awareness

- ***Negative impacts on men and women should be analysed so that awareness is increased and ameliorating action can be taken.***
- ***Investigate how men and women's livelihoods are improved by irrigation.***
- ***Appreciate that communities need help to foresee gender issues.***
- ***Gender-sensitive participation needs explicit attention and resources and should aim to provide win-win outcomes for men and women.***

Gender-based constraints have undoubtedly played a part in the disappointing performance of smallholder irrigation in the region. However, it was evident in the course of the study that many people feel threatened by exposure of gender disparities. They may rationalise their discomfort as a wish to keep their 'culture' intact. It has to be recognised that culture can have negative aspects and that practices that are damaging to women, such as overwork, are usually challenged by at least some of the women. It must also be recognised that women must themselves dictate the pace of change, hence the emphasis on their participation. Gender issues are not the only source of underachievement and this study deals with many issues where gender is only part of the solution to achieving a people–centred approach.

Designers may find their skills challenged to provide users with designs that are sufficiently flexible and robust to provide a sustainable alternative for improving livelihoods of men and women alike. However, this study identified a need to accord as much importance to user needs as to design of the distribution system. Both these issues require high priority. It is hoped that the approaches suggested might lead to the incorporation of user wisdom and choice in design, to improve irrigation performance in the region.

Every brick counts



Preface and Acknowledgements

The need for research into gender-sensitive irrigation design in southern Africa arose from the perception that a large proportion of the human labour for irrigated smallholder agriculture was provided by women, yet their needs were seldom taken into consideration. Thus they are challenged to use irrigation effectively as part of their livelihood strategy, seldom achieving the expected returns, and often accepting unnecessarily heavy workloads. Recent approaches have tended to be supportive to women but have not necessarily ensured that women assume or stay in control of irrigation initiatives. By investigating the concerns of both men and women, it should be possible to gain an understanding of the changes in gender-relations that occur when irrigation is developed and how sustainability and livelihood impacts might be improved by taking account of these changes and related concerns at the design stage.

The objective of the research was to enhance southern African smallholder irrigation through greater gender-sensitivity in design and operation. The approach employed was to identify the gender-based constraints and opportunities in existing irrigation developments, investigate their origins and formulate strategies to reduce negative impacts and increase positive ones. These Guidelines synthesise the lessons learned from irrigators and agencies, who assisted the study (Part 1). The associated reports give an account of the work undertaken and are the basis on which the guidelines stand (Parts 2-6).

The study consisted of two Phases:

- Phase I comprised preliminary investigations in Zimbabwe and culminated in a workshop to prioritise the issues for southern Africa to be explored in Phase II
- Phase II investigated the priority issues in South Africa, Zambia and Zimbabwe

DFID, UK has provided funding for this study. These funds have been augmented by contributions of staff time and local transport by collaborating institutions in southern Africa, namely, the Institute of Agricultural Engineering in South Africa, AGRITEX, in Zimbabwe and the Ministry of Agriculture, in Zambia and CARE in Zimbabwe and Zambia.

The output from the study consists of a six part report on Gender-sensitive Irrigation Design, each part relating to a specific aspect of the study:

Part I, Guidance for Smallholder Irrigation Development, offers guidance on participation, specific aspects of scheme design, training and considerations for future development, distilled from all three country experiences that are detailed in the remaining five Parts.

Part 2, Group-based irrigation schemes in Zimbabwe, provides an account of the gender issues that are common to this type of development taking into consideration the different management scenarios found among the schemes studied.

Part 3, Gender considerations relating to treadle pump adoption: experiences from Zambia, provides a brief overview of the situation of individual families who invest in treadle pumps and the impact on workloads, productivity and incomes.

Part 4, Gender issues in smallholder irrigation rehabilitation: cases from South Africa, looks at the special problems that arise for men, women and agencies that already have a vested interest in an existing, failing scheme and are faced with the challenge of turning it around.

Part 5, An assessment of the implications of pump breakdown and community participation in irrigation schemes, Masvingo Province, Zimbabwe, provides a rough costing of pump failure and draws attention to the gender impacts that were evident in the Province.

Part 6, Consultation on gender issues in smallholder irrigation, prepared by Zimbabwean sociologists, provides insights into the views and concerns of men and women on irrigation schemes in Zimbabwe.

Posters have been developed from these volumes to convey simple awareness raising messages to farmers in their own languages. An example of the main poster is attached to Part 1.

The success of the study has depended on the participation of agencies and farmers in the three countries, without whom no amount of study could have produced results. The assistance and co-operation accorded to the research team has been most gratifying and has served to underline the perceived relevance of the work.

The research team would like to acknowledge the assistance provided in Zimbabwe by AGRITEX and, in particular, the major input of Emelda Berejena without whom the field-work would not have been possible. Particular thanks are also due to Eric Chidenga of AGRITEX for his support in making contacts for us and assisting in the choice of sites for the study. The contribution of Ivan Chatizwa in facilitating and implementing the interactive demonstration of plough setting and selection of new ploughs, is gratefully acknowledged. We are also indebted to the staff of the AGRITEX office in Masvingo for facilitating contacts at the schemes and providing background information. We are also indebted to the staff of CARE Zimbabwe, both at the head office in Harare and in Masvingo. In particular the help of Kelly Stevenson, Alfred Mhondiwa and George Tobiawa and Faraye in identifying sites for study and assisting in the logistics of visits and translation. The support of Alistair Wray and Claire Barrington of British Development Division in Central Africa, Harare is gratefully acknowledged.

The contribution of the Institute of Development Studies, University of Zimbabwe, in the person of Neddy Matshalaga and her research assistant Mrs R Gotura was central to the study. The skills and commitment they brought to the focus group investigations is gratefully acknowledged. Lastly, the many Zimbabwean men and women farmers who gave us their time and shared their opinions brought the subject alive and are due many thanks.

The Research team also acknowledges the help received from the Ministry of

Agriculture in Zambia; the FAO representative in Lusaka; International Development Enterprises; the University of Zambia; and CARE Zambia. In particular, thanks are extended to Mrs A Tembo of the Women and Youth Programme and Patrick Tembo of Lusaka District, both of the Ministry of Agriculture; to Andries Bosma of FAO for his guidance and providing contacts; to Peter Elkind and Angel Daka of IDE for insights into treadle pump design, distribution and support services in Zambia; to Dr Kwendakwema for his overview of the agricultural problems facing smallholders; to Godfrey Mitti in the Lusaka office of CARE and to Florence Mubanga of CARE Livingstone for facilitating field visits.

The team is also indebted to staff in women's organisations, in particular, Gertrude Nkunta of Women for Change and Cecilia Makota of Women in Agriculture. Permission to attend the MAFF training session in Kalomo is gratefully acknowledged, as is the kind reception from participants and lecturers. Lastly we gratefully acknowledge the patience and courtesy of the farmers who welcomed us in their fields and villages, showed us around their irrigation, spared time to answer our many questions and took the time and trouble to explain their concerns.

We gratefully acknowledge the contribution inputs and support of the South African Institute of Agricultural Engineering (ILI), in particular the major contribution of Chris Stimie, Principal Engineer, whose assistance in facilitating the rehabilitation part of the study was invaluable. The support of the Ministry of Agriculture in Northern Province in allowing access to the pilot rehabilitation projects, and in particular to Doctors Tau Mzamane and Michael Shaker for their interest and support. Particular thanks are due to the consultants who were responsible for the institutional and agricultural aspects of the pilot rehabilitation, Loxton Venn & Associates and in particular to Dr Jon Rutherfoord and the extension specialist Johann Adendorff, who shared their insights and considerable experience. Thanks are also due to Lieve Stoops and Tersha Uitenwerde for their investigations at Elandsdoorn, and to Sean van Rij of the Mpumalanga Development Corporation who had previously been involved with the scheme. Particular thanks are due to the extension staff, Maggie Mbatha, Thembi Mteshweni, Julius and Daniel and to the chairman Joseph Seopseh.

The study benefited from the support and interest of British Development Division for Southern Africa, in particular Dr John Barrett and thanks are due to Mark Harvey for his interest in the approach taken at Thabina. The contribution of Mr Charles Crosby from his extensive experience in development initiatives has been particularly stimulating and thought provoking.

The team is particularly indebted to the Tribal Chiefs, Development Committees, Extension Officers, Farmers and men and women, who welcomed us to their meetings, explained their objectives and difficulties to us, cooked for us and made us welcome with songs and dances.

It is hoped that the output from this study will provide useful reference material and that the guidance will play a part in assisting men and women throughout the region to achieve better, more sustainable livelihood benefits from investment in irrigation.

Acronyms

AGRITEX	Department of Agricultural, Technical and Extension Services (Zimbabwe)
CARE	CARE – a Non Government Organisation (Zimbabwe and Zambia)
DWD	Department for Water Development (Zimbabwe)
ILI	Institute of Agricultural Engineering (South Africa)
BDDCA	British Development Division for Central Africa (now DFIDCA)
BDDSA	British Development Division for Southern Africa, DFID, British High Commission, Pretoria. (now DFIDSA)
DFID	British Department for International Development, UK

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1. INTRODUCTION

1.1 What is gender-sensitive irrigation design (GSID)?

Irrigation is rightly perceived as a method of boosting agricultural production (Pinstrup-Anderson and Pandya Lorsch, 1995) and it can make an important contribution to reducing poverty (IPTRID, 1999), yet many existing smallholder irrigation schemes in southern Africa perform poorly. Scheme infrastructure is maintained badly; leaking channels and broken down pumps abound and water distribution is often unreliable and inequitable. In such circumstances, production levels remain low, thus the impact of these projects on poverty alleviation falls below expectations. DFID has funded research into the role that neglect of gender issues in design and operation of schemes has had in this situation. The research project was carried out in Zimbabwe, South Africa and Zambia. These guidelines result from the research and are supported by reference to other findings in the field of smallholder irrigation.

It is not generally appreciated how the design of irrigation dictates the workload of the users. Very often the design is not created for the farmer who ultimately uses the irrigation scheme. Design of schemes, however, determines land preparation tasks, watering techniques and time schedules and these may conflict with other essential activities of the users. It is crucial that the link between design and subsequent workload, particularly, land preparation is understood and fully discussed by all stakeholders. Generally, the ergonomic aspects of infrastructure and equipment are neglected in favour of attention to water conveyance efficiency. This often results in users experiencing difficulties in operating the system and achieving acceptable levels of productivity.

In smallholder agriculture, tasks are traditionally allocated on a gender basis; similar patterns of allocation are often carried from dry-land farming into irrigated farming. The balance of work, however, is altered by irrigation and in the last century there has been much disruption due to demographic changes such as disease, colonialism and male migration to cities (Dey,1990; Carney, 1988; Matshalaga, 1998). Although specific tasks may be formally or informally allocated to men and women, many tasks are highly inter-dependent. The study reported here reveals that the relationships between tasks, and their significance for production were key issues in considering the gender-sensitiveness of a design.

Gender-sensitive design refers to design that recognises the different starting points, job-obligations, constraints and aspirations of men and women regarding the use of irrigation facilities. A good gender-sensitive design would be one that maximises sustainability and production, while empowering both men and women to fulfil their objectives for an acceptable level of effort.

1.2 Why is gender important to smallholder irrigation in Southern Africa?

In southern Africa, the provision of family food crops has long been the woman's responsibility. Men are often the registered users of irrigation plots and prefer to produce crops for cash. Women may have difficulty in securing rights to land for food production yet they are still expected to provide family food; they are also expected to provide labour for men's fields. Thus there is competition for both land and labour and, commonly for other resources too. (IFPRI, 1995; Barrett, 1995; Daimer & Huibers, 1996; Zwarteveen, 1995; Chancellor, 1997)

Structural adjustment has made privatisation a crucial issue for many developing country governments. Whereas irrigation users took no part in the design and management of schemes, the intention now is that they participate in decisions from the outset, take responsibility for projects, manage them and shoulder the costs. Despite widespread commitment to the principle of participation, it is sometimes difficult to include the poorest (and least powerful) sections of the community, particularly women who are in the majority among the poor. If women remain outside these arrangements, lacking a voice in policy and organisation,

using water by way of the rights of male relatives, then a great deal of water will be allocated informally. This will inevitably give rise to inequity and conflict.

In mainstream smallholder projects, women's limited control over land and resources restricts them to labouring, fosters low participation and denies them the opportunity to benefit from technology either to enhance productiveness or reduce workloads (Mehra, 1995). Nonetheless, women are notably successful in developing group-based irrigated vegetable gardens, developing organisational and technical skills to ensure continued control of production, thus demonstrating highly effective participation when conditions are appropriate (De Lange, 1994).

The World Bank has identified investment in smallholders as potentially the greatest contribution to development in Sub-Saharan Africa (Bautista, 1998). New investment should avoid gender biases. As a result of existing gender imbalances, men often achieve greater commercial success than women, reinforcing the perception that they are more innovative and more responsive to technology-transfer. Commercial success tends to makes access to credit easier for men, and the available support services are geared to men's greater mobility and are accessed through predominantly male networks. These factors support strong male roles in irrigation development. Women's cultural perceptions about leadership, deferential public dialogue with men and infrequent use of technology heighten the imbalance. Women's reticence in making their needs known to male irrigation engineers and government agents denies designers an accurate picture of female user-requirements. Thus the gender disparity between men and women can be exacerbated by irrigation development, unless specific attention is paid to gender issues. It is important to emphasise that gender-sensitive design is a tool to redress this imbalance.

It is crucial that irrigation development takes account of the prominent part women play in producing irrigated crops, appreciates their needs and enables them to select appropriate technology to improve productivity. Additionally, it should be appreciated that returns to investment in women, in terms of social and economic objectives, are potentially enormous.

1.3 What is needed to achieve gender-sensitive irrigation design?

Preliminary research in southern Africa explored constraints to gender-sensitive irrigation design by reviewing the problems that women face in their irrigation-related work and the processes that include or exclude them from decision making. Disparity between the needs and opportunities for men and women in relation to essential irrigation tasks such as land preparation, maintenance and marketing were revealed (Matshalaga, 1998). The impact of design on these various issues is poorly understood by those farmers who have little irrigation experience and by those designers who lack experience of smallholder agriculture. Even among men and women farmers with substantial experience, the research revealed poor awareness of the potential for adapting existing infrastructure and tools to meet their user needs, and regular maintenance of equipment and tools.

Designers, agencies, NGO's and communities must ensure that gender-aware strategies are used at the outset of projects to improve design, operation and maintenance of small irrigation schemes, irrigated gardens and individuals' irrigated enterprises.

Attention to awareness raising and participation, in a gender-balanced way, is crucial if investment in smallholders is to fulfil expectations. Governments and civil society must appreciate the need for these so-called 'softer' aspects and be prepared to devote money and energy to them if investment in irrigation hardware is to be used to best advantage.

1.4 How is gender-sensitive design linked to sustainable livelihoods?

In its thrust to eliminate poverty, DFID has adopted the sustainable livelihood approach. This approach embraces a holistic view of interventions and considers five asset categories or capitals. The five capitals - physical, natural, human, social and financial - comprise specific components or elements that together represent the total asset-base of development (DFID, 1999).

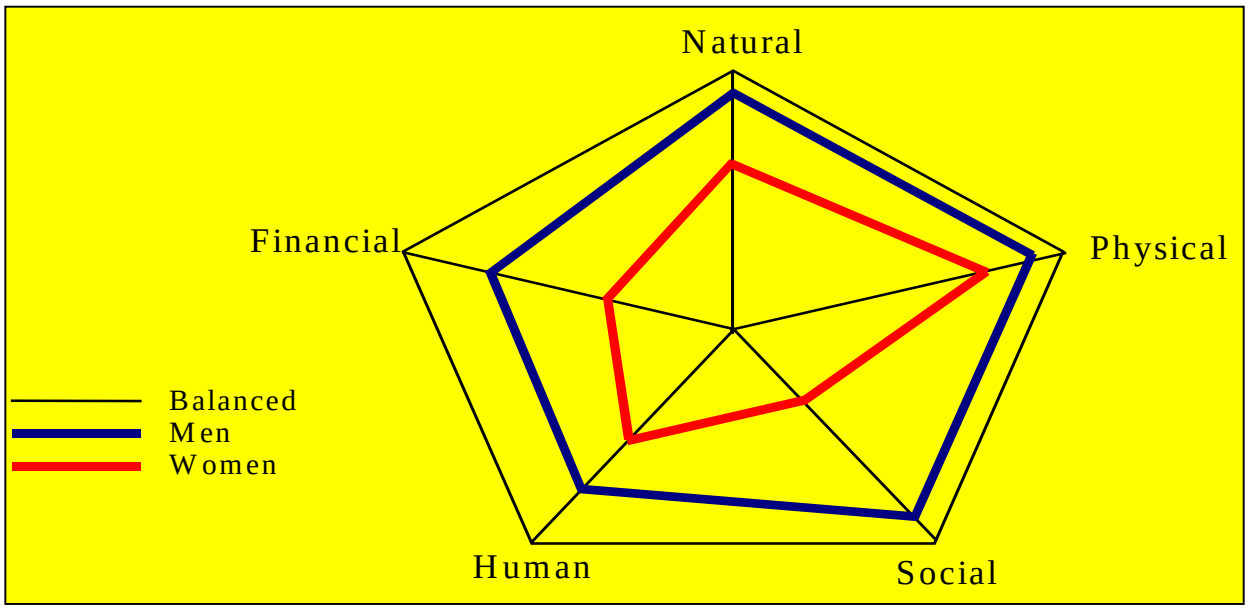
Elements of the "Livelihood Assets"

Human	Natural	Physical	Social	Financial
Labour	Land	Buildings	Networks	Savings
Health	Water	Machinery	Relationships	Credit
Nutrition	Trees	Infra-structure	Affiliations	Remittances
Education	Bio-diversity			
Knowledge				

The pentagon concept is used to illustrate the potential for expansion or risk of reduction of the total area enclosed, as development proceeds. Reduced area is particularly associated with emphasis on one capital, or even on one component, to the exclusion and possible reduction of other components.

Water is one resource of the natural capital. Many of the poorest people are short of water and they need physical capital and other capitals to capture and manage that scarce resource.

In irrigation schemes, the major interests are in the physical assets because of the capital invested in infrastructure and machinery, and in the natural assets, as land and water are the other central elements. Generally speaking, the human capital has been taken for granted and human elements have not been considered as particularly relevant. However, the preliminary investigation in this study indicated that men and women do not access the five capitals equally, as is represented in the pentagon diagram below.



The disparity between the areas enclosed by the men's and women's pentagons reflects the fact that, although they have access to irrigation infrastructure, women may lack the financial and social capital to exploit the opportunities offered. Thus women are less able than men to benefit. The increases that irrigation brings to the women's work calendar often obliges women to weed and water all year round, thereby restricting their other income earning activities and their social networks.

A gender-sensitive approach will solicit the views and priorities of men and women and alert both designers and participants to the expected impact of design choices. By adopting a gender-sensitive approach, it should be possible to ameliorate unacceptable increases in women's work, allowing them to continue to contribute in other ways to their own and their children's livelihoods.

2. THE ROLE OF PARTICIPATION IN ACHIEVING GENDER SENSITIVE IRRIGATION DESIGN

2.1 How is appropriate participation in irrigation design achieved?

Although farmer participation in rural development decision-making has increased steadily over the last 30 years, the increase is not uniform (IDRC, 1996). Perhaps because of the technology required, irrigation development has retained a tendency to be designed external to the community served. In addition, irrigation is not a traditional form of agriculture, but has been introduced from outside (relatively recently). Irrigation has often been subsidised by governments and donors, emphasising high levels of potential that depended on conditions that have proved unrealistic, given farmers' circumstances. It is now seen that in these cases, participation was insufficient to provide an understanding of farmers real circumstances, and new participatory approaches are needed to ensure that key assumptions about farmers, workers, institutions and agencies are closer to reality. Clear objectives need to be agreed upon and the dynamics of change understood and monitored.

The specific knowledge that men and women bring to the discussion should be valuable to designers. Men and women, however, need to be encouraged to take part in discussion. The ambience of technical discussion can make a practical matter appear mysterious and one to which they cannot contribute. It should be recognised also that rural women are particularly unsure of their ability to contribute; prevailing attitudes of men often support social and cultural constraints to women acquiring technical knowledge and skills.

There is general agreement that participation in decision making is a key factor in improving irrigation design, management and operation in small-scale smallholder schemes (Ostrom, 1992; Ubels and Horst, 1993; Chancellor and Hide, 1997). However, recognising the difference between passive acceptance and active support for design ideas is crucial to successful design. A number of factors contribute to the difficulty of achieving effective participation in small-scale irrigation:

- Development and engineering professionals are largely untrained in participatory techniques. Many therefore believe that participation is complete when farmers attend a meeting and agree a proposed plan.
- Effective participation must include the possibility of rejecting projects, yet irrigation professionals cannot realistically countenance rejection, nor can farmers be expected to reject offers of assistance (physical capital).
- Departments, agencies and irrigation professionals are implementers and work to budgets and time-scales that do not match rural decision-making processes.
- The professional culture is oriented to governments, donors and NGO programmes as clients. Poor farmers are not regarded as clients.
- Delegating participation entirely to non-irrigation professionals risks technical misunderstandings.
- Potential irrigators may be overawed by professionals and therefore acquiesce to suggestions they do not fully understand or agree.
- Rural people and poor people are short of time and energy for participation.
- The quality of participation that can be achieved depends on all participants understanding the issues at stake and having knowledge of alternatives.
- Developers need to understand both formal and informal community dynamics.
- The community needs to understand the processes involved in managing irrigation technology, production and business in the context of existing workloads and livelihood strategies.
- Participation often stops short of full discussion of available choices and decision- making so that the incentive for the community to participate further is then rapidly diminished.
- In some cultures it is difficult for women to participate effectively.

Stakeholder analysis is helpful at the outset but new technology brings about changes that are not always easily foreseen. Determining the appropriate people to participate and the appropriate level to aim for is affected by the existing power structure within the community as well as by the objectives of the project intervention. Regular review provides opportunities to include participants who earlier may have seemed only marginally important. If design is to be gender-sensitive, it must take into consideration 'who does what' and how tasks are affected by the choice of technology.

2.2 How can awareness be improved?

Women participated in a brief evaluation of watering equipment at Chikava, Zimbabwe: December 98-February 99.

Women watered their vegetables laboriously with empty margarine tins or heavy buckets, often washing away the manure they had applied and breaking seedlings. They were crying for watering cans. The research team discussed alternatives with the group and it was agreed that some equipment would be bought and the women would test it recording time, and perceptions of effort and efficiency of watering.

After a six-week trial, the women presented their findings: watering cans were good for seedlings but too slow for mature plants. Plastic buckets were light, cheap and durable and made for faster watering.

The women were very pleased. They were aware that the right tool made work easier, and invested their own money in some plastic buckets. The main thing that changed was their perception of themselves as judges and selectors. They soon set about finding a small two-pronged fork for use in the small beds, as an alternative to the standard broad bladed hoe.

A common body of understanding is needed before discussions take place between a community and a government department or development agency. Neither agencies nor communities can make the best of participation unless they are prepared. Agencies often prepare a format or procedure, developed over time, as participation increasingly integrates into the everyday conduct of their work. Although a format may require adjustment for a particular location, the structure provides milestones and ways of progressing between them. On the other hand, the community with which the agency interacts may be novices or have had negative participatory experiences in the past. For any number of reasons, it is advisable to establish common ground and shared objectives that provide a basis for discussion of proposals.

In the mainly rural settings where irrigation development has taken place, people report a range of experiences. In some communities with older irrigation schemes, no participation took place at all but, where participation has taken place, there have been problems:

- Descriptions of irrigation schemes were poorly understood by communities.
- A very limited range of alternatives was offered.
- It was assumed (wrongly) that participants at meetings pass information to others.
- Awareness raising was usually limited to one or two mass meetings.
- Women were not specifically targeted.
- Women tended to see participation as irrelevant.

The exceptions were garden developments undertaken by NGOs where the role of women in production, organisation and management was emphasised from the outset and women were fully integrated in the participation process. The relevance of the gardens to the women's livelihoods was a prime factor in

motivating development. Yet even in these favourable circumstances, women tended to defer design choices to NGO representatives with phrases such as "we cannot know how to distribute the water" or "they know best".

Farmers in Zimbabwe found visits to other sites and interacting with existing irrigators a helpful and pleasant way to learn. The interactive quality was important to them as well as the clear demonstration of layout and equipment in the field. However, it is mainly men who visit other schemes. Special efforts to help women to make these trips could help raise women's appreciation of alternative irrigation developments. On the equipment side too, women's appreciation of alternatives is low.

Awareness raising is possible at mass meetings but the impact is limited. Participatory experience is more effective and can be implemented through use of small-scale interactive and participatory demonstrations and visits and by listening to men's and women's concerns and questions. Attention needs to be given to the art of communicating with rural people, using the language they are comfortable with and words they understand and relate to. Women need to be encouraged to participate not only by making it possible but by alerting them to the impact that participation can have on tasks they do.

2.3 Do agencies need to be gender-sensitive?

Agencies (Government, NGO or outside experts) are accorded high status by rural communities and key decisions may be left to them in the belief that "they know best". On the other hand, officials may be regarded with undeserved suspicion, especially if they attempt to solicit the views of women without appropriate preamble, or appear to suggest redistribution of land, which is often the case when developing irrigation. Also, because participation is hard work for people, it is common to find that:

- Detailed participation is often between a headman or a committee dominated by better off, better-educated, male minorities and the developer.
- Women's and poor people's 'best interests' are considered without their participation.
- Little is asked about intra-household decision-making on irrigation adoption.
- The agency finds it conceptually difficult to take participation to a deep enough level e.g. stakeholder subsets and households
- Participation is often cut short before a deeper level is reached, because the process is overtaken by the administrative or budgetary needs of the agency.

Although agencies are aware of the need to encourage participation and to include women in the participation, motivation to enforce good practice is low. Agency staff may feel participation is not the main thread of their work. They may see it as delaying them in achieving the goals set for them (implementing or rehabilitating an irrigation scheme). Reticent women present even more barriers and delays and it must be tempting to leave them out if they do not show enthusiasm.

Agencies might consider reviewing goals, objectives and perceptions about key elements in smallholder irrigation success. For example, reviewing the relative importance of water-use efficiency and creating sustainable livelihoods, asking themselves if it might benefit them to:

- Monitor the gender-awareness of their own staff.
- Increase staff capacity to participate effectively through awareness-raising/ staff training in gender-sensitive methods.
- Emphasise their own listening role.
- Work with a wider range of local establishments, including groups such as women's clubs, schools and churches.

If participation is to reliably improve decisions relating to technical change, it has to include women as the major users of irrigation technology. The potential benefit from improving participation of women needs to be emphasised. The demographic trends that draw women into tasks previously associated with men, such as land preparation and maintenance, have to be taken into account by using gender-sensitive irrigation design approaches.

2.4 Why are stakeholder groups important?

Stakeholders in irrigation developments naturally fall into groups who share in the common objectives but have specific interests common to that group alone. Their interests have to be taken into account to ensure that each group is committed and well motivated to work towards sustained development. For example, the interests of hired labourers might be of particular importance to small commercial businesses whereas the interests of women are crucial to family farms. To ignore these aspects can jeopardise the development.

All people who are affected, even if adversely, should be regarded as stakeholders. Local people, credit providers, agricultural suppliers, wholesalers and merchants are often neglected in participatory activities yet their co-operation and input are vital to success.

The household is seen as the unit that adopts a sustainable livelihood strategy. However, our gender analysis suggests that men and women, because they have different social and reproductive roles, have different objectives in irrigating and significant disparity in the resources they command. Their strategies are therefore likely to differ and there may not be a 'household strategy' as such. Thus, if men and women do not participate in design decisions, this may reduce their ability to use irrigation infrastructure effectively. Men and women constitute major stakeholder groups but they are divided into subsets upholding different specific interests.

Field study, Zimbabwe (1998)

Q. How do you compare yourselves (married women) to female headed households (FHH)?

A. Married women get help with ploughing and ridging, but FHH have to hire labour. The plight for most of us is that when the cheque comes, husbands become enemies with their wives and spend the money on their own.

Q. What about you women who head household, how is your financial situation?

A. We are better off when it comes to budgeting our income. However, it is not easy to live without a partner, there are so many problems associated with that kind of life.

Field study, Zambia (1999)

Near Lusaka, in Zambia, market women could make significantly more profit from irrigated produce than the growers, by shouldering the risk of marketing and the cost of transporting produce to town. Yet, farmers or developers did not regard them as stakeholders.

It was apparent that access to resources and resource control differed significantly between different subgroups of women, such as young widows or married women, affecting the needs and views they expressed. In addition, very poor men and young unmarried-men have different interests to married men with families.

Recognising that different stakeholder groups exist, and understanding that their different needs are important, is key to successful design. Developers who have analysed stakeholders groups with care are well placed to ensure that each group has an opportunity to participate effectively. Failure to engage people in participation or to secure agreement of stakeholders creates management problems and can put projects at risk.

2.5 Recommendations

"DO"	"DON'T"
• Do make ample budget provision for participation. • Do approach preliminary awareness raising through local groups as well as through local government, traditional leaders and agencies. • Do make special efforts to inform women, poorer people and people at the social margins. • Do consider if it is necessary to have special preliminary meetings with some subgroups. • Do ensure that information is clear and can be easily understood • Do invite and answer questions. • Do listen, watch, make time for participation and learn from it. • Do map out publicly the expected course of participation so that people can see when their participation in decisions is crucial. • Do include participants in decisions, or votes, and make sure they are recorded and agreed by the participants. • Do always make clear what the next step is and who is responsible for making it happen. • Do give responsibilities to both men and women and include members of important subgroups in discussions.	• Don't make meetings the only form of participation • Don't assume that land owners are the only stakeholders • Don't arrange meetings at times when some stakeholders cannot attend. • Don't lecture or restrict awareness raising to a one-way process. • Don't use more technical words than are strictly needed. • Don't always take people's word when they say they understand, if there is doubt test out the understanding. • Don't expect women to have as much time to attend meetings as men. • Don't ignore a non-participating subgroup; try to find out why they are not coming to meetings or not giving their views. • Don't interrupt or exclude people who have difficulty making themselves understood, they may be trying to make an important point. • Don't assume that women are simply shy or ignorant. • Don't dominate and impose ideas. • Don't lose sight of the ultimate objective of carrying out participation.

3. DESIGN FOR SUSTAINABLE LIVELIHOODS

3.1 Smallholder irrigation and sustainable livelihoods

3.1.1 Irrigation development

In considering the pentagon of capitals discussed earlier it is apparent that when attention is focussed on the physical capital, as in smallholder irrigation, the other capitals may be overlooked. This raises the serious possibility that gains on one axis (see pentagon figure in Section 1.4) may be offset by losses on another and the net result may be no enhancement or, even worse, a reduction in the total capital (ie a reduction in the area enclosed). For example, at Chinyamatumwa a donor-led development at an inaccessible location has, from time to time, imperilled farmers' livelihoods. Having accepted inappropriate (imported) machinery, the main problem was a failing of institutional communications, with affiliations neither set up, nor evolving, to serve the farmers' interests. Although all irrigators suffered, women were more disadvantaged as they were less able than men to influence the institutionalised procedures and deal with the pump attendants. Despite the importance of the physical capital, irrigation schemes or systems remain idle without both the human capital to drive them and the social capital to prevent them crashing.

OD 143 (Part 2, Section 5.3.3)
If farmers receive imported pumps, they must get as much information and detail as possible about the supplier and the availability and cost of spare parts. Attention should also be given to reducing potential conflicts between farmers and pump attendants.

However, deficiencies in the physical capital can be accommodated or compensated for by strong human and social elements. The women at Chikava (a women's scheme), for example, grew vegetables with the minimum of physical and financial capitals, which hampered water delivery. They were successful because of the strength of their human and social capitals. When they were introduced to new ideas (through the project), they adopted affordable technology to very good effect.

OD 143 (Part 2, Section 3.1.2)
The women learned from participating in an experiment to compare equipment performance and set off to look into buying more buckets and watering cans of their own.

Across all the schemes studied in Zimbabwe, marketing was identified as the greatest constraint facing the farmers. Nearly all schemes reported difficulties in selling their produce, either by contract or informally and, at more than half of the schemes, there were requests for marketing training. Many of these difficulties may be attributable to a lack of social and financial capitals. Better social capital would be expected to lead to improved affiliations, especially for contract selling, and networks for informal selling. It would also be expected to lead to the better planning of crops, more market-orientation and reduced gluts. On the financial side, better access to transport would help alleviate the marketing problems. At present most farmers complain that they can not afford the transport costs. Women are likely to be more disadvantaged than men because they have less access to cash and credit (there is a social contribution to this too).

The treadle pump is an affordable and manageable alternative to watering with buckets from springs and streams and, as such, is attractive to smallholders. However, the attraction relies on compatibility with other livelihood assets:

- The credit or savings needed to purchase the treadle are acceptable

- No special knowledge needed to use (and maintain) it
- Labour requirements are acceptable although some reports indicate women find it less user-friendly and more tiring than men
- Shallow groundwater or surface water is available near agricultural land (this is generally the case for Zambia but less for Zimbabwe)
- No special social relationships are needed because one family or household can operate a treadle pump autonomously and independently.

Although the treadle pump is being promoted as a means of empowering women in Zambia, there is some evidence that women find it hard both to purchase and, more importantly, to use (Part 3, Section 3.2.1). Where women predominantly used treadle pumps in Zambia, it appears that they worked in a co-operative. Nevertheless, women are expected to benefit generally from the wider use of treadle pumps because, irrespective of the operator's gender, women are relieved of the drudgery of carrying water in cans and buckets and have the opportunity to use their time more productively.

Livelihood gains from the use of treadle pumps (where they are compatible with the other livelihood assets) include higher and better quality yields, greater areas cultivated and crop diversification. As in Zimbabwe, the livelihood gains could be greater if marketing were improved. However, marketing in Zambia draws more heavily on labour because access to transport is low and the associated cost is high. Irrigators in rural areas cycle all night to reach markets and women head-load for hours, even close to towns. One outcome of the high transport costs was that a group living on the outskirts of Lusaka (peri-urban), opted for a livelihood strategy of selling to marketeers, who buy at low prices from the plots but bear the costs and trouble of transport themselves. In contrast, another nearby group of women, grow frequent crops of low value such as rape, rather than occasional higher value crops like potatoes or carrots, because they prefer the steady, albeit very small, cash income. However, they must put up with wearying transport to do so. Development of their social capital would probably enable them to achieve greater economic security on an annual basis. Men are less affected because they are not responsible for purchasing the daily provision of food for the family.

OD 143 (Part 3, Section 3.1)
There is undoubtedly a trade-off between growing subsistence or commercial crops and cash needs. Knowing more about the way in which women have changed their cultivation practice and crop choice is crucial to understanding the impact of increased irrigation on women's livelihood strategies.

3.1.2 The rehabilitation cases

In the rehabilitation programme (South Africa, Northern Province), the Department of Agriculture and their consultants have appreciated the need to consider all five capitals. The overarching aim is still improvement of the physical assets but it has been recognised that sustainability can be achieved only if the following are in place:

- the necessary social capitals (particularly relationships - ie committees, for management, marketing etc),
- the financial capitals (particularly credit, for purchase of agricultural inputs and services)
- the human capitals (particularly knowledge, for improved cultural practices and equipment maintenance)

In the construction of irrigation schemes, and especially in the rehabilitation, improved infrastructure is not, of itself, sufficient to enhance the livelihoods of the smallholders. Different schemes may need capitals strengthened to differing degrees, but all the components must be considered and evaluated at all the schemes.

Within the three capitals referred to above, the particular elements - relationships, credit and knowledge (technical rather than indigenous) - are probably the most prominent areas of gender disparity in southern Africa. It is, therefore, essential to ensure that implementation of the rehabilitation programme does not build on culturally embedded gender disparities and lead to the further marginalisation of women. Striving for the full participation of women - in training, at meetings, in decision-making - by minimising the traditional barriers to involvement, is vital to the success of the rehabilitation programme.

Inadequate attention to relationships and networks at the Thabina Scheme resulted in failure to identify a strong sub-culture. As a consequence, an undue proportion of the blame for poor scheme performance was attributed to the poor state of the physical capital, without acknowledging the poor state of social capital. The involvement of women might have been improved if the women's club had been invited to participate in the rehabilitation process and activities.

OD 143 (Part 4, Section 3.1)
Most irrigation schemes have both formal and informal ways of doing things. Often the informal ones come about because the formal system is not working well. If the Development Committee is to be successful, it must understand the informal systems and ensure unfairness does not exist. If the formal system needs to be changed, do it openly.

The rehabilitation process provides a large amount of farmer training and so is actively engaged in development of the human capital. The training seems biased towards agricultural practices (i.e. better use of the natural capital) and there may be some merit in offering training to demonstrate the importance of the social and physical capitals and possibly to further develop them. There certainly seemed a need for the farmers to improve their organisational skills and any new machinery and equipment provided by the rehabilitation programme must be operated and maintained by the farmers. The training situation at Boschkloof has been strengthened by a, possibly unprecedented, move by a local commercial farmer to provide, what are in effect, apprenticeships to a group of ten smallholders each year. This not only enhances the smallholders' human capital but also provides very considerable opportunities for development of their social capital. The training is linked to the enhancement of financial capital too, through a Bank scheme to relax credit restrictions on trained farmers. Importantly, the trainees are selected by the smallholder community and have included women.

The Elandsdoorn Scheme, is typical of many smallholder schemes and showed serious deficiencies in the physical capital, particularly since the withdrawal of government services. For the scheme to survive, the farmers have had to depend more on their human capital (labour, knowledge) and should have reacted to the withdrawal of services by developing their social capital for mutual support and assistance. However, this scheme seemed notable for its poverty of social assets with the one exception of a thriving Women's Club. The Women's Club members are very productive. Their good organisation and subscription scheme have enabled them to overcome many of the constraints that are still holding most of the non-members back.

OD 143 (Part 4, Section 3.3)
In 1980 the Kwenagadi women's club was formed, based on just one plot. Its main objective is to provide an opportunity for pensioner women, who do not have work, to use a small piece of land to grow food for their families and perhaps even a small surplus (to generate cash income). The club has now been extended to about 4 ha and comprises about 60 members, several of whom are men. There is a joining fee and a monthly subscription which cover the necessary inputs and the enterprise seems to be well organised and enjoys good yields.

It has been observed elsewhere that women seem to be more prepared than men to collaborate, share equipment and resources and to set up co-operatives (Part 3, Appendix 6). For example, the only cases of women buying treadle pumps in Zambia were on a co-operative basis. There is evidence to suggest that women are more predisposed than men to develop social capital. However, it is not clear whether this is because of women's relative deprivation of, or access to, the other capitals or because of an innate gender difference.

3.1.3 Discussion

Of all the livelihood assets the importance of one element, labour, especially for female-headed households, tends to be seriously underestimated in projects involving smallholder farmers. Labour does not exist in limitless supplies, despite the numbers of jobless people, but is restricted to the time and energy available from members of a household. Beyond that, labour may be bought if cash (or an equivalent resource) is available. For almost every agricultural task, labour is used to power and control equipment, thus implicating elements of the physical capital. For land preparation, there is a further interrelationship with one (or more) of the natural elements. For a production system to operate efficiently and effectively, it is necessary not only to have the appropriate elements in place but to ensure compatibility between them. Traditionally, the prime concern of the designers of irrigation systems has been efficient sourcing and delivery of water and the operational needs of the users, who do not necessarily constitute a homogenous group, have rarely been considered. In the rare instances where the users' needs have been accommodated, it has usually been assumed that they are men.

For optimum use of human capital and, hence, the promotion of sustainable workloads and livelihoods, appropriate designs of equipment and systems must be made available, or developed, where necessary. The term design is used here in its broadest sense. There are many design factors that contribute to the effective and efficient use of systems and equipment. The mechanical configuration of the interface, the strength and dexterity needed for operation and the knowledge and skills needed for maintenance (and repair) are all important factors. Although this is relevant to all equipment, it may apply to differing degrees, depending on the equipment. For example, comparing a hand hoe with a diesel pump, more strength and endurance are required for the operation of a hand hoe (i.e. for land preparation or weeding) than for a diesel pump, which requires more knowledge and skill (including for maintenance). Pump operation and associated activities also require more social capital, through organisational factors, than the use of hand hoes.

Developers should always be aware of the possibility of introducing an unserviceable level of technology into a development (or rehabilitation) project and, thereby reducing the net livelihood assets by shortening, absolutely or relatively, the human and social capital axes. In relating this to gender disparities, it should be borne in mind that traditionally in southern Africa, men have enjoyed pre-eminence in at least four of the five livelihood capitals, whereas women have shown greater flair than men for developing social capital. Nevertheless, women still have difficulty influencing networks that have traditionally been male dominated.

3.1.4 Recommendations

"DO"	"DON'T"
• Do recognise the relative strengths of men and women in relation to the different capitals needed for sustainable livelihoods. • Do recognise that the livelihood of an individual may differ from that of the 'household'. • Do take a critical view of the role of key stakeholders, especially considering their accountability to those whose livelihoods may be at stake. • Do beware of institutional arrangements that restrict use of capital that is otherwise available.	• Don't assume the existing gender balance is acceptable to everyone. • Don't assume that development initiatives will reduce disparity in capital assets of men and women. • Don't forget that developing more total capital for one group, such as irrigators, may endanger the livelihood of another group outside the current development framework. • Don't assume that capital growth is homogeneous throughout a scheme, or in a sector.

3.2 Scheme layout

3.2.1 Background

The layout of an irrigation scheme impacts on men and women; firstly, in determining their access to irrigated land and secondly, in determining the nature and extent of their workloads. However, layout depends primarily on topography, soils, cost and water delivery choices and should be influenced by the perceptions of the community about how the scheme's size and shape will affect them. Inevitably, not everyone will have the same views and needs. Thus, it is very important to achieve effective participation of *all* the stakeholders before the layout of a scheme is determined and finalised.

Men and women, old people and young people, have different objectives that affect the way they consider issues such as use of irrigated land, safety, access, or change in opportunity for social interaction. In view of these differences there is a case for consulting groups separately to ensure that all stakeholders get a chance to discuss their concerns. However, it is also important that *all stakeholders* must come together to agree compromises, approve the final layout and give support to the plan.

The compromises that have to be made must fit objectives of the users as well as meeting the technical requirement for sustainable irrigation. For example, if timing of irrigation is critical because of other commitments of the users, then flexible alternatives should be considered even though they may be more costly. This is especially important if the other commitment is income generating and an important part of people's livelihood strategy. The risk of increasing the physical capital when the time or knowledge are insufficient for its use should not be overlooked. Stakeholders should make the decisions relating to the compromises to be made. The GSID study found that some design features were more important to men or women:

Layout feature	Men's issue	Women's issue
Distance from homestead	*	****
Distance from dry land	****	
Personal security along access routes	**	****
Plot size	***	*****
Watering duration and interval	*	***
Reliability of water delivery	*****	***
Pumps	***	*****
Levelling equipment	**	****
Draught power	***	*****

Although obtaining stakeholder consensus can be expensive, exasperating and slow, it is generally more expensive to amend layout after construction. Achieving participation on questions of layout is not an easy option. It requires considerable commitment, development of confidence, listening skills and change in the mindset of everyone to recognise that the goal is a consensus which might radically alter the original perceived objectives of major stakeholders.

3.2.2 Configuration and plot size

Land tenure is often a significant factor in determining the layout and women's disadvantaged status in land ownership and usufruct may result in their views on layout not being taken into account. In addition there are characteristics of layout that are generally poorly understood, such as the concept that compact schemes tend to allow more equal distribution of water than those with a long conveyance system, where water loss can be significant. Farmers, particularly women, may need demonstrations to help them understand this type of concept.

In the past, scheme design was strongly influenced by ideas of equity, resulting in designs that provided a standard plot and, in theory at least, an equal supply of water. In practice, plot sizes gradually change as plots are accumulated, subdivided and abandoned for a variety of reasons. There are often discernible patterns, which may be based on age, gender or socio-economic group, for example better-off men tend to accumulate several plots or widows tend to retain access to small less favoured plots.

There is commonly disparity between men and women in securing the title to an irrigation plot. In general, in the region, the granting authority has been heavily biased in favour of men as a matter of course. Nowadays, many schemes can be found where women have been allocated the exclusive right to cultivate. Nonetheless, on schemes where both men and women are registered, it is the exception to find women in possession of large, well-favoured plots. There are a number of contributing causes including traditional land ownership patterns, colonial and post-colonial bureaucracy, women's lack of wealth and social status and women's lack of control over productive resources. The general trend is for women to access small plots as a result of widowhood or divorce or through deliberate policy, as in women's gardens. When women have limited access to cash, cattle, equipment and credit, they are unable to manage large plots. Operational features such as the watering interval and the duration of watering which are largely determined by layout may have important knock-on effects on women's domestic and reproductive duties.

OD 143 (Part 4, Section 3)
In Elandsdoorn and Thabina (RSA) small food plots have evolved for women. The small plot allows intensification that relies largely on labour, increases profitability, reduces the potential for loss and allows control over the proceeds. It also encourages social contact. Some men are keen to join the women's clubs.

Where opportunities exist for people to match their irrigated enterprise to their resources, more efficient use of water is likely. Each plot-holder can make irrigation more profitable, thus improving the overall

financial viability of the scheme. In considering scheme layout, issues such as the range and variety of plot sizes to be provided, the juxtaposition of different categories of plot, and the institutional mechanism whereby irrigators can move from category to category should be fully discussed.

Alternatives such as the 'women's garden' are often thought to marginalise women from mainstream commercial irrigation, yet women often demand such arrangements on irrigation schemes. Gardens have a role but should not be seen as the solution for all women. On several schemes 'garden' or food plots were popular with both men and women and appeared to serve an insurance function in times of poor water supply, shortage of labour or failure of land preparation arrangements.

3.2.3 Scheme maintenance

OD 143 (Part 4, Section 3)
At Elandsdoorn in South Africa, the women's team that maintains channels free from weed and silt is efficient, provides women with employment and income.

Layout and construction materials largely dictate scheme maintenance, although maintenance needs are influenced by environmental characteristics. Long canals or inclusion of pumps causes heavy maintenance requirements, particularly if sediment is a problem. Where substantial numbers of people have to co-operate to achieve maintenance, delays can result in significant reduction in the system's ability to function. This may start off a spiral that reduces the sustainability of the scheme. The organisation and maintenance skills of women are seldom used effectively yet women are well motivated and well positioned to contribute to maintenance. If women do commit to maintenance, this should be taken into account in design.

Siting irrigated land where a pump is required can add many complications (Section 3. 5). The unreliable performance of pumps has been a significant issue in this study. The implications of motorised pumps in smallholder schemes are more fully discussed in the associated publication: GSID, Part 5, *An assessment of the implications of pump breakdown and community participation in Irrigation schemes in Masvingo Province, Zimbabwe.*

Field study, Zimbabwe, 1997/98
At Rufaro scheme, in Zimbabwe, women are regularly at work in the irrigated fields. Men often work in the dryland or visit town. In the event of a pump breakdown, the women who have no basic skills relating to pumps, cannot continue their work. They must seek the men, who in turn abandon their work to go to the pumps and sort the trouble. A possible solution would be for women to be trained in pump maintenance and minor repair. Both men and women could benefit!

3.2.4 Field layout

Field study, Zimbabwe (1997/99)
Q. How long does it take to level your plots?
A. Two people take about two weeks using hoes or one day using a dam-scoop (requires draught animals)
Q. How many people do not have draught power?
A. Most - about 70%
Q. Is it difficult for female-headed households to ask men for draught power?
A. There is nothing difficult as long as they can pay

Field layout is a major determinant of labour and equipment requirements. For example, land levelling is crucial issue in long furrow irrigation. However, access to levelling is not a simple matter.

Design options that are less demanding of levelling such as short furrows, basins or sprinklers, will be more suitable for women managing alone, of whom there are many on irrigation schemes. On male owned plots too, women are often charged with levelling.

Scheme layout will be strongly constrained by the availability of land and water, tenure arrangements. A balance has to be achieved between these physical constraints including soil, slope and other topographical features but they should not be the only determinants. User preferences and constraints such as those discussed above are important.

3.2.5 Recommendations

"DO"	"DON'T"
• Do encourage stakeholders, including women, to visit the site early for discussions. • Do take into consideration farmer knowledge of the site in the past. • Do organise visits to other irrigation sites or provide interactive demonstrations. Always include women • Do make sure people understand the implications of a proposed layout on workloads. • Do consider men and women's access to plots. • Do address the equipment requirements implicit in different layouts and discuss the availability of equipment to men and women. • Do give information about the equipment required, how it can be accessed, likely costs and reliability. • Do address maintenance implications of layout and emphasise the O&M costs and expected life of long canals, weirs and control structures and pumps. • Do train women in pump maintenance.	• Don't assume everyone understands maps. • Don't assume that men and women have seen irrigation in progress. • Don't ignore the views of non-participants and people who have difficulty expressing their view in technical terms. • Don't use too many technical words to discuss layout alternatives. • Don't assume that men and women have thought about long-term issues, such as maintenance, replacement and rehabilitation. • Don't assume that women don't want to be trained in pump maintenance.

3.3 Land preparation

3.3.1 Background

The term land preparation covers a number of activities, all concerned with working soil into a state which will provide a favourable environment for seeds to germinate, roots to develop, plants to grow and crops to mature. Land preparation exerts a strong influence on crop health and yield, not only from crop to crop but also from year to year. The year to year consumption of soil nutrients and, hence, sustainability is strongly influenced by land preparation.

Irrigation schemes are generally located where the soil is of a reasonable quality and water is accessible, provided that the infrastructure remains operational. Irrigators are, therefore less likely to be affected by the major difficulties (eg severely degraded soil, erratic rainfall) confronting smallholder dryland farmers in southern Africa. Nevertheless, there are some extra factors to be considered by smallholder irrigators. Together, these include

- scheme layout,
- plot size,
- water delivery system,
- crop choice,
- soil erosion,
- access to farm power
- access to equipment.

If fertiliser (organic or inorganic) is used, plants must take up the nutrients through the medium of the soil and the moisture contained in it. One of the greatest constraints on both irrigators and dry-land farmers is access to the mechanical energy required for the land preparation that best allows soil to serve the plants. However, this is not generally emphasised in discussing irrigation design. The GSID investigation revealed that this gives rise to significant gender desparities.

3.3.2 Irrigators' objectives

An irrigator is not primarily concerned with water conservation (although should aim to avoid wastage) but with ploughing deeply enough to permit aeration, water penetration and promote root growth whilst inhibiting weed growth. The quality of land preparation has a significant impact on subsequent operations. Shallow ploughing (up to 12 cm) is generally less effective for both weed control (depending on the main types of weed) and irrigation efficiency. Deeper ploughing (around 20 cm) enables irrigators to apply water less frequently and for longer periods.

One aspect of land preparation of great concern to irrigators is levelling - an operation carried out, ideally, during the construction of an irrigation scheme, but also requiring regular maintenance. Without levelling, the water puddles, resulting in patchy growth and poor crop performance in the field, and on the scheme as a whole. Rectifying poor initial levelling is very arduous and, technically, not easy without the proper equipment. On the schemes investigated, poor levelling was a more serious problem in Zimbabwe than in South Africa. There were probably two main reasons for this - better scheme construction and, until recently, the use of tractors for land preparation in South Africa. The situation at Mushandike is particularly serious with almost half of the scheme badly affected from inadequate levelling at the time of construction. Women have seldom been party to design discussions where the implications of poor levelling have been considered. Yet levelling, where it is needed, is regarded as women's work and, despite the physical intensity, is usually done with just hand hoes. Occasionally ox-drawn dam scoops may be used for bulk movements but the soil is still spread by hand hoes.

3.3.3 Farm power

Land preparation tasks are the most energy-intensive operations in farming. Shortages of mechanical energy or power, irrespective of its source - human muscles, draught animals or engines - are a significant constraint on smallholders. The farmers in our investigation relied on human power for some, if not all, of their land preparation operations. In northern South Africa the expectation, until recently, was that all land preparation would be carried out with tractor power, whereas in Zimbabwe and Zambia (although to lesser extent), the use of draught animal power (DAP) was the expectation and, amongst the poorest, the aspiration. Commercial tractor services are more widespread in South Africa and their cost may be more easily justified because the generally better soils would give greater returns after primary tillage done well with a tractor. Nevertheless, the South African smallholders were reluctant to pay for a service that had formerly been provided free.

OD 143 (Part 6, Section 2.2.1)
'The lady who has just left this place is one good example of a loose widow. Who can allow her husband to plough for such a person? By allowing him, you will be giving him away for free (F).

Access to draught power, which traditionally is male dominated, can be a major problem for female-headed households, especially younger widows who have to rely on the help of other women's husbands.

The wide and increasing use of human power, whether caused by the loss of tractor services or of draught animals, confirms the importance of the hand hoe and the need for working practices that maximise the returns on using human labour. This need applies more to women than men as they undertake the majority of the manual labour, yet have less time available because of their domestic responsibilities. Although not so widely recognised, a lack of human power can also restrict the potential of DAP for land preparation. In Zimbabwe particularly, the smallholders complained about the problems of using traditional DAP equipment because it was so heavy and difficult to use. This complaint was heard elsewhere too, and it clearly must disadvantage the increasing number of female-headed households as, generally, women are not as strong as men.

Whilst a shortage of farm power can disadvantage women in certain types of household, greater access to farm power may adversely affect women in other types of household. A greater area ploughed and planted by men who have access to improved land preparation technologies leads to a greater area that women have to weed (generally the most time-consuming farming operation). The weeding burden also depends on the quality of the land preparation so a greater area badly ploughed could further disadvantage women. To reduce gender disparity, women need either to be able to influence the quality of ploughing or to access improved technology, such as an animal-drawn weeder (cultivator) and the necessary animals. Alternatively, hired labour could be used: this would reduce the household profit margin but increase local employment opportunities.

3.3.4 Land preparation equipment

By far the most common land preparation operation is ploughing and the most popular cultivation implement in southern Africa is the animal-drawn mouldboard plough. The mouldboard plough is attractive because in one pass it can:

- cut a furrow → facilitating aeration, water penetration, seed placement;
- invert the soil → covering weeds, incorporating trash and fertiliser, if applied.

Ploughs may be used, with their mouldboards removed, as cultivators for weed control. This demands less draught force and power, and so is easier than ploughing, but the technique was relatively unusual on the schemes investigated. One manufacturer in Zimbabwe (Zimplow Ltd) is now manufacturing a lighter-weight plough, specifically for use behind donkeys and smaller oxen or cows, and in response to changes in demand has recently launched a lighter-weight cultivator on to the market.

Most, if not all, of the complaints about ploughs being too heavy (see above) have been made by smallholders who had removed the hitch assemblies from their ploughs, in the erroneous belief that they added unnecessary weight to the plough. The correct setting of a plough by proper use of the hitch assembly and wheel, where fitted, reduces the strain on both animals and operators. Correct setting, in turn, leads to faster ploughing, deeper ploughing (or some combination of the two) and the more efficient and effective use of draught animals. At Mushandike, where land preparation problems were particularly evident and exacerbated by the poor levelling, demonstrations and training sessions on the use and maintenance of implements, especially ploughs, were arranged through the project. The training was provided by AGRITEX and strongly appreciated by the farmers, including several women. Some farmers' comments provide useful insights about implement use, availability and accessibility.

OD 143 (Part 6, Section 2.2.5)

Before the demonstration, most farmers here used to remove parts thinking that they were not useful and would make the plough heavy for nothing. Now we know that each plough part serves a particular purpose and a plough with all parts is even lighter and better (M)

I was happy to learn about a small plough which is very light and effective. I wish I knew where I can find it because I want to buy it. It is very light that even women can use it easily and also a single donkey can pull it (M).

I used to have a crop of onions (Texas Grano) yielding at 800 to 900Kg per ha but tried a new method of ridging and planting using a cultivator and was surprised to find an increase in the plant population to range between 4000 and 5000Kg per ha (M).

The experience of another farmer at Village 21 shows how the proper use of farming technology can bring benefits and, conversely, how a lack of knowledge can adversely affect production.

As treadle pumps reduce the time spent irrigating (compared to using buckets), there is a tendency to cultivate more land. Smallholders open new gardens or use their plots in rotation according to localised water availability. Land preparation is generally a male task in Zambia, but women are expected to accommodate the extra weeding burden.

Treadle pump users, as other smallholders either turning to irrigation for the first time or changing their method of water delivery, may change the layout of their plots or gardens to be compatible with the water delivery system. This will affect their land preparation options: for example, the output from a treadle pump is best taken to the crop along furrows and levelling becomes important, whereas this would not be the case using buckets.

3.3.5 Recommendations

"DO"	"DON'T"
• Do discuss land preparation specifically in Focussed Group Discussions with farmers • Do assess how well the land on a scheme has been levelled. • Do provide proper services if land levelling is required. • Do consider crop water requirements and soil type in determining appropriate land preparation. • Do assess soil characteristics before recommending ploughing depth. • Do use ploughing depth to determine draught requirements and select power source accordingly. • Do offer training in implement selection and use, harnessing and general care of draught animals. • Do assess whether donkeys could provide enough draught force. • Do encourage farmers to club together to get a good deal if they want tractor services. • Do support training with leaflets using the vernacular and simple diagrams, and with training to local traders and artisans.	• Don't expect farmers to make a good job of land levelling. • Don't assign the task of land levelling to men who do not help with the watering. • Don't assign the task of levelling to women who lack access to farm power • Don't recommend land preparation without consulting farmers' indigenous knowledge. • Don't predict weeding needs without assessing dominant weed varieties and their control options. • Don't assume smallholders with ploughs have access to draught animals. • Don't assume smallholders with ploughs know how to operate and maintain them. • Don't assume women can work as hard or as long as men. • Don't encourage farmers to depend on tractors without full consideration of the advantages and disadvantages. • Don't overlook how plot size, scheme layout and water delivery interact with the needs of draught power sources. • Don't overlook the potential benefits of weeding with draught animals. • Don't expect farmers to adopt new (to them) techniques without good economic reasons and proper (hands-on) training.

3.4 Water distribution and application

3.4.1 Sharing water

In group-based irrigation, sharing water equitably between farmers is often difficult because of limitations of the infrastructure or management difficulties. In systems where distribution is poor, some farmers suffer more than others.

OD 143 (Part 2)
At Rufaro, in Zimbabwe:
The volume of water available to distribute by gravity was drastically reduced by pump failure, forcing farmers to irrigate only a small area and redistribute land. Widows struggled to claim land where water was reliable.

At Mushandike, in Zimbabwe:
Inadequate land levelling hindered water to flow along furrows in some areas. The farmers in the affected areas were aggrieved at what they saw as a design and construction fault and did not believe that they should be obliged to rectify it.

OD 143 (Part 4)
At Thabina in South Africa:
Failure of the weir and the main pump restricted the distribution to a smaller area and to farmers who could afford private pumps.

At Elandsdoorn in South Africa:
Difficulty in distributing water in the main system was a major problem for the men who had large areas to irrigate. Women on small adjacent plots had less of a problem.

When water distribution is a major problem, people get around the system by investing in more labour or by buying a pump for their own use. They solve their immediate problem but may make the distribution problem even greater for those who remain dependent on the original system. The demand for repair is weakened when some users turn to an alternative. Women, with relatively less access to cash for emergency expenditures than men, are more vulnerable to unreliable water distribution. On the other hand low-value crops, extensively grown under irrigation (often by men) are very vulnerable to distribution problems, more so than small intensive areas of high-value crops (often grown by women).

Women suffering shortage due to poor water distribution may find it hard to argue their case to the farmer committee or the irrigation agency because of the few women in committees, or agencies, and their lack of impact on male-dominated institutions. Heavy workloads, on and off-scheme, deny women opportunities to complain, especially if a long journey to an external organisation is required.

3.4.2 In-field water distribution

Women generally water the crops, either for their husbands or, in the case of widows and divorcees, in their own right. The design of the scheme has a strong impact on the ease or otherwise of accomplishing water distribution in the field and ensuring that all the plants get the water they require. The preparatory work of ploughing and levelling has a significant effect on the watering task. Farmers were able to give examples of the positive impact of deep ploughing on infiltration and therefore on the interval between watering that can be tolerated by crops (Section 3.2). This is significant for the deep-rooted crops such as

maize. The interval between watering has implications not only for the workload of the people responsible for watering (mainly women) but also for the management of water in the scheme and the scheduling of irrigation turns (mainly men). A major source of disparity arises from the difficulty women meet in ensuring good ploughing depths. If they are short of draught power and use poorly set implements they are unlikely to achieve the recommended depth (Section 3.3.2). In that case, the scheduled interval may cause stress in plants and reduce yield with consequences for livelihoods.

Long or Short furrows?

Achieving accurate land levelling to ensure water is distributed evenly by long-furrows is often left to women, creating a lot of extra work. The difficulty of the work is greater if access to draught power is limited. Much levelling is done by hand (Section 3.2.4) and is a source of exhaustion and back-ache.

In the rehabilitation of Thabina scheme in South Africa, short furrows fed from piped supply lines are being promoted to meet the needs of farmers, which were identified through needs assessment. There are compromises between layout and cost that need to be fully discussed between users and designers.

OD 143 (Part 6, Section 2.2.2)
Q. Why is it that women are the majority, who do levelling and yet it is the most difficult task in land preparation?

A. We have other work such as looking for piece jobs to raise money for water bills, after all it is not that difficult, women and children can manage. (Man- Mushandike, Village 21)
A. Levelling is most important to women because they are the ones who will suffer the consequences when watering. If she decides to leave the job of levelling to a man and he does not do it properly, she must know that he will not be there to help when water is not moving smoothly. (Woman-Chinyamatumwa)

Are Sprinklers a good investment?

Despite the welcome reduction in land levelling that characterises sprinkler irrigation there are a number of other issues. Heavy drag hoses were a particular problem to women irrigators on account of the weight and friction that has to be overcome. Both men and women are slow to recognise when the sprinklers function poorly. When replacements are needed, it is usually necessary to go to a town, which is not always possible or affordable for women. Scheduling the repositioning of sprinklers needs careful thought and, at Rupike, where much work had gone into educating farmers on correct positioning and the merits of different arrangements, this worked well. At Lowlands, which had not benefited from an intensive training approach, the sprinklers in were poor condition and crop growth was patchy. Where sprinklers depend on pumped water there are additional risks to reliable supply (Section 3.6 and Part 5).

Buckets or treadle pumps?

Where individual smallholders develop irrigation, as is generally the case in Zambia, or in garden developments common to women's groups in Zimbabwe and South Africa, much of the water application is done by women using buckets. Bucket systems are water-efficient but greatly reduce the time and energy available for other essential production tasks. Replacement of buckets by treadle pumps is heavily promoted in Zambia. The study noted some interesting effects of adoption of treadle pumps:

- There was significant reduction in the time taken to water vegetables.
- The intensity of work required by a treadle pump caused difficulty for users, depending on the pump used and the depth from which water must be pumped.
- Women tended to find pump operation more tiring and difficult than men.
- In some places, men took over the pumping, assisted by women who conducted the water along the in-field channels. This reduced women's workload and freed women for other productive work such as weeding and transplanting, with positive effects on yield and quality.

- Women found that faster watering schedules allowed them more time for domestic work such as food preparation and fuel collection (Part 3, Appendix 4)
- Improvements in yield and quality led to improved sales.

Low cost drip systems?
Low cost drip systems, promoted successfully in India, have not yet been widely adopted in Africa. Some simple systems are being tested in South Africa. NGO developers appreciate the potential of drip systems to contribute to nutrition and livelihoods and note their suitability for women users. Water quality and lack of awareness may be constraints to adoption in African rural areas.

3.4.3 Recommendations

"DO"	"DON'T"
• Do identify the people who will take day to day responsibility for water application and investigate their concerns. • Do discuss the different water application methods and their different costs, maintenance problems, risk of breakdown, flexibility and work requirements. • Do discuss local availability of spares such as sprinkler heads and pipes and expected life of components. • Do ensure that the land preparation needed for different water-distribution choices is fully understood. • Do encourage designers to take farmers land preparation capacity into account. • Do provide demonstrations of, or visits to different application systems in use.	• Don't encourage adoption of application systems that rely on mechanised land preparation, unless it is clear that the users can afford and sustain such a system. • Don't rely on reported willingness to undertake maintenance tasks. People may not have a clear idea of the time within their household nor of the energy, time or skill needed. • Don't assume that a farmer committee is representative of the farmers. Committee members tend to be better resourced than other farmers. • Don't neglect the large numbers of female-headed households who need special consideration.

3.5 Institutions and management

3.5.1 Background

Smallholder farming in southern Africa[1] functions on a household or extended family basis, which is not immediately compatible with the level of organisation needed to run an irrigation scheme effectively and successfully. Irrigation schemes depend heavily on the correct functioning of the infrastructure and physical capital. In smallholder schemes where the families have very little purchasing power, the physical capital has usually been provided by what is best described as an institution. In most cases these are departments of governments (more than one government for the "aid" or donor-funded schemes) because of the high financial investment, but in some smaller schemes an NGO may be the responsible institution.

[1] The Zambian situation is not included in this section because no formal schemes were investigated. Treadle pumps were managed on a household basis and there was very little institutional activity, except training (see section 4).

Either way, institutions are major stakeholders in irrigation schemes and, therefore, have a large impact on the smallholders' livelihoods. There is generally a gulf between institutions, particularly the officials of government institutions, and smallholders, resulting in poor communication and poor appreciation of each other's needs and expectations. This can lead to conflict, which is more likely to be to the detriment of the smallholders than to the institutions or their representatives.

Apart from the ready availability of water for crops, one of the biggest differences between dryland farmers and irrigators is the greater amount of produce they must sell to cover their costs. Marketing is not an activity that smallholders find easy for several reasons (Section 3.7) and the efforts of each household can be enhanced if they work together rather than individually. This requires management within the scheme and externally with customers or potential customers.

In such situations, women would be expected to fare worse than men because of the custom of male representation of any organisation or group.

3.5.2 Management alternatives

Irrespective of the sources of funding for the schemes, three types of management were encountered: Government Department(s); NGOs; the farmers themselves. Table 1, which was compiled by the team on their subjective assessment of the problems encountered at the various schemes, shows the degree of impact of specific factors of irrigated production on all smallholders and on female smallholders only. The schemes are grouped according to the type of management. Analysis of this Table shows that, on average, the government-managed schemes created the greatest number of major issues, followed by the farmer-managed, followed by the NGO-managed. This is not surprising because most NGOs lay strong emphasis on participation, whereas this was least evident on the Government-run schemes, particularly in Zimbabwe. Government-run schemes show fewer women only issues than the farmer-managed schemes[2]. The NGO-run schemes are excluded from this comparison as this management type includes women-only schemes.

[2] The ratio of red solid circles to all solid circles

Table 1 Overview of issues

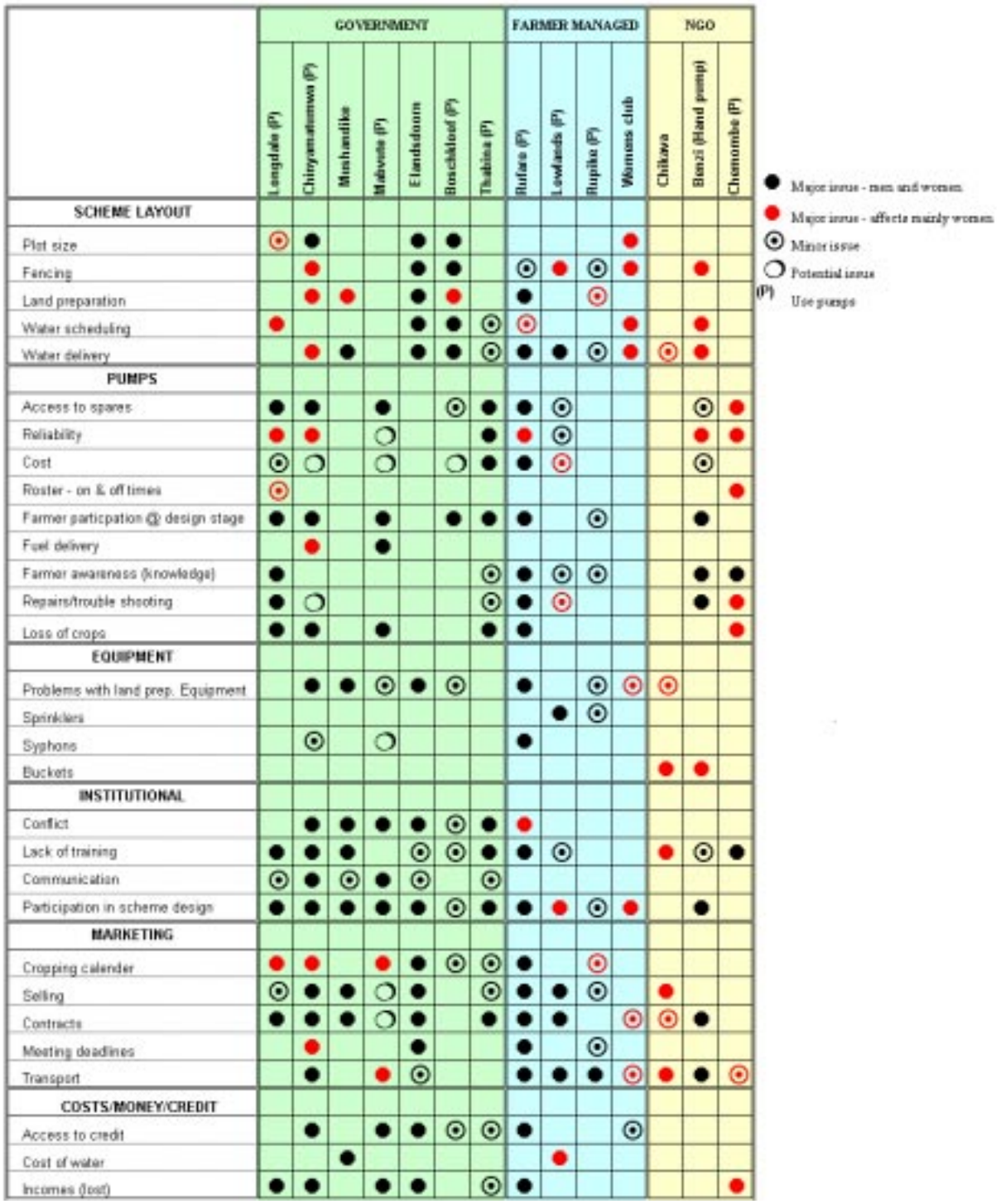


Table 2 summarises the incidence of issues according to the general type of factor and the type of management (i.e. number of circles recorded expressed as percentage of the maximum possible in Table 1. The weighting used was filled 2; unfilled 1).

Table 2 Incidence of issues (%) according to general type of factor and type of management

Type of factor	Government-run	Farmer-managed	NGO-managed	Average
Scheme layout	52	52	23	46
Pumps[1]	52	39	61	50
Equipment	16	28	21	21
Institutional	75	37	29	4
Marketing	52	57	33	50
Costs/money/credit	45	29	11	33
Average	**49**	**40**	**30**	**42**

Table 2 shows that, on Government-run schemes, the institutional factors generated, by some considerable margin, the most important issues. On other types of scheme, the institutional issues were less dominant, with pump factors and marketing factors being to the fore on the NGO and farmer-managed schemes respectively. Taking account of major and minor issues on the ten pumped schemes reveals that participation in design and availability of spares are important issues in 75% of cases. If the incidences of issues on each type of scheme are ranked (e.g. institutional would rank first on Government run and third on NGO-managed), the highest ranking issue across all types of scheme is marketing. On the other hand, the general factor generating the least major issues across all types of scheme is equipment. This is attributed to the relatively small scale of operations and the good situation on the government-run schemes. It must be emphasised that the tables above are based on subjective assessments. The exercise serves to illustrate the importance of aspects that have, in the past, been ignored in the design process such as marketing, institutions and the human factors in scheme layout and pump selection. When schemes where women dominated in plotholding were compared to those where men dominated the issue that affected women's schemes most strongly was pumps. Other issues were similar for the two categories, although men had greater problems with credit, partly due to their greater involvement in commercial growing and their relative lack of informal savings clubs.

3.5.3 Institutional issues

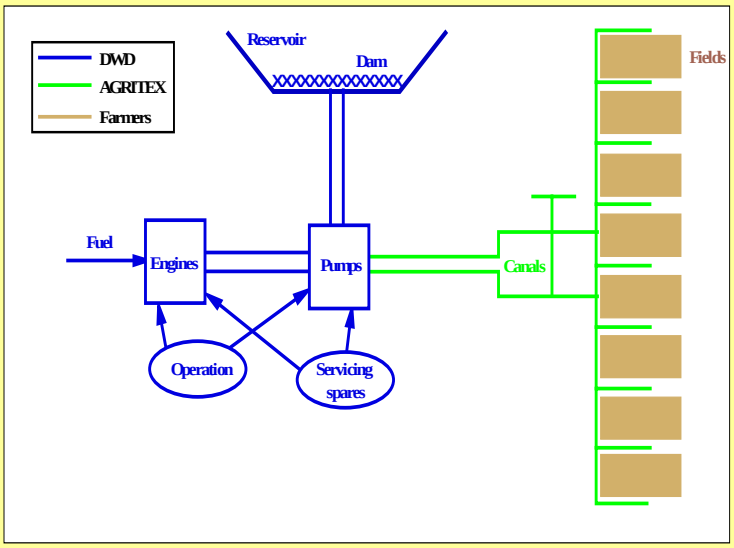
Most smallholder irrigation schemes are not self-sufficient and depend on outside agencies for their operation. In South Africa this is beginning to change and the government has embarked upon a programme of withdrawing its support in, at least, the Northern Province, where the research team became involved with the rehabilitation programme. The main aim of the rehabilitation programme is to transfer scheme management to the smallholders by empowering them to perform all the necessary duties and functions to run a successful irrigation scheme. The withdrawal of government support has created a number of institutional problems, most of which were anticipated and largely catered for, but there were some for which the rehabilitation team were not prepared. The greatest difficulties arose at Thabina, where considerable management and training inputs were made as part of the empowerment process, but these were perceived by farmers as increased government support and the warnings of withdrawal met with disbelief. A further, and complicating, institutional factor was the existence of a sub-culture amongst the local stakeholders (plotholders, extension workers, labourers) which had not been identified by the team. In ignorance of the under-currents and a certain amount of conflict, the local management structure that the team planned to introduce was inappropriate. Withdrawal of government support on the other South African schemes investigated was initially denounced by the smallholders who did not see how they could

[1] Pumped schemes only

cope but, as the benefits of empowerment became clearer, their enthusiasm for the new regime started to grow (Part 4).

The institutional issues in Zimbabwe created, and contributed to, major problems on some schemes. The root cause of the problem seemed to be too many stakeholders with divergent interests and expectations. At Chinyamatumwa, for example, successful functioning of the scheme demanded that several organisations and groups pull together and deliver their inputs at the correct time. The problems at Chinyamatumwa have been classified as pump unreliability but, in reality, there is a cluster of interlacing problems.

Chinyamatumwa Irrigation Scheme, Zimbabwe



The dam and two diesel pumps were donated by a foreign government through AGRITEX but the pumping equipment and the dam became the responsibility of the Department for Water Development (DWD), whilst AGRITEX held responsibility for water distribution to the field edge and for agricultural extension. One or other of the pumps has been out of action almost since the scheme began because of the difficulty in obtaining foreign spare parts. Farmers are not allowed to operate or interfere with the pumps, as DWD provides male pump attendants to operate and maintain them. At the outset DWD mechanics came from Masvingo (approx.120 km) every month to service the pumps but, before long, the visits became very irregular. The farmers have to pay water charges to DWD to cover pumping costs, including delivery of fuel. However, deliveries have been erratic because of DWD's budgetary problems. The farmers' livelihoods are thus at the mercy of the DWD, but the DWD has virtually no vested interest in the success of the scheme. Furthermore, the DWD is not prepared to negotiate their charges if the farmers can arrange their own supply of fuel. Such a management structure puts the institutions, especially DWD who can exercise power without responsibility, in a win-win situation whilst the farmers find themselves in a hopeless situation. When the farmers approach AGRITEX, to whom they have direct links, for help, AGRITEX were unable to intercede on their behalf. In terms of the livelihood assets, the farmers can not fully utilise their human and natural capital because they do not have sufficient financial capital to compensate for the shortcomings of the physical and social capital. Furthermore, it seems that no amount of financial capital (provided by farmers) could rectify the deficiencies in social capital that have been allowed to develop, or evolve, as a consequence of the (imposed) institutional arrangements.

3.5.4 Recommendations

"DO"	"DON'T"
• Do be aware of differences between types of management and the consequences for smallholders. • Do identify all major stakeholders and analyse their interests. • Do be aware that the greater the number of stakeholders, the greater the potential for conflict. • Do be aware that different types of institution (eg Govt. Depts, NGOs) work from different agendas and encourage different levels of participation. • Do aim to empower the smallholders and allow them influence over institutional inputs. • Do arrange institutional inputs to be, as far as possible, complementary, mutually dependent and in the interest of smallholders' productivity (creative use of "sticks and carrots").	• Don't assume that institutions and agencies, which are involved in irrigation schemes, will necessarily behave in support of the smallholders. • Don't allow stakeholders to influence the success of a scheme without underwriting a share of any losses. • Don't assume that smallholders and institutions (or their representatives) are able to communicate effectively. • Don't assume that Govt. Depts. and NGOs are equally technically competent. • Don't assume that smallholders naturally form allegiances to deal with management issues (there may be sub-cultures fuelling quarrels and conflicts – family or otherwise). • Don't forget that marketing is the single issue that is the biggest smallholder concern and has most influence on the success of the scheme.

3.6 Pumps and Modern technology

3.6.1 Background

This study has shown that the use of pumps and modern technologies in smallholder irrigation schemes can introduce problems associated with maintenance and repair. Equipment selection, when influenced by donor policy, can cause problems due to the unavailability of spares and lack of technical knowledge. Inappropriate selection of pumps can affect scheme sustainability due to increased risks associated with breakdown and failure, leading to crop loss. In all three countries, individuals use small diesel pumps to irrigate plots up to a couple of hectares. These pumps were mostly funded from non-agricultural work or had been given by a relative. Although knowledge is still a problem, organisations and motivation problems do not occur to such an extent and because most small pumps are bought locally, access to spares and service is less of a problem. In South Africa, ownership of a portable pump was clearly an advantage to a farmer, both in accessing water and reducing labour requirements. In Zambia it was less of a bonus because the market situation was such that much of the increase in production remained unsold. In Zambia, low cost alternatives such as treadle pumps were popular due to their low running cost as well as the low purchase price, as a low cost production system was perceived to be less risky given the high market risk for irrigated produce. However, although the impact of diesel pumps and treadles is thought to include a reduction in labour, particularly for women, the study did not find that this was always the case.

People should be assisted to choose equipment that takes account of personal strengths and weaknesses. Use of appropriate lightweight equipment by women can ameliorate gender disparities and help prevent adverse health impacts.

3.6.2 Information, awareness raising and technology choice

At the beginning of the design process, it is extremely important that scheme implementers, such as governments and NGOs, encourage both men and women to participate in choosing the appropriate technology and equipment for their scheme (within budget and feasibility limits). In order to do this successfully, the farmers need to be knowledgeable about all the feasible options that are possible at their scheme.

On schemes that can not rely on gravity, potential irrigators need to be aware of the full implications of all costs (direct and indirect) associated with engines and pumps. Where modern technologies such as sprinkler and drip systems are being considered as an alternative to surface application, irrigators need information on the advantages and disadvantages of each application technology, so they are able to make an informed choice. In order to make informed choices, they also need information about which engines, pumps and modern technologies can be serviced locally by artisans with access to the necessary range of spare parts and accessories.

Information on service requirements is needed. For example, although electric powered pumps need fewer services than diesel ones, farmers on smallholder irrigation schemes may not appreciate that local capability for service for electric pumps is scarce. They may have no basis for comparing costs, and no appreciation of the cost implications of poor reliability.

Concise and uncomplicated information should be made available to the farmers covering the differences that will apply to their scheme, between:

- **Gravity-fed and pumped irrigation**
- **Sprinkler and drip irrigation**
- **Electric and diesel engines and pumps**
- **Human (e.g. treadle) and engine powered pumps**
- **Imported and locally manufactured pumps and application equipment**

This information should include:

- **Initial cost**
- **Reliability and potential life span**
- **Operation, maintenance and repair requirements and costs**
- **Local availability of spare parts or company and country of origin**
- **Availability of local technical knowledge and manuals in local languages**
- **Farmers' roles in routine operation and maintenance**

It is also typical of schemes that rely on pumps and other modern technologies that farmers are not clear about the real costs involved. As equipment becomes older, repairs are necessary more frequently and costs increase rapidly. Irrigators' need to be alerted to these issues, need to understand why they must save for equipment replacement and when it is the best time to make a replacement.

When explaining costs to potential irrigators, the initial costs involved with implementing a gravity scheme should not be directly compared with those of a pumped scheme. At the beginning, it may cost more to build a gravity scheme if long distances of buried line or open canal are needed, but in the long term, when operating costs and risks are taken into consideration, the total cost will probably be greater for pumped schemes. Irrigators on gravity fed schemes may, in the long term, be better off than those on pumped schemes, as the former will only have to pay for water whereas the latter will have to pay for both water and fuel. However, the flexibility of a pumped system may warrant the greater expense if it allows the farmers to grow high value crops for which demand is robust.

The study has shown that management of pumps and modern application technology may be more efficient if undertaken at scheme level. Local control helps reduce institutional conflict and consequent delays that affect the farming process. There is thus a need for trained local farmers, both men and women, who can attend to minor problems (Section 3.6.4).

OD 143 (Part 2 and Part 5)
In Zimbabwe, it is often the case that in government-run schemes, pump attendants are employed by DWD to manage the pumps. The attendants may not be irrigators and are not motivated by the impact of pump breakdowns on their own crops and therefore tend not to treat breakdowns as an emergency. This leads to conflict and communication difficulties between the farmers and the DWD.

OD 143 (Part 4)
In South Africa, delays in attending pump repairs force farmers, who can afford, to invest in private, portable pumps. Those who are not able to afford (some men and most women) become economically weaker, and can no longer successfully lobby for prompt repair.

3.6.3 Access to spare parts

At some schemes, irrigators have lost income due to loss of crops resulting from pump failure. Repairs have either been too expensive, or impossible as spare parts have not been readily available.

Generally, imported equipment should be avoided where possible, as spare parts are often difficult to obtain. There are some exceptions to this, for example the Lister engine, which although not made in Africa is widely available in many African countries. Even if pumps are offered free of charge from overseas, local widely available pumps should be given priority, as spare parts will be easier to find, facilitating maintenance and repair. This study has investigated a number of schemes where donated pumps have broken down and spares have not been found (Parts 2 and 5).

Field study, Zimbabwe (1998)
Longdale irrigation scheme received an electric pump from DANIDA in 1993. Because no information was given on service requirements, the pump received little attention and has recently begun to give problems. In 1998, the pump was out of action for a number of months due to failure of a rubber seal, which led to the loss of one season's crops. A replacement rubber seal could not be found in Zimbabwe or South Africa. Finally the seal was reconditioned in Masvingo, but this is only a temporary measure and a new seal will be needed in the near future.

At schemes where there are no arrangements with outside organisations for pump operation and maintenance, a register of all local irrigation suppliers, spare part dealers, welders and mechanics would be useful for irrigators. Farmers would save valuable time in the case of equipment failure, which could be crucial to preventing the loss of a crop and consequent decrease in livelihoods.

3.6.4 Access to technical skills

In many schemes there are often just one or two people (usually men) who have received training in operation, maintenance and repair of pumps, engines and other modern technology. Women, because they are the main providers of labour, are often on their own in the fields when the equipment breaks down. Their lack of knowledge and training prevents them from being able to undertake routine maintenance and repair. Training in equipment maintenance and operation is therefore necessary for both men and women irrigators. It is necessary, however, that training takes into consideration women's availability to attend. The scheme gains because women are on hand on a daily basis and trained women are less likely than men to leave in an attempt to find work elsewhere.

Women are often wary of volunteering for irrigation committees, as they are afraid of being given the responsibility for tasks involving modern technologies. Men and women should be encouraged to work together and share responsibilities to suit all. Training of women could lead to a win-win situation whereby men would have more time available for other tasks.

Government departments and NGOs should be aware of all training courses available in their country. Encouraging farmers to attend training can help create a maintenance culture in which people take pride in smooth running, operational machinery.

Case study, Zimbabwe (1999)
If AGRITEX purchase a pump from Stewart and Lloyds, one or two representatives from the receiving irrigation scheme are entitled to receive training in pump operation, correct maintenance procedures, trouble shooting and repairing of simple faults. Trainees can choose the duration and location of training and it is free of charge.

However, a maintenance culture cannot be adopted without support from the scheme members and will be strengthened by a positive attitude toward funding spare parts and compensating trainees.

Communities should be encouraged to select candidates including women and support trainees. By doing so the community can foster the maintenance culture hence improving the reliability of water delivery and sustainability of the scheme.

Pump training should include men and women and cover:

- **Correct management procedures for pumps and application systems**
- **General maintenance of pumps and modern technologies**
- **Simple trouble-shooting tips**
- **How to carry out simple repairs**

Simple illustrated instructions (written in the local language) should be prominently and permanently displayed adjacent to all pumps, engines etc, including:

- **Service requirements**
- **Simple operation instructions**
- **Routine weekly and monthly checks**
- **Trouble-shooting tips**
- **Log book for recording faults and actions**
- **Emergency contacts**

3.6.5 Recommendations

"Do"	"Don't"
• Do offer farmers information on all alternatives in their local language to ensure the implications of using pumps are fully understood. • Do discuss future replacement costs of equipment and low cost, low maintenance alternatives. • Do encourage management of pumps and other technology at scheme level, if a pumped scheme is chosen. • Do select suitable people such as women who are based on the scheme to take day to day responsibility for pumps and modern technologies. • Do install local pumps rather than imported pumps as spare parts will be easier to locate. • Do offer a list of local pump suppliers and contacts for farmers in the case of breakdowns. • Do display simple, well-illustrated instructions adjacent to pumps. • Do organise visits to sites where different pumps and modern technologies are in use. • Do emphasise the versatility of small diesel portables and treadle pumps. • Do consider women-friendly designs. • Do consider the work requirements and responsibilities of different pump choices.	• Don't design a pumped scheme rather than a gravity-fed scheme just for the sake of being modern. • Don't be tempted to make decisions about pumps and modern technologies without extensive farmer consultation and participation of both men and women. • Don't use an imported pump because it is a donation – it may cost more than a local pump in the long term. • Don't forget that women can be good technicians. • Don't assume men have to be pump managers as they are stronger and more technologically aware. • Don't assume that women don't have time or the capability to attend training courses. • Don't encourage the use of expensive, high technology, high maintenance equipment. • Don't assume that farmers are not capable of management. • Don't assume that instructions aren't necessary or that problems can be solved without available information. • Don't assume that treadle pumps necessarily reduce workloads.

3.7 Marketing

3.7.1 Background

The GSID study has found that marketing is a widespread fundamental problem, which seriously constrains the success of smallholder irrigation schemes. The investigations carried out throughout the project confirmed that gender disparities exist in marketing.

3.7.2 Selling vs marketing

The study has found that men are normally responsible for bulk marketing and women are commonly involved in day to day selling of small quantities of produce. Because rural men and women tend to be unaware of "marketing" as a concept, they only see a problem in selling, which limits their ability to address the problems they face. At many of the schemes visited, farmers were struggling to sell their crops individually at the scheme, at local growth points or in nearby towns. Large markets are not favoured by small-scale irrigation farmers because of the many problems they face with long distances, poor transport and roads and the difficulties that they meet at the market. These can include, for example, time restrictions causing farmers to sell at low prices to clear their produce before they leave. Competition from more commercially based farmers, who enjoy economies of scale and higher-input production, is more intense in larger town markets.

Selling – Where farmers grow produce without prior knowledge of demand and attempt to sell on an individual basis to passers-by or in town centres.

Marketing – Involves an element of planning, and implies that farmers have some prior knowledge of demand and grow produce to meet this demand (quantity and quality), often locating buyers for their produce such as local hotels, schools, shops or companies. Marketing often takes place in bulk as well as on an individual basis. Marketing may involve an element of grading, processing or packaging.

Although marketing committees have been established in many smallholder schemes, many of them are not active. Many committees are just a formality and do nothing towards meeting the marketing goals. They mostly consist of men as it is perceived that women have too many other chores and would not be able to give up the time.

The lack of well-defined markets and marketing strategies are major problems for most small-scale farmers. If marketing is to replace selling, marketing committees need to be helped to develop a useful role.

3.7.3 Information, awareness raising and choice

It appears that smallholders often grow crops because they have been strongly advised to grow them by extension workers and not because they are knowledgeable about demand. For example, in many smallholder schemes in Zimbabwe and South Africa, wheat is still being grown even though farmers find it difficult to sell and women complain that it is difficult and time consuming to harvest. The imposition of a crop calendar is questionable, but where it is in use they should be made with full participation of men and women farmers in order to incorporate their concerns about crops that are difficult to sell.

Competition when markets are flooded with produce can result in reduced prices and lead to produce selling below production cost or remaining unsold. Farmers, who have less access to extension advice, often women, commonly bear more losses.

Field study, Chinyamatumwa, Zimbabwe (1998)
Q. Generally do you sell as much as you would want?
A. No, most of the things dry for storage
A. Wheat has always been very difficult to sell
A. Only maize is easy to sell

Q. How long does it take you to sell all your produce after harvest?
A. It depends on the crop, for beans it takes about 3 months but things like wheat can take the whole year if ever they are to be bought.

Farmers should be encouraged to think about their marketing opportunities and to diversify in response to demand. There is evidence that private companies have a role in encouraging diversification but problems can occur (see below).

Irrigators are aware of the importance of meeting the deadlines set by their extension worker for planting, land preparation, watering and harvesting. Farmers are aware that late planting and lack of water can lead to low yields and an unsuccessful poor quality crop, which will be difficult to market. This aspect of irrigation produce marketing works for bulk marketing objectives, but is not sufficiently flexible to accommodate more opportunistic marketing at the individual level. Female household-heads in particular often find it difficult to meet deadlines and so feel that marketing in bulk is an area where they lose out to men. It may be in women's interests to focus on the non-bulk market and concentrate on more frequent small-scale sales (Section 3.1.1).

Field study, Mushandike, Zimbabwe (1998)
Q. Which times are most difficult for selling leaf vegetables?
A. Mid year, every household seems to have vegetables at that time, even those in dryland

Field study, Longdale, Zimbabwe (1998)
Q. Can you say you have an easy market?
A. Not these days, because there is a lot of competition, our neighbours sell vegetables at very cheap prices and provide transfer for the customers.

Field study, Benzi garden scheme, Zimbabwe (1998)
Q. What problems do you encounter in selling your produce?
A. There is too much competition and the market is flooded

Field study, Mushandike (1998)
Q. Which crops are problematic to sell?
A. This year it was paprika. A company from Harare promised through a local commercial farmer that if we grew paprika they would buy the crop at Z$35.00 per kg. We were given seeds but later when the crop was harvested, the company said it would only pay Z$20.00 per kg because the world market had gone down. Then the price went down to Z$13.00 for grade A and Z$10.00 for grade B. The whole crop was graded as Grade B and only sold for Z$10.00 per kg. It is believed that they later packed some of the crop as Grade A.

Q. What type of contract did you enter in with this company?
A. It was a verbal contract, affectionately known as a "gentleman's contract"

OD 143 (Part 3, Appendix 5)
In Zambia, adoption of high yielding varieties improved maize yield, but, the grain does not have the robust storage characteristics of the former poorer-yielding varieties and indigenous storage systems are failing. Farmers sell harvested grain immediately, causing glut and poor prices, only to buy back later at much higher prices. The livelihood impact of the yield increase is thus doubtful.

Generally, contracts are not used as much as they might be because farmers realise that they could be sued for failure to deliver produce in the specified quantities and to a satisfactory quality because of unreliable availability of water. This is a significant feature on pumped scheme, where reliable functioning of the pump can not be guaranteed in present circumstances. (Section 3.6 and Part 5). The farmers, however, have some experience of 'Gentlemen's Contracts' which are not reliable and do not protect them from unfair practices by companies. Farmers should be aware that with skilled handling, improved results are possible even from non-contractual marketing.

The lack of on-farm processing and storage facilities for most smallholders means that produce can not be stored for home consumption or for marketing out of season, thus contributing to market glut that causes slumps in product prices.

Management and marketing committees must take into account these major different marketing options and ensure that their activities reflect the balance of interests among the scheme members. On-site storage can bring benefits to farmers. Storage will help avoid situations where farmers buy back crops for three times the price they where paid by wholesalers at harvest time (Part 3).

3.7.4 Transport

Transporting produce to potential markets can be a major problem for both women and men, although women tend to find it more difficult. In many cases where vehicles are available, men have greater access to them, whilst women have no alternative to carrying produce on foot or waiting for infrequent buses. Where there is a lack of transport and roads are very poor, farmers should be encouraged to explore the possibility of selling in bulk rather than individually, as buyers of bulk supplies will often collect from the scheme.

Transport, in that it is related to infrastructure, can be improved through government investment and policy. However, for individual farmers and small group-based schemes, factors such as cost, bulk and market characteristics are crucial. The gender issues that arise are linked to the poverty of the individuals, hence their access to transport and to the time, contacts and organisation they can muster.

Some producers opt out of transport by using middlemen and women who shoulder the cost and trouble of transport in exchange for the opportunity of a trading profit. Although the producers' margin is small the rise is low, reforms reliable and the human and physical capital otherwise absorbed by transport can be switched to production.

Women have less access than men to power (draught animal or engine) or technology to make transport less labour intensive. They also lack cash to hire or buy transport.

OD 143 (Parts 2, 3 and 4)

In Zimbabawe, public buses often refuse to lift women with loads for market. This often results in harvested produce deteriorating and remaining unsold representing significant losses.

In Zambia, transport problems are acute due to the poverty of smallholders, dispersed farms and long distance, poor roads and scarce transport. Men use bicycles to take produce to market, whereas women carry produce on their heads.

In South Africa, women groups often enjoy assured local markets for their crops. The men, in contrast, have difficulty in obtaining reliable, affordable transport for their bulk sales. Loss of these crops represents a high proportion of total income.

3.7.5 Training

Field study, Zimbabwe (1998)

Q. Can't you have one voice and stand against buyers who want to exploit you?

A. The problem, when we find a customer, we are in such deep financial problems e.g. we want to pay water bills, school fees etc. We are afraid that if we voice against the customers they will find another farm where they can buy the same produce. We cannot afford to let the money go.

Many farmer committees have stressed that they would appreciate training in marketing, especially how to source potential markets. Both men and women farmers lack confidence and feel vulnerable when meeting commercial customers and feel that training would benefit their bargaining capability. By promoting the concept of marketing as opposed to selling training should include for bulk contracts and for small quantities

It is important to encourage women to participate in marketing committees so that their specific needs are addressed. Marketing has been identified in the focus groups as the point where gender disparity is perceived by women. Farmers would also benefit from training in grading of produce and market differentiation i.e. different qualities for different markets.

3.7.6 Recommendations

DO'S	DON'TS
• Do encourage farmers to participate in developing suitable cropping calendars. • Do offer training in marketing and use of contracts. • Do encourage diversification to meet demand and spread risk. • Do investigate options for market restructuring – assigning one market day/week to areas around the centre of demand – focusing buyers into different growing areas each day thus evening out opportunities for growers and transferring the cost of transport to the buyer. – Needs full participation of all stakeholders. • Do encourage marketing committees to investigate bulk marketing. • Do encourage the building of storage facilities as this will enable crops to be stored for home consumption or for marketing at alternative times of the year (when not in season). • Do investigate the options for transport to market for both men and women. • Do consider options for food processing, to give added value and maybe better preservation (pickling, sun drying and cooking). • Do ensure that marketing committees have resources to visit and contact potential customers.	• Don't confuse selling with marketing. • Don't choose cropping calendar without knowledge of cash flow constraints. • Don't underestimate the improvements possible from good marketing. • Don't ignore the possibility of growing higher value crops less frequently. • Don't forget the importance of transport and organisation. • Don't underestimate the losses that can occur in storage.

3.8 Finance

3.8.1 Finance and resource control

The financial viability of an irrigation scheme is closely related to the financial viability of the member households. It also depends the sense of ownership and commitment that members feel towards maintaining and sustaining the scheme. Finances of households, in turn, are closely related to the composition of the household and the access to and control of productive resources. The many female–headed households are often financially disadvantaged.

Control over productive resources in rural areas is deep-rooted in tradition. Many people have traditional views and expectations about resource control that do not change rapidly and may become out of step with current needs. Social or traditional constraints can be circumvented to some extent by cash payments. For example, some households need to hire draught power if they have no animals, thus cash is doubly important for some people, usually those who find difficulty in accumulating any.

Group financing creates difficulty in agreeing priorities and is always open to abuse. Both men and women contribute to group finances in smallholder irrigation but, because women are less active in committees, decisions about spending the contributed funds tend to be made by men. In some cases this leads to conflict. A source of gender conflict is the different production and marketing objectives of men and women. Gender conflict may arise from the different production and marking objectives and men and women, but gender is not the only axis of conflict. Nevertheless, it appears to be strong when compared to economic status or ethnic group.

Field study, Zimbabwe (1998)
Rufaro irrigation scheme had a tractor that was communally owned and managed. The community had difficulty in financing operation and maintenance and in setting a realistic budget or a realistic price for using it. Conflict arose between men and women about use of funds, prioritising the uses of the tractor and pricing those various uses

Common problems appear to be failure to plan ahead and a tendency to minimise the recurrent costs met on a group basis. At present, unreliable machinery and reduced reliability of water delivery, leads to low profitability, entering into a downward spiral (see Part 5). Women and poor people without the resources to make alternative arrangements suffer disproportionately in these circumstances. In all three countries, financial viability can be improved by increasing farmers ability to absorb unforeseen financial crises through contingency planning, budgeting and group activities.

Focus group discussions revealed that women have particular difficulty in acquiring and retaining the cash that they feel they have earned by their efforts in irrigated agriculture and, further, in financing inputs through existing credit facilities.

OD 143 (Part 6, Section 2.4.4)

'Women who keep money in formal bank accounts feel highly pressurised by men (husbands, fathers, brothers and even brothers-in-law) to use their money as the men want. As a result women used 'Bra-banks', a strategy not likely to improve their credit access or their (personal) security.'

'Women who work on land held by their husbands growing commercial crops complain that, because contracts are made between the commercial company and the plot-holder, they have no way of accessing the payments and may never benefit from the monies that have been received.'

Field study, Chamba Valley, Lusaka (1999)

'We need small money each week to buy meat and give children school money and medicine. It is very important for us'

Women in Zambia illustrate the importance of cash flows, by choosing to grow successive plantings of rape, despite the low market value of the crop. The short growing time assures them of regular income. However, as a result, they forego growing higher value, slower maturing vegetables that would bring them higher overall returns for their work (Part 3).

These examples illustrate the way that the potential for irrigation to bring women out of poverty is reduced, by lack of credit, particularly on schemes where the focus of development has been to bring smallholders into commercial growing. However, some women suffer increased workloads and no benefit whilst others experience uplifting of the standards. The issue of women's empowerment has been addressed by subsidiary arrangements and in some schemes in South Africa the parallel development of women's club gardens has successfully provided women with enterprises for income-generation.

3.8.2 Credit and Multiplier effects

Credit for large plans tends to be easier to obtain than for small ones. A largish-scale smallholder often finds it relatively easy to obtain a loan for an ambitious plan when his or her poorer neighbour cannot borrow a small amount for a modest plan. The small producer is then challenged to make profit from an essentially high input system when he or she cannot finance the inputs.

Women, despite their generally good record of repayment, find credit difficult to obtain because they often want only small loans and because lack of land rights denies them collateral. These difficulties, along with the general difficulty of establishing their right to hold money, have led to the formation of numerous successful women's saving groups to provide small loans. The strength of women's savings clubs, as a source of small credit, is significant. In Zimbabwe and South Africa, women mobilise funds for small garden development and administer local savings clubs to allow bulk purchases at cheaper rates than if they acted individually. In some places, women use funds from savings clubs individually on a rotational basis for a range of enterprises including non-agricultural or food processing businesses. This extends their range of livelihood options.

Cash in the hands of poor people is spent rapidly giving rise to a strong multiplier effect. This is possibly more the case for women than for men. Providing for families tends to give rise to high, sustained local expenditure; nonetheless, women do not neglect saving as the successful savings clubs illustrate. NGOs appear to be successful in channelling credit to women; they report good repayment rates. Providing credit for inputs to women has potential to increase the impact of irrigation on poverty.

3.8.3 Institutional arrangements

Poorly functioning institutional arrangements can play havoc with farmer finances.

It is important that the ministries and agencies whose finances control irrigation are sensitive to farmer needs and accessible and accountable to farmers. Dialogue between farmers and an agency or ministry can be almost impossible if the ministry office is physically distant, particularly for women, who find travel difficult and unaffordable. This fosters lack of understanding and potential conflict. Options for financing recurrent costs at scheme level allow farmers more control of their system and should be considered where possible. This is a strong element of the South African Rehabilitation Programme

Field study, Mabvute, Zimbabwe (1998)
Farmers paid an irrigation fee and a fuel levy, depending on the ministry to fuel the pumps that provided water to the system. The ministry's financial problems rendered it unable to pay for fuel, so farmers got no water and no income.

Field study, Chinyamatumwa, Zimbabwe (1997/98)
While one ministry supported and encouraged irrigators it was unable to ensure continuous supply of water from the dam because a different ministry controlled the pumps. The second ministry was inaccessible to farmers, particularly the many women farmers on the scheme. As a result the scheme was without water over a critical period and crops were lost. Here the institutional set-up contributed directly to income loss and future financial difficulty.

It is difficult for farmers to interact with several ministries and for ministries to interact with one another (Section 3.5).

3.8.3.1 Payment for water and services

Farmers are genuinely struggling to understand the rationale of water payments.

Despite the advantages that are expected, the current climate of 'user-pays' has potential for increasing the disparity between men and women irrigators. As discussed earlier in this section, women have difficulty in asserting and retaining control over cash. Payment for water is therefore likely to be problematic for female-headed households, especially the *de facto* household heads, whom the study identified as having least control of the household funds. Withholding water from such households may start a rapid downward spiral in their ability to sustain livelihoods.

In South Africa, the withdrawal of tractor services from existing irrigation schemes has raised problems of both organisation and finance. In some of the affected schemes, it is evident that the previous level of mechanisation will not be sustained by many of the farmers. Cheaper alternatives are not readily available thus serious rethinking of the financial viability that can be achieved is underway. In Zambia, the low cost of treadle pumps and the negligible running cost avoid major financial problems.

Field study, Zimbabwe (1998)
" The dam was built by our grandparents in 1945 through forced labour, why now do we have to pay for their labour, they sweated for nothing" (M)

" The government must consider we have other expenses and are remaining with nothing after paying for water" (F)

"We are not happy about how the payment is calculated. We are paying for leaked water."(M).

3.8.4 Economic environment

Smallholder farmers in southern Africa have a comparative advantage in serving the local demand for food. However, existing smallholder irrigation, geared to production of the same cash crops that are grown commercially on European-owned large-scale farms, competes against high-input production systems. This induces a degree of financial strain in which the farmer is constantly struggling to finance inputs and facing the risk of marketing failure. Women are particularly vulnerable because of their lack of control over money and the logistic, social and cultural difficulties they meet in trying to access commercial markets. It is important to consider the marketing environment at design stage in order to pitch operation and maintenance costs at levels that will be affordable in the foreseeable future.

3.8.5 Recommendations

'DO'	'DON'T'
• Do consider targeting credit to irrigators who are otherwise disadvantaged in terms of resource control, often women. • Do encourage farmers to give 'accountability' a high priority in the arrangements they accept for financing operation and maintenance. • Do encourage farmers to consider how they can retain control of monies raised by them. • Do promote women's involvement in handling group finances. • Do facilitate training opportunities for groups and individuals to develop planning and budgeting skills. Include women. • Do alert users to operational circumstances that are likely to reduce the expected life of parts, such as sediment wear in pumps, because these circumstances will affect the budgets. • Do encourage formation of women's savings groups to provide funds • Do promote women's gardens in association with schemes that have a more commercial focus. • Do prompt farmers to plan replacements by providing information on expected life of equipment or infrastructure.	• Don't involve ministries that are inaccessible to irrigators, remembering that access is different for men and women. • Don't assume that men and women irrigators will be able to communicate effectively with accessible ministries. • Don't design around assumptions of sustained high costs and high input unless the market forecast is reliable and positive. • Don't assume that remote farmers will readily exploit high value markets. • Don't assume that farmers have a long-term view of recurrent costs and plan for replacements. • Don't neglect the need for small credit provision.

3.9 Health and environment

3.9.1 Background

Many smallholders in southern Africa have a marginal existence which they have little chance of improving unless they can expand their livelihood assets (Section 1.4). The opportunity to move into irrigated agriculture from dryland farming offers the prospect of improvement, provided that the smallholders are able to sustain care of their families and their environment. Upgrading to irrigated agriculture has the strong attraction of higher production and, in theory, higher productivity. Upgrading should lead to greater economic security and self-determination (empowerment), but brings with it more demanding human inputs. Intensification, diversification, more inputs, more cash, more debts, more decisions, less time, more worries, all combine to result, in higher levels of human, occupational and environmental stress. For sustainability, all these demands need to be managed, otherwise, there will be a loss from the human and natural capitals and, thus, a net loss of livelihood assets. Men rather than women tend to be in control of the decision to irrigate and subsequent management, therefore, there is potential for these new demands to fall to women. Men tend to underestimate or ignore the negative impacts on women's health. Gender sensitive irrigation design draws attention to these issues.

3.9.2 Health

The labour inputs for smallholder agriculture in southern Africa, whether for dryland or irrigated, are very high and require the active population to be reasonably healthy. As livelihoods improve, it is expected that health and nutrition will also improve and levels of drudgery will decrease. These expectations are largely realised in practice where the active household members are not clinically ill. Women who become ill are likely to be more disadvantaged than men because of the greater range of responsibilities to which they are committed. Many smallholders on the schemes studied wanted medical care and clinics to be closer, to reduce the time and cost involved in visiting them. Again, because of their caring role, women are more likely to be disadvantaged than men if the need for local clinics is not met.

More and more people are being affected by the HIV/AIDS pandemic either directly, through debilitation effects, or indirectly, through the loss of or reduced activity and work output of household members. This situation is particularly bad on some schemes in Zimbabwe where some households now comprise youngsters and children who have lost both parents. Households in this situation are severely disadvantaged in terms of productive capacity, being short of labour, cash, credit and social status. This puts an added burden on these scheme members who may feel responsibility to the children and the future of the scheme, although adverse social attitudes can develop towards such families. It seems appropriate to look towards an institutional approach to take account of these extreme circumstances.

Many of the farmers, both men and women, feel that irrigation had raised their nutritional level. For some, this was a direct result of being able to produce more of the family staple or a wider range of vegetables and relishes. For others, the improvement was the result of more cash to buy additional foods, particularly meat. People suffering from ailments and treatable diseases are likely to fare better in richer households because of their ability to purchase medicines when needed.

For the able-bodied, some women have commented that hard work is affecting their health. However, it was evident that women are reluctant to complain of drudgery. Many women emphasised that they did not mind working hard, although they also emphasised that they worked harder than men did. There is social pressure put upon young women to prove their devotion to work and older women are likely to warn their sons against marrying women who are quick to adopt labour-saving tools and techniques. This was a strongly held perception and should be taken into account when promoting labour saving techniques. Claims to enhanced production, may be more successful in leading to adoption.

Comments referring to hard work or drudgery were usually associated with particular tasks such as levelling, ploughing, weeding and harvesting wheat with sickles. Both men and women believe that the

hard work of ploughing may be a threat to health. Women also pointed out the change that irrigation had brought about in their annual work pattern. Formerly, the dry season had been a time when the lack of agricultural necessity allowed them some time for reorganisation, time for children, time for visits to relatives living distant to them and time to recover from repetitive strain injuries.

OD 143 (Part 2, Section 4.3.1)
Sustained levelling using hand hoes affects health, causing symptoms such as back-ache

OD 143 (Part 6, Section 3.1)
Lack of appropriate land preparation technology has negative impact on the physical being of men and women as well as the draught animals

Marketing was found to be a widespread problem with transport (or lack of it) as a major contributory factor. When transport services are limited, as they usually are for smallholders, men tend to dominate or control what is available, leaving women relatively disadvantaged. Women who have no access to transport must go by foot, usually head-loading. This may have serious health implications relating to long-term musculo-skeletal damage. Men seemed to have a widespread belief that women's necks were stronger and that head-loading was therefore easier for women than men.

On irrigation schemes, there are also likely to be greater risks of contracting water-borne diseases or diseases carried by water-borne vectors (eg Schistosomiasis, malaria) (Thomson, A. J. et al, 1994). These are best avoided, or dealt with, by taking appropriate precautions, which may be relevant to discussions at the scheme design stage and by designing schemes to reduce vector breeding, minimising stagnant water and draining down and drying out the infrastructure periodically (Thomson, A. J. et al, 1996). In general drainage is a low priority and is ignored until either salinity or sodicity is evident (Section 3.3), risking permanent soil damage. Poor levelling can also result in standing water and provide vector breeding grounds. Easy access to medical advice is also important.

One of the options used increasingly, as farmers become wealthier, is to control pests by the use of chemicals. This is an extra input, which has to be managed and which will damage human health and the environment if it is not managed properly. Both men and women applied chemicals using backpacks but employing the minimum of personal protection. The implications for women and young children, who are often strapped to their mother's backs immediately after a leaky backpack, deserve further investigation.

Raising the awareness of women to the long-term effects of exposure of young children to pesticides should be incorporated into the training offered to both men and women (Section 4).

3.9.3 Environment

There are several environmental concerns associated with methods of increasing production or productivity on smallholder irrigation schemes. Perhaps the most obvious is the use of pesticides, referred to above, and their intrusion into the food chain. Clearly this is of concern to both men and women in their role of family providers. However, women as carers are doubly concerned but they may lack a decision-making role in the selection and application of these chemicals. Other manufactured chemical compounds are also used, such as fertilisers, fuels and containers, which are unlikely to be bio-degradable and may cause damage or injury to irrigation equipment or livestock. Insecticides, fungicides and herbicides must be of special concern because their use, so close to large amounts of water, must increase the possibility of their entry to the human food chain. Great care, therefore, must be taken in using these chemicals, not only for the individual safety of the operator but also regarding the disposal of unused chemical (undiluted or diluted) and of containers (Pearce, G. R. 1998). On the schemes investigated there appeared to be fairly widespread use of fertilisers (inorganic) but much less use of pesticide. In Zambia and Zimbabwe, many

of the smallholders could not afford pesticides, nor the equipment to apply them, but in South Africa, where the farmers were relatively better off, there was greater use of pesticides. Pesticides are more likely to be used on higher value cash crops where the investment, if it can be afforded, would be well repaid. Some farmers who were growing crops under contract received pesticides as part of the deal. Unfortunately, regarding both human health and care for the environment, it appeared highly unlikely that any of the smallholders on any of the schemes had received adequate, if any, training on the use and management of agricultural chemicals. This is set to become increasingly important as more smallholders decide to grow and, therefore, protect higher value crops. Because of the work patterns, women must be the priority target for such training.

Irrigated agriculture is a heavy user of water. Extensive development of smallholder irrigation will inevitably put pressure on the natural resource and can affect water availability for domestic uses of non-irrigators and irrigators alike. Shortage generally results in people having to travel greater distances and wait longer in queues to fetch water. The impact is likely to be greater for women in their traditional role as providers of domestic water. This in itself can have a negative health impact as could the alternative of making do with lower water quality which, in turn, is also likely to increase women's work in caring for ailing family members.

The increasing use of treadle pumps in Zambia is taking more surface and shallow ground-water and redistributing it over smallholders' plots. Although no problems relating to this have been identified yet, it might be appropriate to monitor these ground-water supplies to ensure that this use remains within sustainable limits.

3.9.4 Recommendations

'DO'	'DON'T'
• Do consider how scheme design and layout can affect human health. • Do consider how changes to working practices may interact with human health, particularly in relation to repetitive tasks. • Do assess whether, and how, labour demands can be met with household resources. • Do investigate opportunities for introducing labour-saving tools and reducing drudgery. • Do find out what smallholders (at the individual level) know about agricultural chemicals. • Do encourage public-private partnerships for chemical safety training. • Do monitor ground-water levels and flow patterns in areas of expanding treadle pump use. • Do avoid creating disease vector-friendly environments.	• Don't overlook the importance of health care and transport as major infrastructure issues. • Don't overlook how HIV/AIDS affects labour availability and household composition. • Don't impose new equipment without participatory technology development (PTD) or farmer field schools (FFS). • Don't assume smallholders will be able to handle chemicals safely without thorough training. • Don't be complacent that uncontrolled expansion of treadle pump use (in Zambia) will not adversely affect access to groundwater.

4. THE ROLE OF TRAINING IN AMELIORATING GENDER BIAS

4.1 Identification of needs: What, who, where, when and how.

In order to help both men and women achieve the best results from the effort they devote to irrigated agriculture, more attention should be given to training. Irrigators generally welcome training so long as they feel it is relevant to their needs and convenient. They are very specific about the sort of delivery that is acceptable and, in all three countries, people prefer interactive and hands-on experience to manuals.

There are gender disparities that relate to training. In general, the identification of women as main actors in any particular task is hindered by men's perception that they themselves do most of the work. The small survey of work undertaken in Zimbabwe in Phase 1 showed that men and women often perceive themselves as doing most of the work or claim to be doing the same piece of work. However, the abundance of women to be found in the field at any given time, suggests that women are likely to be doing the work they claim. Agencies and institutions traditionally regard women as helpers of men and, for this reason too, women have, over the years, been offered less training opportunities than men.

These factors added to the heavy and time-consuming domestic and reproductive obligations of women, and their disadvantaged educational status, have contributed to a situation where training must be explicitly targeted to women in order to enable them to get better results from irrigation. If women's training needs are neglected, they will have only limited opportunity to make an appropriate contribution to sustainable irrigation and sustainable livelihoods. This situation is not conducive to the future sustainability of irrigated smallholder agriculture, particularly as rural demographic change is leaving more women in charge of households, nor is it satisfactory in terms of women's empowerment.

What type of training is needed?

The main gaps in training identified by the study relate to use of technology, use of equipment and to marketing. Routine maintenance, minor trouble-shooting and repair skills were notably lacking in both Zimbabwe and South Africa, despite the widespread use of engines and pumps. This is the case in government-assisted, farmer-managed and NGO-assisted schemes. Although government-assisted schemes often had pump attendants, they were poorly supported by their organisations and were not motivated to respond quickly to farming needs. Furthermore, their presence stifled initiatives to help irrigators to develop their own skills to deal with technical problems. In farmer-managed and NGO-assisted schemes, farmers use their initiative but, without advisory support or basic knowledge on service provision, their efforts are frustrated.

Maintaining sprinkler systems to distribute water evenly was another area of difficulty: both men and women farmers were relatively unaware of poor performance. Women were further hampered by being unable to travel to buy the spare parts required. Nonetheless, women were innovative in attempting sprinkler repairs but their work was of limited success and short lived because of their lack of technical skill and knowledge. A combination of training and arranging for a stock of spare parts on-site could alleviate some of the worst effects of poorly maintained equipment. In this respect, Rupike scheme in Zimbabwe was the exception, having well designed training on the use and care of sprinklers and skilled artisans on site, who are able to repair and weld equipment.

Training in the use of agricultural equipment was also identified as a major need both in Zimbabwe and South Africa. The need to achieve a reasonable quality of levelling and adequate depth of ploughing has already been discussed (Sections 3.2, 3.3, 3.4). Although some equipment was available lack of training resulted in ineffective use and increased workloads. The demonstration and hands-on experience provided through the project in Zimbabwe allowed both men and women to realise improvements without, necessarily, the purchase of new equipment. It was evident that women were less able to purchase different tools and equipment and this should be borne in mind when training is planned. Ploughing was less of an issue in Zambia as most people irrigate small plots and largely rely on basin layouts. However, adoption of treadles might change the situation (Part 3).

In the rehabilitation in South Africa, training was emphasised from the start. The main focus was on agricultural practices, which inevitably included equipment. In the past, reliance on mechanisation was possible in the South African schemes due to the heavily subsidised arrangements. When subsidies are withdrawn, this poses a problem for farmers. The equipment that was formerly used is costly to hire, but alternatives such as draught animal power are not always available. Innovative ways of helping farmers rehabilitate existing, largely dilapidated equipment or secure services from the private sector were being sought. Training included organisational and communication skills as well as the more usual agricultural focus (Part 4).

In South African projects, preliminary needs assessments revealed that training in irrigation related subjects may not be the priority for women. Women prioritised training that helped them reduce the costs they had to meet from income, such as sewing school uniforms. While women continue to be under-rewarded for their irrigation work and lack control of benefits, this makes sense. Outside very special pilot developments, it may be difficult to cater for this type of parallel training through an 'irrigation' budget. However, it may be possible to form linkages that result in women's priorities being addressed. Creating a training culture by responding to client demand is important.

Marketing was identified as an essential element of training in all three countries. There was wide recognition that marketing was the key to profitability and that technical and agricultural knowledge was only useful when there was a market to grow for. However, there was low appreciation of the need to develop 'marketing skill,' as opposed to simply selling produce. Generally, because the smallholders have low levels of production, poverty is a significant constraint to taking entrepreneurial risks. This appeared to be the case for both men and women but, as women deal with smaller quantities more frequently, this offers them more scope to change their market tactics. Men with their 'cash crop' may market only a couple of times per year and therefore feel the need to be more conservative.

The concept of value-added is limited and in marketing to rural communities the added value has to be perceived to be good value. Grading of produce is usually part and parcel of the women's market activities, although the form it generally takes is to sort fruit into equal piles rather than offering better quality at a higher price. There is clearly an opportunity for women to apply market research to the local situation to improve their marketing skills, which could be encouraged through training.

Adding value through household processing and improved presentation is also an important area of potential for women. Low-cost processing such as sun drying, grading and packaging can differentiate products to ameliorate price fluctuations. Crop diversification and staggered plantings are also strategies that can be used. Women are reluctant to take risks with new crops and this is where advice and facilitation to experiment could be helpful. Experimentation in small groups appears to be acceptable to women farmers.

Field study, Zimbabwe (1998)
Q. What are your biggest problems in marketing
A. Marketing is the biggest worry that we have, we can even call it a disease.
A. When we make contracts, everything is well, come harvest time the prices fall from $20.00 to $5.00. Beans and Paprika are a problem to sell.
A. The contacts are not properly done, some of them are verbal and even if you are given a written contract you can't sue the defaulters.

Contracts for bulk marketing of cash crops, such as grain, tomatoes and beans have limited appeal. Neither farmers, nor commercial wholesalers and manufacturers, have sufficient confidence to make the system work. Farmers have had bad experiences in both Zambia and Zimbabwe relating to the volume bought by firms and to the grading rules applied to the crop at the time of purchase (Section 3.7).

These disappointments rapidly create an atmosphere of distrust. The problems often arise in the interpretation of the original contract, both in formal contracts and in 'gentlemen's contracts'. Farmers need guidance on which features to look for, which to query and how to negotiate.

Who should be trained?

Communities generally regard men better suited to fix pumps. However, men are often occupied elsewhere when breakdowns occur. It is appreciated that it might be logical for women to learn about simple checks and troubleshooting, which it was agreed, were often the solution to breakdown.

Training needs should be identified together with the farmers, taking care that the training content closely relates to the day to day conditions. Requests for parallel training should not be rejected out of hand. They may be requested to relieve a pressing constraint so that irrigation training can become relevant at a later date.

Men appreciate that it would be in everyone's interest to train women in daily pump operation and maintenance and to teach women the rudimentary checks to make in the event of trouble, such as oil and fuel checks, etc. However, they were a little sceptical about taking pump maintenance training further and questioned the ability of women to learn technical work and use tools skilfully. The control and ownership of tools is seen as a male preserve. Doubt was expressed about how women might find the time for training. However, it was generally appreciated that a great deal of time (both men and women's) was wasted, at present, dealing with emergency breakdown and chasing spare parts and appropriate tools.

At Boschkloof in South Africa, the community selected candidates to benefit from training offered by a local commercial farmer (Part 4). Their selection included women and conditions agreed in the contract between the community and the trainer indicate that the community must support the candidates it has selected.

Field study, Zimbabwe (1998)

Women at Chemombe (Zimbabwe), who rely on a pump to lift water from the dam were not even able to start the pump on their own so were vulnerable to all manner of delay.

Women at Rufaro (Zimbabwe) had to walk a long way to the dryland fields to drag their men away from other work to deal with irrigation pumps.

Women at Longdale (Zimbabwe) could not deal with their pump failure until the return of their extension officer from leave, meanwhile losing their crop.

If a candidate performs poorly or has for some other reason to withdraw, the community must be responsible for replacing the candidate. This is an interesting example of private sector initiatives in training and has been undertaken in response to the perceived need to improve community relations in rural South Africa.

Training should be targeted to those who are responsible for doing particular tasks and to the users of equipment and technology. If the trainees identified are predominantly women, this should be taken into consideration when designing the course and fixing the venue so that they are able to take up the training offered with least inconvenience.

Where is the best place to hold training sessions?
Where possible, training should be held where it is convenient for the trainees, although it is clearly necessary that the site is suitable for the subject matter. Suitable places might be in the village, in the field, at a training centre or at the local market, depending on the participants, subject, numbers and the type of training being given.

The extension training initiative in Zambia, takes place in the community and the field, using a mixture of formal but interactive work sessions and practical field application. What has been learned or agreed upon in the formal session is then applied to the farmers' own immediate surroundings and the participants are asked to make judgements and recommendations based on the earlier work session (Part 3, Appendix 6). Organisation of this type of training relies on a high level of skill and commitment among the extension staff.

In South Africa, the rehabilitation approach prioritised training in an attempt to raise the level of agricultural performance and restore self-esteem among the farmers. The preliminary needs-assessment identified the content required (Thabina and Boschkloof schemes). This rise in agricultural performance was seen as an essential preliminary to decision-making about infrastructural changes. An improvement in yields freed farmers from the immediate worry of making ends meet.

Initially, existing trainers had to be assisted with retraining to provide them with a sound foundation from which to answer farmer queries and to restore their self-confidence and pride in their work. The preliminary work had identified that farmer respect for the trainer was fundamental to the adoption of his/ her advice on new techniques and good practice.

The subsequent training by the retrained staff, which took place in the field, was effective and resulted in significant improvement in yield and quality. The farmers were themselves surprised by their achievements and by the change in attitude this brought them from outsiders. Women were keen to participate in the training sessions, but clearly responded more readily to the interactive field demonstrations than to the more inactive 'meeting' situation where they tended to catch up on sleep. This did not appear to be the case in Elandsdoorn, where the trainers were women.

Visits to existing irrigators are helpful in stimulating ideas and questions among potential irrigators. Often farmers find it easier to discuss potential advantages and problems when they can see a system in place, rather than visualising from a map or illustrations. Visits to sites where alternative systems are used, promotes learning and adoption of new ideas. When it can be afforded and organised this is an excellent and enjoyable form of training and is very popular among farmers. However, care has to be taken that women are enabled to join in as their domestic obligations constrain them from long absences.

Training that takes place in the everyday setting of farm work and relates directly to specific conditions on the farms appears to be effective. It should be remembered that the everyday conditions facing men and women are different. Training in the field is accessible to all and allows people to practise new techniques immediately and with minimum interruption to their working day. Visits have a place but may be costly and gender-insensitive.

How should training be approached?

The theme of participation has to be strong in training. A change in approach is needed to leave behind the rather top-down image of training and promote a culture of facilitation. New approaches in all three countries are welcomed.

At a practical level, training should be approached with the situation of participants in focus. Social, educational and resource control constraints are key factors in determining the appropriate form of sessions. Literacy rates are often poor among rural women and traditional story telling may be an effective method in these circumstances. Traditional knowledge should be acknowledged and built upon rather than denigrated.

OD 143 (Parts 2,3 and 4)

Participation is a huge conceptual change for existing trainers and the experience in South Africa in retraining trainers has highlighted some of the difficulties. In general, a much higher level of skill is required of a facilitator. He or she has to enter into discussion and argument, defend their advice and work with farmers to achieve solutions in a wide range of settings. For many existing extension staff in southern Africa the changes are threatening unless support, resources and advice are available. Commitment to revitalising extension has to be expressed in budget terms and resources allocated for this purpose.

In Zambia the facilitation role was well demonstrated by a training day in which the farmers themselves provided most of the course content, with prompting and help from the facilitator. The prompting was particularly useful in soliciting the contributions of women who might have failed to contribute if not explicitly invited. The group clearly felt pride of ownership in the work done.

In Zimbabwe, AGRITEX has recently espoused the Participatory Extension Approach, which is designed to draw farmers into the training process to a much greater extent than was the case during the study.

Learning Together through Participatory Extension (AGRITEX 1998)

" In top-down extension we used only one brain (the extensionists'), farmers brains remained dormant. In participatory extension we use all brains together."

The new approaches should employ participation from the start and involve farmers and communities in determining the objectives, the level of training to be aimed for, the content, venue and so forth. It will, however, be necessary to monitor the participation of women to ensure that the strategies to include them are effective. The advisory and facilitating role of trainers should be emphasised.

4.2 Ensuring motivation and continued development

Training should be relevant and enjoyable. If it is not people will not stay the course. Enjoyable training must:

- avoid conflict with other activities. There can be no hard and fast rules such as' keep it short' although this is generally advisable but in some circumstances people may prefer a training day.
- deliver a message that is seen to improve farming either by increasing production or quality or by decreasing cost or labour
- motivate people to come again. Humour is as important in rural African culture, as anywhere, and the delivery of information is more memorable when a joke or amusing analogy is used.

Field study, Zimbabwe (1999)
In Zimbabwe, in the past, the awarding of the master farmer certificates was restricted to plot-holders so that, when a woman qualified, the certificate was awarded in the husband's name. The result was that women's skills remained invisible. In South Africa, sewing certificates awarded to women, assured potential customers of a certain minimum standard and assured the owner of some business.

It may need special efforts to involve women and encourage them to commit to participation and development of their skills. It should be emphasised that development of technical skills can empower women to improve their livelihoods despite their relative disadvantage in relation to access to land and other resources such as cash and credit.

Praise and encouragement are essential and should neither be neglected nor be valueless. If a certificate is to be awarded and valued, it must be useful to the person who has earned it. It may be accepted as a passport to further training, favourable credit terms or employment opportunities. If arrangements of this sort help motivate farmers to participate in training, general improvement in standards can result. However, because of the existing bias of the qualification system to men, careful consideration should be given to any qualification system to ensure that women will have equal opportunity to benefit and that they are not likely to be further excluded.

Men and women need evidence of qualification. Certificates should be awarded in relation to the training successfully completed not dependent on other conditions. This is particularly important for women who may have suffered in the past from their lack of qualification.

4.3 Recommendations

'DO''	'DON'T'
• Do involve both men and women in identifying the training priorities. • Do consider if men and women need different training. • Do involve participants in determining course content, venue and time. • Do keep training specific and demand-led. • Do make training enjoyable. • Do make certificates worthwhile. • Do grade certificates. • Do offer short refresher courses. • Do make it possible for groups of farmers to request special training. • Do acknowledge local traditional knowledge. • Do make 'listening to trainees' an integral part of training courses. • Do make training as interactive as possible.	• Don't reject requests that are only tenuously connected to irrigation without investigating further. • Don't neglect updating of training programmes once they are established. • Don't assume that indigenous knowledge is not important. • Don't force women into training that conflicts with the community social codes, even if it does seem empowering. • Don't assume that women can't benefit from technical training.

5. GENDER CONSIDERATIONS FOR FUTURE IRRIGATION DESIGN

5.1 Men and women in smallholder irrigation

Many smallholder irrigation developments have failed to achieve the hoped for increase in production and contribute less to increasing the standards of nutrition and welfare than expected. Gender-based constraints have played a part in this disappointing performance. It is common that women provide labour and men control resources and benefits. However, it was evident in the course of the study that many people feel threatened by exposure of gender disparities. They may rationalise their discomfort as a wish to keep their 'culture' intact. It has to be recognised that culture can have negative aspects and that practices that are damaging to women, such as overwork, are usually challenged by at least some of the women. It must also be recognised that women must themselves dictate the pace of change, hence the emphasis on their participation. Gender issues include problems that face men and several examples were found in the study. Gender issues are not the only source of underachievement and this study deals with many issues where gender is only part of the solution to achieve a people–centred approach.

In order to improve agricultural water-use projects for men and women, negative gender impacts must be recognised, to some extent quantified and their origins understood, so that awareness is raised and precautions can be taken against continuing negative effects.

5.2 Operating, managing and assessing existing irrigation

The operation of schemes and individual irrigation brings men and women into contact with technology. The prevailing perception is that men are more able to deal with technology than women. There are a few exceptions but, generally, women are excluded from this area on account of lack of literacy, strength, skills, tools, time or transport. In practice, this often makes life more difficult for both men and women. Many examples from the study, particularly relating to the use of pumps, show how providing training to women could improve irrigated production and livelihoods. (Section 3.6 and Part 5)

Management of irrigation brings men and women into contact with their fellow irrigators, with outside organisations and with the commercial world. Men and women both bring skills to management that are complementary, such as women's local networking and men's greater capacity to travel away from the site. Co-operation between men and women can improve management.

In the past, monitoring and evaluation of smallholder irrigation has relied on physical measurement to define success, leaving aside human, family or individual assessments entirely. Now it is time to look to the people-centred approach. Food security and cash to meet school fees are repeatedly identified by men and women as key indicators of the success or otherwise of their irrigation work. The study has highlighted the disparity between the ways that men and women can access the resources that are needed for different types of irrigation. Thus highlighting, by implication, the different sort of irrigation that will serve them usefully and that will sustain them and can be sustained by them.

The concept of sustainable livelihoods supported by irrigation, rather than sustainable irrigation supported by lives is perhaps suggesting too simplistic a change, yet it seems necessary to move in that direction.

5.3 Gender considerations in design of new schemes

Taking account of men's and women's human capital in design is likely to empower them. The NGO gardens that were part of the study appeared to illustrate that low cost, low technology solutions were manageable by women - not perfect, but flexible and apparently durable. There were several examples where men were keen to take part in garden development, presumably because the scale of the operation suited their resources at the time.

Where women's needs were not specifically considered at the time of design, it appears that it has been difficult for women to gain control of resources or to influence management at all. Typically, they have taken on the role assumed for them as unpaid helpers of the husband who is seen to be the farmer. Women are not satisfied with this role and the women who have to assume the role of household head and farmer are aware that they have the ability to manage an irrigated farm but that they face more constraints than men farmers.

Although people appreciate gender issues on existing irrigation schemes, where irrigation is being newly developed, communities need help to appreciate the gender implications of design choices.

5.4 Gender considerations in rehabilitation

Where rehabilitation or remodelling of a scheme is undertaken, the opportunity for people to be alarmed or fearful about change is enormous. Individuals have vested interests in the existing system both at the formal level and the informal (sub-culture) level. If the system is biased in its operation and management in favour of one group or another, the favoured group will naturally want to maintain their advantage and is likely to be in a powerful position to do so. These vested interests and fears will make the task more difficult even though men's and women's understanding of the implications of different design options may be excellent and their contributions to design may be invaluable.

Participation needs special attention and designers must commit resources to understanding the status quo, encouraging transparency and seeking win-win scenarios.

5.5 The potential for gender-sensitive approaches to improve smallholder irrigation performance

The approach taken by the Gender-Sensitive Irrigation Design Study has been to identify and consider the impact of common design features, particularly those identified by the Phase I workshop as being important in relation to gender disparity. A major issue in past designs has been failure to take account of the smallholder's resource base and, in particular, to recognise that women have less access to resources than men. This failure has left irrigators, but more significantly women, in a poor position from which to achieve positive results. The significance that attaches to women arises from their major role in irrigated smallholder agriculture and from their key role as providers for rural children and elderly people. Design failure has been most noticeable in relation to land preparation issues, use of technology and equipment, especially pumps, and in the approach to marketing. The impact of poor marketing was a major issue throughout the study and affected the ability of men and women to resource equipment and maintenance, causing a vicious circle.

The guidance that has been detailed in Section 3 emphasises a number of key general principles that should be applied in respect of different features of scheme design.

- **Reduce the risk of negative livelihood impacts of irrigation development, particularly for omen and children.**
- **Ensure that both men and women participate fully in the decision-making processes that relate to development choices and that they continue to participate, as near equally as possible, in management decisions.**
- **Draw attention to the different economic and ergonomics needs of men and women and children.**
- **Provide adequate, accessible, attractive advice and training opportunities to reduce the gap between men and women in use of technology to improve production and reduce labour.**

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