Agricultural Water Use in Homestead Gardening Systems

Volume 1: Main Report

Report to the

Water Research Commission

by

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Rural Integrated Engineering (Pty) Ltd.
2001/027770/07
RIEng
Systems for Sustainable Development

WATER RESEARCH COMMISSION

WRC Report No: TT 430/09

January 2010

Obtainable from:

Water Research Commission
Private Bag X03
Gezina
0031

The publication of this report emanates from a project entitled: "*Participatory Development of Training Material for Agricultural Water Use in Homestead Farming Systems for Improved Livelihoods*" (WRC Project number K5/1575/4)

This report forms part of a series of two reports. The other report is entitled "*Agricultural Water Use for Homestead Gardening Systems – Resource Material for Facilitators and Food Gardeners*" (WRC Report No. TT 431/09). The Resource Material report should be read in concurrence with this report.

ISBN 978-1-77005-917-7
Set No. 978-1-77005-919-1

Printed in the Republic of South Africa

Executive Summary

The Water Research Commission (WRC) solicited this research project, which was formulated through a multi-stakeholder 'Terms of Reference workshop' held at the Water Research Commission in 2003.

The **overall objective** of the project emphasises household food security:

> To improve food security through homestead gardening, by developing and evaluating the appropriateness and acceptability of training material for water use management, training the trainers and training of household members in selected areas.

In accordance with WRC procedure for solicited research, the overall objective was broken down into specific objectives. The research team was then required to develop a research plan that specified the reports (or "deliverables") that the team would submit on agreed dates to the Steering Committee as the research proceeded.

The deliverables are required to relate directly to the specific objectives. It is important to appreciate that in the case of a research project of this complexity and magnitude, it would be strange if the original specific objectives tabled by the WRC or the research team's corresponding formulation of the deliverables would go unscathed through four years of research. This indeed proved to be the case, but it is gratifying that the deliverables have all been submitted and approved and the team believes that the specific objectives have been met and in some respects exceeded.

The specific objectives were to:

1. Identify current indigenous crop/livestock production practices.
2. Describe water related practices and efficiency of water use.
3. Identify developmental constraints on opportunities from natural resources, infrastructure, human resources, HIV/AIDS, gender considerations, nutrition, institutions and culture, for both rural and urban households.
4. Specify alternative and improved agricultural practices for use in homestead gardens.
5. Determine economic incentives and entrepreneurial opportunities with specific reference to the youth.
6. Identify value adding opportunities and appropriate marketing systems.
7. Determine training needs of household/home gardeners in relation to available knowledge.
8. Develop and test training material to address needs.
9. Implement the training programme and interactively refine materials with trainers and households.
10. Assess the impact of the project on food security of trained households.

In recent years, development practitioners in South Africa have recognised the central importance of household food security – and especially the impact of malnutrition among preschoolers – on the individual, the family, and the wider economy. Focus has started to shift to the potential role of the homestead yard in food production for improved family diets, while the authorities have begun to realise that lack of water has prevented many people from growing crops on their premises.

In the decade or so following the 1994 elections, village agricultural extension and assistance has been targeted at group projects, rather than at individual or household initiatives. This

approach was adopted to enable government to reach more people simultaneously, but has meant that assistance was not targeted at households who wanted to develop independently rather than form part of a group project (such as communal gardens, chicken projects, irrigation schemes, land reform projects, etc.).

Several shifts in thinking have since taken place, including the following:

- An increased realisation of the reality of malnutrition and food insecurity in rural households, exacerbated by the rapid food and fuel price increases globally in 2007/08;
- Better understanding of the challenges inherent in group-based projects – especially the typical conflicts around the handling of group finances;
- An appreciation of the potential for food production in the homestead yards – a neglected tradition – and the need for water to enable production at the homesteads; and
- An awareness of the potential of a range of water access options, or 'multiple-use-systems (MUS)', over and above the conventional bulk supply and piped distribution systems – and especially rainwater harvesting in its various forms.

A new focus developed on the household itself – in its existing context – and how people could produce food (and possibly some income) in their own homesteads, to improve their food security situation.

The principal product of this research project is the publication "**Agricultural Water Use in Homestead Gardening Systems: Resource Material for Facilitators and Food Gardeners"** and should be read in conjunction with this Report.

It is doubted if at the time of the initiation of this project there was full appreciation of the magnitude and complexity of the subject. This is reflected in the Resource Material. It comprises more than 800 pages containing around 200 000 words with matching illustrations, graphics, graphs and tables.

The publication has seven Chapters and a set of handouts that deal with production potential, environmental degradation, water supply and management, poverty alleviation, human ecology, participatory rural appraisal and applicable adult educational methodology, and rural social structures, in addition to the specific techniques and infrastructure required to harvest and exploit rain and manage soils and produce crops that will impact on the essential dietary needs of people living with limited means and opportunities. The collection of illustrated handouts (Homestead Food Gardeners' Resource Packs) which the facilitator can copy and hand out to gardening households during the learning processes are available in English, isiZulu and Sesotho.

The material is written in the format of Outcomes Based Education (OBE) and can be adapted to fit into the envisaged career based qualifications system. This reference material is mainly aimed at a community facilitator at the first year of tertiary education.

The following remarks can be made about the material. The research team believes that:

- The material succeeded in drawing widely from local and international materials and experience;
- The material is based on practical experience and field testing;
- The material has proven to be useful in practice, also when used by facilitators who were not part of its development; and
- It can be drawn on by a variety of stakeholders to develop course material for their own purposes, or by practitioners as a resource to draw from.

There is a ready demand for this material from those Universities and Colleges that are aware of the material because they have been involved in the project.

Acknowledgements

WRC Research Project Reference Group:

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Backeberg, GR (Dr)	Water Research Commission
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Engelbrecht, J (Mr)	Agriseta

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M de Lange (Ms)	**Coordinator** – Socio-Technical Interfacing
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M Botha (Mr)	**Layout and Sketches** – Tribal Zone
W van Averbeke (Prof)	**Urban agriculture** – Tshwane University of Technology
J van Heerden (Mr)	**Engineering** – Rural Integrated Engineering
CT Crosby (Mr)	**Advisor** – Private consultant

The dedication and passion of Erna Kruger, Marna de Lange and Charles Crosby for this project and its outcomes are acknowledged with gratitude.

Special recognition and acknowledgements to:

- LIRAPA – Ministry of Agriculture and Food Security Nutrition and Home Economics, Horticulture Division, PO Box 14915, Maseru 100, Lesotho.

  Department of Crop Services, Horticulture Division, PO Box 7260, Maseru 100, Lesotho
- MaTshepo Kumbane and the Water for Food Movement

Collaborated with:

- The Smallholder Systems Innovation (SSI) Programme from UKZN in Potshini,
- The Farmer Support Group
- School of Bio-resource Engineering, UKZN
- Specific thanks to Michael Malinga and Monique Salomon (FSG), Prof Graham Jewitt, Victor Kongo, Jody Sturdy (SSI).
- DWAF pilot programme for Homestead Rainwater Harvesting
- World Vision; Okahlamba Area Development Programme – specific thanks to Jamie Wright and Monica Holtz
- ARC (ISCW); Eco-Technologies Programme in Hlabisa – specific thanks to Hendrik Smith and the local DAEA extension office
- Pegasus, Mpumalanga
- LIMA Rural Development Foundation – Eastern Cape
- AWARD – Limpopo
- Bush Resources – Bushbuckridge
- Border Rural Committee – Eastern Cape.
- Centre for Adult Education (UKZN) – specific thanks to Zamo Hlela and Kathy Arbuckle.
- Umbumbulu – thanks to the Ezemvelo Farmers Association and assistance by Dr Albert Modi, Crop Science Department, UKZN

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1. Introduction

The publication "**Agricultural Water Use in Homestead Gardening Systems: Resource Material for Facilitators and Food Gardeners"** was developed with funding by the Water Research Commission of South Africa, and is the output of a solicited research project titled: ***"Participatory development of training material for agricultural water use in homestead farming systems for improved livelihoods".***

1.1 The need for this project

In recent years, development practitioners in South Africa have recognised the central importance of household food security – and especially the impact of malnutrition among preschoolers – on the individual, the family, and the wider economy. Focus has started to shift to the potential role of the homestead yard in food production for improved family diets, while the authorities have begun to realise that lack of water has prevented many people from growing crops on their premises.

In the decade or so following the 1994 elections, village agricultural extension and assistance has been targeted at group projects, rather than at individual or household initiatives. This approach was adopted to enable government to reach more people simultaneously, but has meant that assistance was not targeted at households who wanted to develop independently rather than form part of a group project (such as communal gardens, chicken projects, irrigation schemes, land reform projects, etc.).

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- An awareness of the potential of a range of water access options, or 'multiple-use-systems (MUS)', over and above the conventional bulk supply and piped distribution systems – and especially rainwater harvesting in its various forms.

There developed a new focus on the household itself – in its existing context – and how people could produce food (and possibly some income) in their own homesteads, to improve their food security situation.

1.2 The Water Research Commission recognised a need

The Water Research Commission (WRC) recognised homestead farming (and especially food gardening) as a coping strategy for poor households to enable them to overcome their vulnerabilities caused by poverty. The WRC then decided to develop training material for facilitators on 'Agricultural Water Use in Homestead Gardening Systems' to help support poor households in their efforts to grow food.

1.3 Terms of Reference and objectives of the research

This was a solicited research project, which was formulated through a multi-stakeholder 'Terms of Reference workshop' held at the Water Research Commission in 2003.

The **overall objective** of the research emphasises household food security:

To improve food security through homestead gardening, by developing and evaluating the appropriateness and acceptability of training material for water use management, training the trainers and training of household members in selected areas.

In accordance with WRC procedure for solicited research, the overall objective was broken down into specific objectives. The research team was then required to develop a research plan that specified the reports (or "deliverables") that the team would submit on agreed dates to the Steering Committee as the research proceeded.

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10. Assess the impact of the project on food security of trained households.

1.4 Deliverables

The deliverables can be divided into two categories:

- The shaded deliverables are essentially extensive reports and consist of the hard core data, results and conclusions arising from the activities of the research team; and
- The others are progress reports, stakeholder workshops and other consultations, as well as popular articles.

Table 1: Deliverables for the project

	YEAR ONE
Deliverable 1	Detailed project plan for the whole project.
Deliverable 2	Situation analysis report for South Africa.
Deliverable 3	Situation report for the selected target communities.
Deliverable 4	First Popular Article
Deliverable 5	Report on how to use or to improve indigenous practices / systems, and possible alternative agricultural practices/systems for the selected areas.
Deliverable 6	First Progress Report
	YEAR TWO
Deliverable 7	Report on economic incentives and entrepreneurial opportunities with reference to the youth and value adding and marketing systems.
Deliverable 8	Report on training needs of home gardeners in the selected areas & most promising opportunities.
Deliverable 9	Proceedings of the First Stakeholder Workshop
Deliverable 10	Second Popular Article
Deliverable 11	Second progress report
	YEAR THREE
Deliverable 12	Report on the refinement of practices after participatory evaluation.
Deliverable 13	Progress report on development and testing of training materials.
Deliverable 14	Report on the effectiveness of the training methodology and implementation.
Deliverable 15	2nd Stakeholder workshop (Proceedings)
Deliverable 16	Third popular article
Deliverable 17	Third progress report
Deliverable 18	Final training material.
Deliverable 19	Fourth popular article
Deliverable 20	Final Report.

The highlighted deliverables are in themselves major reports dealing with the situation in rural South Africa and the attempts that have been made to promote development in the past and what worked, and what did not work, and why. Apart from deliverables 18 and 20 these reports were not published, but could be of some use to researchers at tertiary institutions.

The main task the team faced was to distil from this mass of information an innovative way forward, based on the achievements of predecessors in combination with current new thinking. The deliverables represent a valuable resource for any future research in rural development.

1.5 Products

The principal product of this research project is the publication "**Agricultural Water Use in Homestead Gardening Systems: Resource Material for Facilitators and Food Gardeners"** and should be read in conjunction with this Report.

It is doubted if at the time of the initiation of this project there was full appreciation of the magnitude and complexity of the subject. This is reflected in the Resource Material which comprises of more than 800 pages containing around 200 000 words, with matching illustrations, graphics, graphs and tables.

The publication has seven Chapters and a set of handouts that deal with production potential, environmental degradation, water supply and management, poverty alleviation, human ecology, participatory rural appraisal and applicable adult educational methodology, and rural social structures, in addition to the specific techniques and infrastructure required to harvest and exploit rain and manage soils and produce crops that will impact on the essential dietary needs of people living with limited means and opportunities. The collection of illustrated handouts (Homestead Food Gardeners' Resource Packs) which the facilitator can copy and hand out to gardening households during the learning processes are available in English, isiZulu and Sesotho.

1.5.1 Guiding Principles and Overview

The Chapters contained in the Resource Material follow a logical pattern, based on key questions the WRC research team had to ask itself.

On household facilitation:

Acknowledging that, while more and more households are starting home food gardens, many others don't believe it is either possible or worthwhile, the research team asked itself:

"How can the significance of food gardening become a reality in people's minds?"

The research team developed and field tested the Nutrition Workshop, and found it a very effective method to 'create discomfort' – which we know is where all changes in habit spring from.

"*Isn't discontent the lever of change?*" (Steinbeck, 1958).

The Nutrition Workshop enables the household to analyse their own diets, discover the gaps, and choose crops to plant in their home gardens to fill those gaps.

On 'need-to-know':

Deeply aware of the bewildering amount of information on organic production methods, family nutrition, irrigation and water management, the researchers asked themselves:

"What is the minimum, essential knowledge a household would need to successfully grow an intensive, year round home food garden? And then, what does the facilitator need to understand to accompany these households on that journey of discovery?"

The Resource Material contains much more than the essential information, but enables a facilitator to select what is appropriate to any specific household and garden learning group.

On cash-scarcity:

Recognising that these households are growing their own food precisely because they have too little cash to buy enough nutritious food, the research team asked itself:

"How can we select the methods included in this resource material to be appropriate to the cash-scarce context they will be used in?"

Because of the reality of cash-scarcity, the research team believes that the Low-External-Input Sustainable Agriculture (LEISA) farming system works best for homestead food gardening. Therefore, LEISA principles form the basis for production methods selected for inclusion in the Resource Material.

1.5.2 Content of the Resource Material

As mentioned above, the principal product of this research project is the Resource Material for Facilitators and Food Gardeners.

The reader will notice that an Outcomes Based Education (OBE) approach has been adopted in the layout and presentation of the material to improve its readability. For instance:

- The Tables of Content are organised logically, and almost in narrative form;
- Each Chapter starts with a brief 'Introduction' and 'Aims' section;
- This is followed by an overview of the learning objectives for the Chapter, in an easily accessible self-check table format; and
- A page is included below called "How the Chapter is organised". It shows the use of icons for the easy identification of learning aids which are used extensively throughout the material, namely:
    - Facilitation tools
    - Research/ case studies
    - Text that explains the 'bigger picture', or broader context
    - Activities, both for individual and group application
    - Copy and handout pages

Icons used

You will find that several different 'icons" are used throughout the Chapter. These icons should assist you with navigation through the Chapter and orientation within the material. This is what these icons mean:

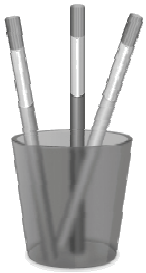
Facilitation tools

Processes that you can use in workshop situations, to support your work in the field.

Research /Case study

The results of research or case studies that illustrate the ideas presented.

Looking at research, facts and figures to help contextualise things.



Activity

This indicates an exercise that you should do - either on your own (individual) or in a group.

Copy and handouts

These sections can be copied and used as handouts to learners / participants

Agricultural Water Use for Homestead Gardening Systems: Resource Material for Facilitators

List of Chapters:

Chapter 1 Rural realities and homestead food gardening options

This chapter introduces you to the realities of life in rural areas. We also introduce different systems of farming, such as traditional farming, and high versus low external input systems, to see which approaches are likely to fit better within the realities of homestead farming.

Chapter 2 Facilitation of homestead farming

This chapter aims to introduce facilitation strategies for food security. An overview of facilitation processes and resources needed is given. The aim is to ensure that facilitators understand the cyclical nature of facilitation processes to include a detailed understanding of the indigenous situation that leads to action. This is followed by review and further action. A range of participatory techniques are presented as these are essential tools for facilitators.

Chapter 3 Living and eating well

The aim of this chapter is to introduce you to the concepts of food security and nutrition. We will look first at international food security concepts and then how these are applied in South Africa. We then explore food security in South Africa and focus on what the malnutrition issues in South Africa are.

Chapter 4 Diversifying production in homestead food gardening

This chapter aims to introduce you to some ideas for intensification and diversification of homestead food production. Throughout this chapter, you will be given practical ideas and examples of how you can implement diversification in your own garden or in the gardens of the farmers and gardeners you are working with.

Chapter 5 Garden and homestead water management for food gardening

This Chapter aims to open your eyes to the typical problems and challenges households have with watering their gardens – and to offer workable solutions for almost all circumstances. The following will be covered:

Typical problems with watering household gardens

Water sources

Rainwater harvesting

Balancing water needs and sources

Applying water sensibly

Irrigation technology

Chapter 6 Soil fertility management: Optimising the productivity of soil and water

This chapter aims to introduce the facilitator to ways of optimizing the productivity of soil and water available to homestead food gardeners. The chapter starts with looking at how to understand soil. This refers to various characteristics of different soil types and soil structures. The chapter then looks at soil fertility. When is soil fertile? This is followed by techniques to increase the fertility of soil, i.e. soil building techniques and bed design.

Chapter 7 Income opportunities from homestead food gardening

This chapter aims to introduce you to some of the basic concepts of market gardening. We will look at incentives and disincentives for marketing and appropriate strategies of marketing for various situations. We will consider local marketing, pricing and niche marketing in different areas. We will look at some of the principles of marketing by using case studies and examples. These include the principles of supply and demand, the principle of continuity and the principle of innovation.

Handouts Homestead Food Gardener's Resource Packs

The handouts, in English, isiZulu and Sesotho for household farmers/ learners are contained at the end of each chapter.

2. Project Process: Developing the Resource Material

2.1 Rationale for this work

The process of 'participatory development' of the material entailed two main aspects:

- Drawing widely on the **material and know-how of practitioners** in the fields of household food security, homestead farming, farmer training, rainwater harvesting and homestead water management, thereby achieving a collation of existing expertise and material; and
- **Field testing and refinement** of the collated material with food secure and insecure households in rural villages.

The material built particularly on existing FAO (Food and Agricultural Organisation of the United Nations) material, the LIRAPA (Livelihoods Improvement through Agriculture Programme, CARE, Lesotho) manual, (LIRAPA, 2008) and various South African resources, and has been integrated with the practical experience of practitioners and then field tested – in its integrated form – for local circumstances.

This resource material is aimed at facilitators and tutors of facilitators in household food security, homestead gardening and rainwater harvesting.

The following aspects of this resource material can be viewed as innovations or useful adaptations of existing practices:

- The research team developed the Nutrition Workshop as a facilitation tool. The Nutrition Workshop, measured effects of its use, and later refinements of the process are described in this material.
- The use of learning groups has been advocated and used with varying degrees of success in agricultural development in recent years. Through this research and by testing in practical situations, it has been possible to better define and refine the proper role for a 'Garden Learning Group'.
- In knowledge sharing with and among food gardeners, the successful use of household experimentation as a learning process is well worth mentioning, and discussed in more detail in the material.
- On the technical side, a significant range of technologies were selected and field-tested, based on their affordability for cash-strapped households and environmental building rather than degrading characteristics. Of particular interest is the practical integration of a range of rainwater harvesting techniques with organic plant production practices.

This resource material complements the Household Food Security Facilitators' short learning course at UNISA, and was an important source for the development of that material. This WRC material will again be used as resource material for further courses planned by UNISA's Human Ecology Department for extension staff and other graduates and individuals in a wide range of facilitation roles.

The University of KwaZulu-Natal has been a valuable partner in the development of this material and is presenting an elective on household water management as part of its CEPD (Certificate in Education: Participatory Development) programme.

The Department of Agriculture has requested the project team to develop specific training courses as part of the implementation of their Agricultural Education and Training programme, drawing on this resource material.

What became apparent in the course of the project is that appropriate sustainable production can only be achieved if households have access to assistance, guidance and support over an extended period. This can only be achieved if the responsible authorities have at their disposal facilitators capable of undertaking the task. The Resource Material has been designed to provide all concerned with facilitation with the necessary know-how and reference material that they will need to undertake the task.

2.2 Developing the Resource Material

The research process and the development of the resource materials can be summarised as follows.

The Water Research Commission research team:

- **Collated** existing material;
- **Consulted** other practitioners in three different ways, namely:
  - one-on-one consultations;
  - worked together in the field; and
  - held two well-attended stakeholder workshops;

The first stakeholder workshop produced a significant recommendation which was accepted by the WRC Reference Group, namely that the output of the research would be more useful and widely applicable if it was structured as a "Facilitators' Toolkit" or "Resource Pack" rather than "training material" for a single training course. The Resource Material is the result of that recommendation.

- Developed and implemented **draft learning material** with households in several villages, with Potshini (Bergville, KwaZulu-Natal) as the main site. In implementing the draft learning material, the research team:
  - worked through learning groups;
  - emphasised follow-up home visits;
  - emphasised learning processes that spanned at least one full growing season, but preferably longer;
  - used food gardener experimentation as a learning tool;
  - refined the facilitation and support processes; and
  - refined the technologies with households, based on their experiences with them;
- Wrote the required **deliverables** and built these into the Resource Material where relevant. Of special significance were the following **methodologies** used: (described in more detail in section #4 of this report: "Project Methodologies and Technologies"):
  - An alternative approach to training needs assessment;
  - Refinement of practices and technologies after participatory evaluation; and
  - Impact assessment on the effectiveness of the training methodology and implementation;
- Tried several approaches for **training and support of facilitators**, and built these lessons into the Chapters of the Resource Material where relevant;
- Refined and **finalised Resource Material**; and
- Wrote this **final report**.

3. Analysis

3.1 Analysis of research outputs

In this analysis of the research and the outputs delivered, we will reflect on whether the research objectives had been achieved.

But first, the main points regarding the research outputs can be summarised as follows:

1. It is the opinion of the research team that the Water Research Commission has shown vision and leadership with the formulation and the timing of this project. The importance of homestead food gardening has increased in real terms, and has also gained remarkable recognition in the four years since the commencement of this research project.
    - The unprecedented rise in global food and fuel prices in 2007/08 placed considerable further strain on poor and food insecure households, thereby creating a very direct incentive for households to produce more of their own food.
    - Many a politician urged households to engage in home food production (with statements from, amongst others, the Minister of Finance, Minister of Land and Agriculture, ANC Youth League, etc.), which resulted in more awareness of government's role in support for home food production.
2. The Resource Material for facilitators, which is the main product of this research, is earmarked for a range of immediate applications in response to the increase in demand for home food production as described above. This is detailed below in section #6 of this Final Report: "Proposed dissemination and implementation."
3. The research objectives have been achieved, and all deliverables have been submitted and accepted. More work could be done on entrepreneurial opportunities and marketing systems for homestead produce.
4. A summary of valuable lessons learnt is discussed in more detail later in sections 4.2.8 "Effectiveness and impact of training" and under the heading 4.3 "Refinement of Technologies."

3.2 Objectives achieved

The research team is of the opinion that, on the whole, the objectives of the research project have been met. The research deliverables and products were planned and designed to address the specific objectives. All the deliverables were submitted and approved by the Water Research Commission and the Reference Group, signifying that the objectives have been met. The table below reflects how deliverables address the objectives and states whether the objectives have been met.

Table 2: How deliverables address objectives and whether they are met.

Specific objectives		Objective achieved Yes/No	Deliverable (#n) which addressed the objective.
1.	Identify current indigenous crop/livestock production practices.	Yes	#5-Report on how to improve indigenous practices/systems, and on possible alternative practices/systems. #12-Report on the refinement of practices and technologies after participatory development.
2.	Describe water related practices and efficiency of water use.	Yes	
3.	Identify developmental constraints on opportunities from natural resources, infrastructure, human resources, HIV/AIDS, gender considerations, nutrition, institutions and culture, for both rural and urban households.	Yes	#2-Situation analysis report for South Africa.
4.	Specify alternative and improved agricultural practices for use in homestead gardens.	Yes	#5, #12 as above.
5.	Determine (i) economic incentives and (ii) entrepreneurial opportunities with specific reference to the youth.	(i)Yes (ii) Partially	#3-Situation report for the selected target communities. #7-Report on potential economic incentives and opportunities with specific reference to the youth and value adding opportunities and appropriate marketing systems. #8-Report on training needs of households/home gardeners in the selected areas in relation to most promising opportunities.
6.	Identify (i) value adding opportunities and (ii) appropriate marketing systems.	(i) Yes (ii) Partially	
7.	Determine training needs of household/home gardeners in relation to available knowledge.	Yes	
8.	Develop and test training material to address needs.	Yes	#13 – Progress report on development and testing of training material. #14– Report on the effectiveness of the training methodology and implementation. #18– Final training material.
9.	Implement the training programme and interactively refine materials with trainers and households.	Yes	
10.	Assess the impact of the project on food security of trained households.	Yes	#14– Report on the effectiveness of the training methodology and implementation.

4. Project Methodologies and Technologies

4.1 Defining the most promising methods and technologies

After much debate, the WRC research team reached agreement on how to define the "most promising" methods and technologies that would be included in the learning processes and training.

These methods and technologies share the common characteristic that they help people get **"more for their effort"** in a cash-scarce situation. These methods help people to **intensify** their production and ensure **year round production**, thus getting better crop yields and quality, while using low cost methods. More intensive production which maximises the use of locally available inputs, means improved **efficiency** in the use of resources.

We believe this definition provides a handy way of identifying further "promising technologies" in future. The most promising technologies identified included low external input sustainable agriculture (LEISA), deep trenching, run-on, home-based water storage, tower gardens, treadle pumps and drip kits.

Following practical implementation, experimentation and evaluation in the field, we were able to write the "Report on the refinement of practices and technologies after participatory evaluation". Section #4.2 analyses the learning processes and training methodologies and Section #4.3 analyses each of the technologies through the following questions:

1. A description and/or analysis of the method/technology (**what does it entail?**);
2. How the method differs from existing local practice (**how is it different?**);
3. How has the method been refined or adapted to improve it or make it more suitable (**how has it been refined?**)
4. The outcome of assessments with households on how their performance compared to existing local practice (**do people say it works better?**); and
5. Measurements (where possible) of the performance of these methods and technologies (**how much better/worse?**).

These questions provided a framework for systematic and relatively comparative analysis and reporting on the refinement of the technologies, and the effects of the refinement. It provided a framework within which both people's opinion on the usefulness of a technology, and available scientific work on the subject, could contribute to the analysis.

It also provides a mechanism for analysis and comparison of further technologies as they become available in future. For instance, in field visits subsequent to the completion of this report, we have found it easier to assess the suitability of the newly developed 'pipe pump' and the diaphragm pump, and a home-made innovation for water storage-and-irrigation which we discovered in one of the sites.

The method of analysis also helped highlight for us where we may not have been clear enough in our own thinking on certain aspects. For instance, it has been somewhat difficult to explain the run-on concept to households, and working through the theory and practice of it amongst ourselves, we all gained new insights and felt we would be better able to explain it to others in future.

It is a well-known phenomenon that tension almost invariably arises in multidisciplinary teams, typically because of the difference in points of departure and thinking processes employed by technically and socially oriented people. We feel that the development of this module has benefited greatly from constructive interdisciplinary analysis and interaction among members

of our team. Possibly, the way in which the questions lent equal weight to technical and social matters, helped the interdisciplinary process of analysis.

Section #4.3 below provides a rich resource for newcomers to the field, to get behind the reasoning and value of low cost, reliable, high-yielding methodologies.

4.2 Training Methodologies

4.2.1 Development and Testing of the Training Material

The research team used the following two questions in deciding the basic content of the learning material contained in the resource pack:

1. For Households' learning content: 'What is the essential knowledge a household needs to grow food at home?'
2. For Facilitators' learning content: 'What would a facilitator need to know and how can he / she implement ideas and teach or facilitate this content to food gardeners?"

This approach provided sufficient structure and logic to plan the layout and content of the learning modules for facilitators, as well as the handouts for food gardeners, the latter which is available in several languages.

The feedback received on the draft material, both during the second stakeholder workshop and independently from other individuals, has been positive. There is great interest in the utilisation of the material by several public and private training institutions (See Section #4.5).

4.2.2 Approach to training needs assessment

Conventional training needs assessments attempt to produce a list of 'training needs' for a geographical area. This inevitably results in a 'shopping list' of training needs which may well be generally applicable, but almost certainly would fail to fit the specific training needs of any particular individual within that area. This results in ineffective spending on 'training needs assessments', and subsequently less-than-ideal content of learning processes.

In contrast, the proposed approach to training needs assessment for homestead food gardening starts with the generic (which is broad enough to cover this topic in almost any context), followed by an approximate conceptualisation (for instance, according to the local natural resource base). Then eventually, specific training needs are defined only once the learning group has been formed, and prior learning of the participating households had been established.

4.2.3 Stakeholder consultation

In addition to one-on-one discussions with other practitioners and various stakeholders throughout the research period, two stakeholder workshops were held.

The first stakeholder workshop was well attended by a good cross-section of practitioners, researchers and officials. It was held in Bergville in March 2007, and included a field visit to Potshini village, where stakeholders could interact with households that had been part of the research process, and could witness the results of the facilitation and learning processes. For the research team, the main outcome of the first stakeholder workshop was a strong recommendation by stakeholders that the research output should NOT be a single 'training course' or 'training material'.

Stakeholders argued that due to the range of situations found in practice, resource material or a "facilitators' resource packs" would be of greater benefit. This would enable practitioners to select material from the resource material and tailor make their own learning processes in response to every new situation they encountered. The Reference Group and the Water Research Commission accepted this change, with the following consequence:

- The material in Chapters 1 to 7 was structured as Resource Material, rather than a training course.
- The material was still structured along Outcomes Based Education principles, using interactive layout, examples, case studies, activities for facilitators and self-study.
- The material also contains structured facilitation tools which the facilitator can use for interactions with target households in field situations.

The second stakeholder workshop, held in March 2008 was not a large affair. Instead, the team aimed at inviting skilled and knowledgeable individuals representing a cross-section of fieldworkers, training and development practitioners and academics, who all have an interest in the interface between household food security and homestead water management.

The day was most valuable, with meaningful debate and concrete suggestions to the WRC team towards the refinement of the material, its possible application through various institutions and processes, and mechanisms for the future training and establishment of Household Food Security facilitators.

Some of the key suggestions were to strengthen the Facilitators' Resource Material as much as possible with references to scientific work, where these were available; and to seek opportunities to introduce and test the material in further test sites in follow-up work to the current WRC project.

4.2.4 Most promising production methods and technologies

The team found that the most promising production methods and technologies relate in the first instance to an understanding of an appropriate starting point for poor households, and in the second place to those production and water management methods which respond to this appropriate starting point, namely:

- First and foremost the role of homestead agriculture in offering the opportunity to poor households is to attain good nutrition through intensive home food production. Therefore, the **"first-round" training** developed in this project focused on addressing the most pressing dietary shortfalls in the household. Many households, who consider themselves food secure, may still benefit from the nutritional insights gained from "first-round" training, which helps them towards a diet which is not only **adequate in quantity**, but also **balanced nutritionally.**
- **"Further rounds" of training** are then derived in response to specific needs that households identify from implementing the knowledge they had gained from the "first round" training, or to pursue further opportunities they may identify. Economic opportunities often become relevant once households are "free from worry over where the next meal will come from," – which is indeed a powerful definition of food security. "Further round" training needs are often identified outside the agricultural field (e.g. English literacy, computer training).

There is much confirmation for this viewpoint in ancient and current literature, experience and even statistics, and it echoes the International Peasant Movement's push for "food first" – at household, village, and national levels.

This understanding of the "most promising opportunities" for homestead agriculture, based on a starting point of "food first", followed by "economic opportunities", informs the usefulness of specific production and water management methods as follows:

- Water management and food production methods for food security must respond to a food insecure household's reality of cash-scarcity and low resilience to shocks like droughts, illness and any events that demand cash (weddings, funerals, school fees) or additional labour (repairing flood damage, etc). Therefore, the research team believes in the relevance of low external input sustainable approaches (LEISA) for home food production.
- LEISA remains relevant in the establishment of fledgling economic opportunities, helping to avoid debt risks before the household has established a solid "fall-back position" in terms of their food security needs. Higher cost methods and equipment could become more relevant during the "business expansion" phases.

Preference is given to equipment which places no on-going cash demands on the household and other assistance which requires minimal on-going external inputs that could create household dependency. The "most promising" methods and technologies share the common characteristic that they help people get **"more for their effort"** in a cash-scarce situation. These methods help people to **intensify** their production, thus getting better crop yields and quality, while using low cost methods. This means improved **efficiency** in the use of resources. Examples of intensification techniques:

- **LEISA**: With low external input production methods people can get good yields of high quality, e.g. by using organic waste for plant nutrition, thus avoiding the need to buy fertilizer;
- **Deep trenching**: With deep trenching (and other 'permanent bed' systems), nutrients and water are concentrated in the plant root zone;
- **Run-on**: By making ditches and laying out the garden with rainfall run-off in mind, the gardener can channel rainwater to the plants during rainstorms. Directing rainwater from external surfaces like roads, roofs and paved areas towards the garden is called 'run-on' and increases the total annual water flows to the garden;
- **Water storage**: Underground water storage tanks enable the gardener to collect and store rainwater running off vast surfaces around the house, yard and roads for use during dry periods;
- **Tower gardens**: By building tower gardens (especially next to the kitchen), the household creates a convenient permanent vegetable bed which uses grey water and continues to yield for a long time. The uptake of tower gardens is best where they can be made from local materials; and
- **Treadle pumps**: Where households have treadle pumps, they have a non-cash dependent way of pumping water for food gardening without being dependent on external power sources like petrol, diesel or electricity.
- **Drip kits**: These are efficient, small scale irrigation systems that can save water and time.

"First-round" training in the application of these methods and technologies aims to cover the essential aspects people "need to know" to experience successful production. An overload of information is avoided. As will be seen, the actual content may differ from group to group, depending on their prior experience, priorities, stated needs and the season the training is taking place in. Flexibility in the learning agenda (or training schedule) is important to be able to provide input timeously on issues as they arise, e.g. dealing with a fruit fly problem quickly. Some content is only meaningful to cover if the problem occurs at all, e.g. bacterial wilt on tomatoes.

"Further round" training can go into more depth on specific aspects, and build on concepts covered in the first round. As an example, the "first round" may cover one type of brew as a generic pest remedy, while "further rounds" may get more specific about specific kinds of pests and remedies that target them more exclusively. Learners can thus keep building their skill and knowledge within this integrated system.

4.2.5 Determining training needs

Conventional Training Needs Assessments

Training needs for rural populations are generally determined using a combination of the following formal and mostly highly structured approaches:

- A situation analysis for the region, area, ward or village; and/or
- Surveys within the villages that include questions on income and expenditure, infrastructure, development, levels of education, literacy, general educational needs, skills development needs and present skills; and/or
- Community skills audits and asset based assessments.

Once the information is compiled and summarised, a generalised assessment of training needs is derived. Sometimes it is attempted to narrow the training needs down per target group. Then usually these generalised needs are compared to available training to decide on a training programme.

Some limitations of conventional assessments

- Training needs mentioned by community members are invariably expressed in **general and even generic** terms, providing training planners with little specific understanding of areas of content required.

  For example, people would typically say they need training in "crop production", "poultry", or "grazing management", without specifying what they may need to know about it. For instance, people may ask for training in 'grazing management', while actually conjuring images of fat cows, and not realizing that 'grazing management' may entail the complete rearrangement of the management of their natural resources.

  To further illustrate this phenomenon, examples are given in Table 3, below of the overlap in training needs expressed in various training needs assessments, conducted recently by various organisations in different villages.

Table 3: Overlap in training needs expressed in various training needs assessments

Training needs assessments for various communities: Agricultural Focus						
KamaFurrow EC[1]	**Umzimvubu EC[1]**	**Wolf River EC[1]**	**Tamboekiesvlei EC[1]**	**ACAT[2] KZN,EC**	**SRCD, KZN[3]**	**Ethekwini Municipality Rural Agricltture projects KZN[4]**
Crop production (maize, beans, potatoes),7/7	Crop production, 4/5	Crop production, 3/6, 3/3, 5/5	crop production and rotation, 2/20	crop production	general agricultural skills such as animal and crop production	**Ximba; Ubhobhonono;** Application of fertilizer, pesticieds, general crop management
Vegetable production, 4/5	vegetable production (succession, rotation, pest and disease), 3/5	Vegetable production, 3/6	vegetable production, 2/20	Values; a scientific approach, positive attitude toward agriculture, love of plants and animals, managerial skills		**Mkhizwana, Lindelani project;** planting times, production of seedlings, planting vegetables, applying chemicals
		Soil fertility including alternatives to fertilizers, 2/5		Soil		**Adams Mission**; Adding organic matter to soil, local marketing, irrigaiton techniques
dairy, 2/7	dairy, 3/5	Pest and disease management, 3/6, 1/3	Pest and disease control, 4/20	climate		
livestock management, 3/5	New crops; barley pastures, sugar cane, 2/5	Cattle management, 3/5	Disease management in cattle, 6/20	animal production		
Poultry, eggs, 2/5	Poultry,3/5	Marketing, 1/6	Marketing and pricing, 5/20		market management	**Ntshongweni, Zakhiweni garden;** poultry, sewing, marketing
Financial Management, 1/5	Financial management, 3/5		grazing management, 2/20	farm management	Institutional and leadership development	
	Fruit trees and processing, 3/5		bees, 3/20	farming technology	Sustainable development; a range of production and job skills; literacy and numeracy	
	Tourism, 5/5		Cooking, 1/20	traditional relevance.	urban contact and development brokerage	

Notes on Table 3:

- *[1]Eastern Cape Resource Poor Farmers Irrigation Scheme Feasibility Study. (7 Schemes). DWAF, November 2004. Arcus-Gibb(Pty)Ltd. East London; information gathered through household questionnaires mainly, but also focus group discussions*
- *[2]A Curriculum Design for Adult Education Programmes according to identified needs and wants in KwaZulu-Natal, Eastern Cape and Swaziland. Curmo-designs cc, 1995, for ACAT (African Co-operative Trust) Information gathered through household questionnaires only*
- *[3] SRCD Certificate Research and Development project. Phase 1. Evaluation and Audit, June 1999. Centre for Adult education, University of KwaZulu-Natal. Information gathered through interviews and discussions with role players – indirect*
- *[4]Ethekwini (Durban) Scoping for 7 Agricultural Projects, Rural Area based Management Programme, 2006. Lima Rural Development Foundation, Pietermaritzburg. Information gathered through group interviews with members, focused on immediate needs, rather than general training.*

- Training needs mentioned by community members generally focus on **immediate problems** that they are encountering. These change over time.
- No two individuals usually mention the **same combination** of training needs.
- Training needs mentioned for **facilitators or extension officers** are generally extensive, broad ranging and in a way "**all encompassing**"; trying to ensure that these facilitators can be "all things to all people at all times".
- Another characteristic of conventional methods to determine the actual content of the training course or intervention is that these are usually **defined by the service providers** according to their own knowledge, biases and assumptions, abilities and resources, and may or may not be appropriate to learners, even if the level of education is appropriate.
- Further, it is often assumed that for any particular theme or content area, there is already an **existing body of authoritative knowledge** from which to draw. This is often an erroneous assumption.

Participatory ways to find out what people's learning needs are

Early in the project, the decision was taken not to perform structured formal training/learning and needs analyses at all the project sites. This decision is linked to the original title and concept of this research project, namely "***participatory development of training material***…" Formal training needs assessments tend to be top-down and questionnaire-based and easily end up being a 'shopping-list' of training needs, with limited practical value as discussed in the paragraphs above.

Instead, the team put together a **set of processes** (based on a typical cyclical action research approach, See Figure 1), which enables a facilitator **to determine and work with the specific training and learning needs in any particular garden learning group**.

The research team itself also used consultative and participatory processes to collate and verify the content of the WRC Resource Material for Facilitators.

- The team used outputs from previous phases and existing experience (See Table 4), to put together and verify preliminary training content areas for a training programme for intensive homestead production.

- Available training in these content areas was collated from various sources, and from this was identified the "first-round" content (what people need to know to first experience successful production).

- This was then tested for relevance and practical application in Potshini, one of the selected areas. Examples from the work with the Potshini Learning Groups are given throughout this document.

- *Note: This method also creates awareness among learning group members of each other's know-how, which fosters mutual support and sharing of information. This engenders a culture of continued learning and sharing beyond the facilitator's presence.*

An alternative approach to working with training needs

The recommended processes for working with training needs for homestead agriculture have three components which move from the generic to the specific, namely to:

1. Use the WRC Resource Material for Facilitators as a tested and fairly comprehensive source of learning material for homestead agriculture training;
2. Limit the scope of a local situation assessment to "need to know" aspects; and
3. Use iterative participatory methods to refine and agree a "learning and action agenda" with household learning groups.

These recommended processes are discussed in more detail in the table below:

Table 4: Recommended process to work with training needs

Recommended processes to work with training needs in homestead agriculture	
Generic: **LEARNING CONTENT AREAS**	The WRC Resource Material for Facilitators contains a generic set of learning content areas applicable to homestead agriculture. This is effectively what is "on offer", from which an applicable combination of material can be extracted for any particular set of needs. The WRC Research team collated this Resource Material through wide consultation and in-field testing. Facilitators can further augment this from other sources should peculiar needs arise in a particular learning group.
Situation analysis: **REVIEW BROAD CONTEXT**	It is NOT necessary to perform a detailed training needs assessment at the village or regional level
	Establish whether there is an **expressed need** for household gardening, and specifically for training in household gardening
	Look at **physical factors** to see whether and which of the recommended soil and water management practices would work in the local context. Walk around the area and use external data sources to find out more about the conditions for gardening in the area.
	Find out what **related processes** have already taken place in the area. Are people gardening? How well are they doing? Have they had training before? What types of learning processes are preferred? Who is the specific **target group** for further training interventions?
	Establish whether there are any **socio-political issues** which may help or hamper the implementation of a training programme in homestead agriculture
Specific training needs of household learning group: **"LEARNING AND ACTION AGENDA"**	Confirm that the members of the household learning group are clear about what they want and can expect from participation in the homestead agriculture training programme**; their expressed training need/agenda**
	Facilitate a group process through which members can express their know-how in gardening. This provides a way to **recognise prior learning (RPL)** in the group.
	Facilitate a "**nutrition gap analysis**" with the learning group. The households' shortfalls in the "Go, Grow and Glow" food categories are then used to plan their garden production and their "learning and action agenda" for the current season.
	Pick the actual training content from the WRC Resource Material for Facilitators to suit their **learning agenda**
	Incorporate own **experimentation** throughout the learning plan
	Throughout **the training programme**, ask households about whether any specific problems are arising and where appropriate and possible, adapt the learning agenda to cover such issues.

Consultative processes used to develop the WRC Resource Material for Facilitators

A more cyclic versus the traditionally more linear approach was also used by the WRC research team to develop the training content areas reflected in the WRC Resource Material for Facilitators. This corresponds to the action research cycles discussed earlier and depicted in Figure 1 and Table 5, below.

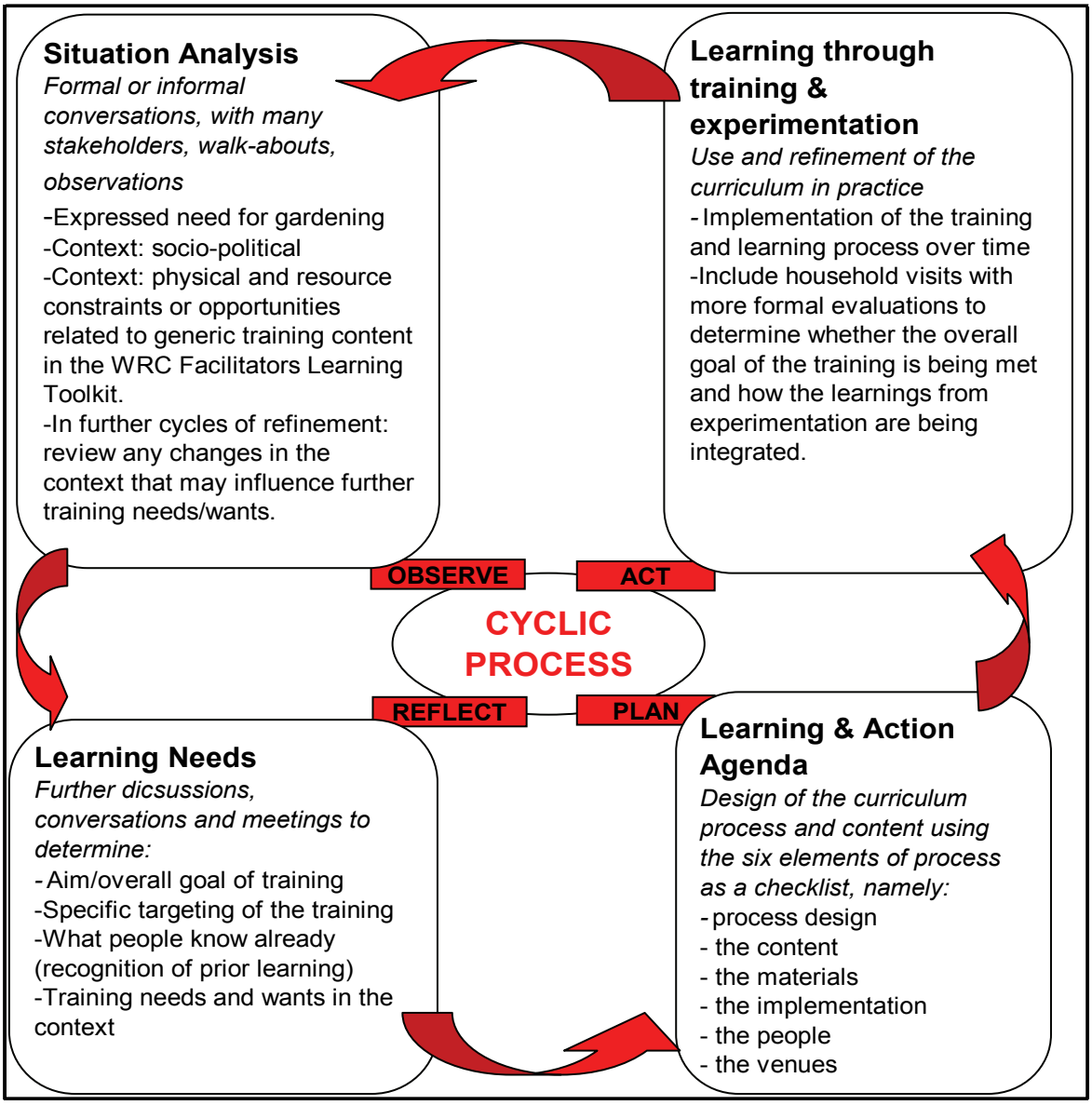


Figure 1: Cyclic process for learning in Garden Learning Groups

Thus it can be said that, in line with the WRC research team's recommendation to follow more consultative and cyclic processes, a considerable departure was made from the more standardised approach in developing the learning content areas, as follows:

1. Targeted communities and groups were asked about their training needs as part of an initial situational analysis and no further surveys were conducted.
2. Content areas were pre-designed by the research team, drawing on the existing body of knowledge, but also taking into account:
    a. Our own experience and that of other stakeholders in these content areas; and
    b. Adult education principles and experiential and group learning processes.

3. Training processes using these content areas or baskets of options within content areas were then designed and facilitated both with household learning groups and at facilitator level.
4. From these processes it was possible to further refine training needs, content and training processes that work in the particular contexts.
5. *Nutrition gap analysis with participating households:* The team first round training focuses on ***food insecurity*** which is seen as a deviation from a balanced and sufficient diet. ***Food security*** can be improved by identifying and addressing the specific nutritional gaps on a household-by-household basis.

   A practical methodology was developed to enable households in a learning group to identify their food gaps and plan what to plant accordingly. Training content is then extracted from the WRC Resource Material for Facilitators to support these implied household training needs.

6. *Prior learning in food gardening:* As good facilitation practice, a method is recommended to assess and work with prior learning in household learning groups. This provides a way to give recognition of prior learning (RPL) in a specific learning group, and shape their unique training content accordingly.

The WRC Resource Material is thus a standardised process within which particular bits of content can be fed into, rather than a course consisting of designed content per se.

4.2.6 Training Content and processes at household level

Introduction

Content for household training was based on a number of processes and documents in the field of water management and food security, as well as the actual implementation, analysis and assessment of new technologies by the food gardeners and the WRC research team.

- The LIRAPA manual: "How to get the best from your garden", which was designed for householders in Lesotho in a participatory manner, and in partnership with CARE International and the Livelihoods Recovery through Agriculture Programme (2005); and
- An important departure point is the inclusion and focus on family nutrition within the learning process.

Homestead **soil and water technologies** introduced as part of the learning/training process, include the following:

- Deep trenching (to concentrate water and nutrients in the plant root zone);
- Run-on ditches for in-garden rainwater harvesting;
- Tower gardens (labour saving, using grey water);
- Drip-kits (time saving and water management);
- Underground rainwater storage tanks;
- Measurement of soil water for decision making in irrigation; and
- Diversified, low external input agricultural practices.

Cyclic, interactive learning processes: Look, learn, do

In the report on training needs assessment (Deliverable #8; summarised in Section #4.2.5 above), the research team argued that cyclic, interactive learning processes were most appropriate and effective in the homestead food gardening context. Adults learn best from each other when there is an immediate need. And then, learning is most effective in cyclic, practical processes.

Table 5: Cyclic, interactive learning processes

PROCESS	*ACTIVITIES*	*METHODS/TOOLS*
Assessment	**OBSERVATION**	Layout drawings Focus group discussions Sustainable Livelihoods Participatory Rural Appraisal
Analysis	**LEARNING**	Adult Education Farmer-to-Farmer Learning groups *In situ* analysis of gardens
Experimentation - for problem solving	**ACTION**	Farmer experimentation Demonstrations
Empowerment -for own choices to change	**PLANNING**	Nutrition workshop

Using a greater variety of methods/tools, as shown in the table above, maximised opportunities for interactive, practical learning. In each cycle, learning is reinforced and deepened.

The Household learning process

The learning programme outline

The Potshini Learning Groups are again provided as a concrete example.

- The **learning programme outline** was designed to take place over a period of nine months, in the form of one-day workshops (approximately once a month) for the two learning groups. Each workshop was held at a different member's homestead.

> LEARNING PROGRAMME OUTLINE
>
> One-day workshops over a six-month period.
>
> Outline of workshops
> (workshop dates in brackets)
>
> 1. Family nutrition *(22/06/2006)*
> 2. Seedling production *(14/07/2006)*
> 3. Fertility *(28/07/2006)*
> 4. Demonstration of fruit tree planting + delivery of trees *(25/08/2006)*
> 5. Pest and disease control, including windbreaks *(07/09/2006)*
> 6. Garden layout; run-on and bed design (bed positioning and bed preparation). Reflection on organic vs. inorganic and till vs. no-till options *(11/10/2006)*
> 7. Irrigation, including a demonstration of a treadle pump (26/10/2006)
> 8. Processing, value adding and seed saving + Celebration!

- A description is given in Table 4 of how **family nutrition** was used **as the starting point** or "anchor" for the overall learning process.
- Learning group members were also encouraged and assisted throughout to do their **own experimentation**. (See box below).This engenders creativity and a culture of learning as a buffer against changing circumstances. While this has always been important to households fighting poverty, it becomes even more essential in a world affected by climate change.

The CARE International LIRAPA manual: "How to get the best from your garden" was used as the basis for learning sessions. Specific sections were translated into isiZulu for this purpose.

The WRC team also assisted members of the learning groups to purchase cheap fruit trees, which were ordered in bulk from the commercial nurseries in the Western Cape. Types of fruit purchased included: peaches, plums, apricots, pears, grapes, oranges, naartjies and lemons.

HOUSEHOLD'S OWN EXPERIMENTATION

A process for conducting individual household experiments was introduced early on in the process, to encourage creativity and problem-solving. Members of the learning groups each undertook specific experiments to conduct at their homes. At every workshop, participants reported back on their progress. The community facilitator (Mr T Madondo) conducted regular visits to members' homes to discuss their progress with them. He is an experimenter himself, as well as an enthusiastic and knowledgeable farmer.

To further strengthen the household experimentation process, a post graduate research student from SSI worked with six volunteer households from the learning groups at their homesteads. She helped them to consolidate their experiments and together they monitored in depth the changes and impacts of various technologies and innovations tried by these volunteer households.

Scientific measurements of soil and water management support the household's own observations. They keep records to track changes in their production as well as the social impacts in their homestead. This makes it possible to track the longer term implications of changes made by the households and will provide working examples of intensive homestead farming systems (with improved diversity, fertility and water management processes) for the larger community.

4.2.7 Recommended training methodology and learning process

Introduction

The recommended processes for a more ongoing and iterative process of training that includes ongoing needs assessment was implemented in Potshini. Evaluative comment has been obtained from members of the learning group and other stakeholders involved. Generally, appreciation was expressed for the homestead-based practicality of the process.

The impact of the process is clearly visible through an increase in the presence of homestead food gardens from around 7% in 2004 (prior to any of these interventions and training), to around 70% after the learning group training process.

Impact of the use of the material

The report on the effectiveness of the training methodology and implementation (Deliverable #14, summarised in Section #4.2.8 below), seeks to answer two main questions:

1. To what extent have people taken up and implemented the new ideas brought to them through the training?
2. How has the process used to introduce people to the new ideas affected the uptake of the new ideas?

From surveys undertaken by the WRC team and others, it was clear that both the uptake and continued use of the technologies at Potshini surpassed expectations.

The following table shows extracts from the results of the Potshini Learning Group process.

Table 6: Potshini Learning Group Process – 2006

POTSHINI: LEARNING GROUP PROCESS – 2006				
	Nutrition workshop **(22 June 2006)**	**Seedling production** workshop **(14 July 2006)**	**Fertility** workshop **(28 July 2006)**	**Pest and Disease** workshop **(7 Sept 2006)**
SUBWARD **Name of Person**	1.Supplied the following **types of seeds;** and 2.*Progress by 14 Aug 2007*	Seeds supplied to sow **row crops**: **carrot (C), beetroot (B)**	Seeds supplied to sow **legumes** (as requested from nutrition workshop): **peanuts (P) and Jugo beans (J)**	*1.Progress by 7 Sept 2007;* 2.**Remedies** supplied: **Soap & Chillie remedy (SC), Rosemary (R), Lemon verbena (L) and Rose geranium (Rg) cuttings, Napier Fodder (N), Garlic seed (G)**
CELOKUHLE – subward				
Hlatshwayo, Bashongani			**P,J**	*Not yet planted* **R, Rg, L, Napier**
Hlongwane, Cebisile	**Fennel, parsley, Masihlalisane**			
Hlongwane, Phindile		**B ,C**		**Rg, R, Garlic**
Khumalo, Mtshadu	**Fennel, Tree tomato, granadilla**			*Fennel growing; unsure what to do with it* *Tree tomatoes germinated Has made trench beds as his soil is bad and shallow. They are working well* **R, L, Napier**
Mabaso, Samuel	**Parsley, granadilla, tree tomato** *Planted and germinated*	**B,C**		
Mabaso, John	**Masihlalisane, parsley** *Planted and germinated*	**B,C**	**P,J**	**R, Rg, Napier**
Mbhele, Phumzile	**Fennel, Granadilla**			*Birds have eaten most of seedlings. Now also big white ants, not sure what to do* **R, Rg, L**
Mbhele, Shoti	**Spring onion and Mhlonyane**			
Mdakane, Khonzaphi		**B,C**	**P,J**	**SC, R, garlic**
Mduba, Khanyisile				**SC, R, garlic**
Mduba, Lingeni	**Masihlalisane, shaladi, tree tomato** *Planted on 05/07; not germinated yet*	**B,C**	**P,J**	
Mduba, Wombe	**Fennel, Shaladi, Tree tomato**	**B,C**		

Ngcobo, S'bongile	**Spring onion**	**B,C**		
Nzimande, Fikile	**Shaladi (garlic chives)**			
Shabalala, Khethiwe	**Shaladi (garlic chives), spring onions**	**B,C**		*Planted spring onions, carrots, spinach and garlic chives – all growing* **SC, R, garlic**
Ncamsile Mduba		**B,C**	**P,J**	*Not planted* **SC, R, Rg**
IMPUMELELO – subward				
Bhengu, Jabu	**Spring onion, Masihlalisane** *Planted 26/06; SO-not germinated, M-growing*	**B,C**		**SC, R, Rg, L, Napier**
Bhengu, S'thabiso Bhengu, Gogo	**Granadilla, masihlalisane**		**P,J**	*Peanut germinated in garden*
Dladla, Gcini	**Parsley**		**P,J**	**R,Rg, L**
Dladla, S'bongile	**Parsley, Masihlalisane** Planted *25/06, and now germinated*	**B,C**	**P,J**	*Peanut germinated in garden* **R, Rg, L, Napier**
Dladla, Thobile	**Shaladi (garlic chives)** *Planted, not germinated*	**B,C**	**P,J**	*Peanut germinated* **R, Rg, L**
Dladla, Thabani Dladla, S'bongile	**Spring onion, parsley, masihlalisane** *Planted and germinated, mice eating*	**B,C**	**P,J**	*Problems with moles and birds, made little wig-wams for birds, nothing for moles. Grubs in manure; do they eat seedlings, planted the peanuts. Used liquid manure – now only use this, as it is good. Tree tomatoes came up, but destroyed by rats.*
Hlatswayo, Wimile	**Masihlalisane**			*R60 for fruit trees*
Hlongwane, Eric	**Spring onion, Tree tomato** *Planted 03/07, not germinated yet*			
Hlongwane, Nokuthula	**Masihlalisane** *Planted on 25/06 and germinated*	**B,C**		*Started experiment of digging in manure with mulch, planted seedlings R60 for fruit trees* **CS, R, Napier?**
Mabaso, Hlengiwe	**Spring onion** *Planted, not germinated; mice*	**B,C**	**P,J**	**R,L, Napier**

Mabaso, Masiza	**Tree tomato**			*Tree tomato germinated in a trench bed he made (2mx50cm). He put in grass and filled to the top with soil* **R, Napier**
Mabaso, Nthombifuthi	**Tree tomato** *Planted, not germinated yet*		**P,J**	*Not yet germinated*
Madondo, Thabani		**B,C**		*Comparing how to plant carrots:* *his way and new way with deep beds*

The process of analysis of the impact of training had a useful side-effect for the research team. It sharpened our minds on the challenge of 'training the trainers' especially for those for whom this would be a relatively new and unknown field of practice. Again, rushed, quick-fix approaches to the preparation of facilitators yielded disappointing results.

In contrast, the material was used very effectively (with some telephonic and emailed input from the WRC team members) by an experienced facilitator with appropriate agricultural background.

This led us to identify two complementary strategies for the development of skilled Home Food Security Facilitators, namely:

1. Longer term, structured academic and practical education of Home Food Security Facilitators; and
2. Transfer of the material and concepts to skilled agricultural facilitators, who could in turn provide a 'learning-by-doing' opportunity for others by training and mentoring new facilitators in real-life implementation situations.

4.2.8 Effectiveness and impact of the learning approach

Primary points of departure in this "Intensive Gardening Introduction Process" (our methodology) as compared to standard training processes include the following:

1. Training is for individuals, but occurs in a learning group
2. Each training programme is tailored for a specific area and group of people. Therefore, a process of recognition of prior learning is crucial, as is a quick assessment of training expectations or learning needs.
3. Training is done over a period of time (preferably at least throughout one or more seasons), and in the community itself.
4. Each session is 3-5 hours long and the sessions are spaced from 2-6 weeks apart to allow for implementation of the ideas at participants' homesteads.
5. Each session is started with a review of what participants have tried at home (their experiments) and how this is going.
6. Gardens/ homesteads of participants are used for practical demonstrations and for holding the training events. Venues are rotated; meaning that each workshop happens in a different homestead.
7. Materials are provided for experimentation with new ideas. New ideas are not introduced if the facilitators cannot provide the inputs with which to start. For example; do not talk about comfrey, if you cannot provide samples for people; or treadle pumps if you would be unable to at least show people what they look like.
8. Handouts are provided in the local language and must include many pictures, line

drawings and photographs.

9. Ideas and technologies introduced do not require external inputs and/or financial outlays. Especially, technologies that require ongoing financial outlays (like petrol, electricity, maintenance) are avoided.
10. Ongoing support by community level facilitators is advisable.

This "Intensive Gardening Introduction Process" has now been used in at least eight locations, but with varying degrees of input and follow-up. Some of these were in WRC selected areas, while others were processes initiated by other organisations, but which had contributed to the insights gained and reported here by the WRC team. This document outlines the training process and impact in **Potshini**, KZN, where it was first implemented, and provides in-depth assessments of the training content, the technologies introduced, the process used, outcomes and potential refinements.

This report goes on to compare the training process (See Section 4.2.9 below) used in Potshini, to that used in another of the WRC sites, namely **Phuthaditjaba**. Comments are provided on the differences between the two processes and the perceived differences in impact of the training. A further example, the **World Vision** learning process, is used to illustrate how this training process fits into the learning and development needs of the poverty stricken rural sectors of our society.

Effectiveness of introduction of specific learning themes in Potshini

Nutrition

A session on nutrition was held at the beginning of the process to focus participants on their nutritional needs and how their gardening could augment and diversify their diets. We wanted an indication from participants in Potshini how much of the discussion around nutrition they had brought into their thinking and gardening practice. They were asked what they could remember about nutrition. As can be seen in the table below, the outcome is somewhat disappointing.

Table 7: Significant innovations (extract) – Nutrition

Innovation	Yes	No	Tried but don't use any longer or did not try	Adaptations made/ comments
Remembered the nutrition training and includes it in gardening	3	16	Not at training --------4 Did not remember --11	Plant different things to get a range of vitamins ----------2 We should eat more greens, beans and meat ----------1

Only 16% of respondents in Potshini remembered anything about the nutrition input whereas 84% of participants had completely forgotten. However, those that did remember were indeed including these ideas in what they would grow in their gardens.

The nutrition workshop forms the beginning of the learning process and serves to focus people on their food and eating habits and the need to diversify and produce a continuous supply of fresh vegetables and fruit to improve the health of the various members of the family. During the workshop, participants put together a list of crops that could address their own household's dietary shortfalls. Where possible, seed or seedlings for these crops are then

provided, meaning that participants get at least one round of growing crops in response to their own diet requirements.

However, if participants do not remember why they chose those crops, they would not be in a position to use this information to plan future cropping. It is evident that this learning processes would need to be refined, as a more intensive and repetitive process would be required on nutrition to embed this understanding into people's practice.

People's eating habits are very entrenched and their sense of identity, belonging and comfort is tied into the food they eat. Rural people in particular become accustomed to a narrow range of very familiar foods and tastes and are not very experimental in terms of trying new foods or preparing food in different ways. "New" foods are seen as items that can be bought from shops, rather than crops grown. There is thus a high level of inertia to change.

In summary, the following can be said about inclusion of nutrition in the learning process:

- The inclusion of nutrition in the learning process is a major step forward, for several reasons. Participants' analysis of their current diets caused a lot of energy and animation during the workshop, and resulted in at least a first-round selection of crops to address their specific deficiencies.
- Further, this process provided facilitators with a good understanding of the dietary situation of participants in the specific learning group, which is important for current and future workshop planning, and provides a basis for comparison with other learning groups.
- It has helped clarify the questions remaining about the purpose of a focus on nutrition in the learning process, and therefore the nature of the learning to plan for, for instance:
    - Should the facilitator introduce nutrition primarily as a short-term incentive to jumpstart people into gardening?
    - Should this be followed up with different processes to entrench a new habit of crop planning aimed at family health, or is this over-ambitious in this context?

In Potshini, although few people could remember the nutrition input they had received nine months earlier at the start of the learning process, most had continued gardening! The survey also showed that approximately 70% had started gardening as a result of the learning workshops.

It is uncertain what the role of other incentives had been in the Potshini context, for instance, the possibility of receiving a DWAF subsidy for a RWH tank; the sustained outside interest created through the SSI and UKZN activities; or the combined effect of all these? Possibly, the nutrition focus was important in getting people going, while other factors helped to keep them going.

Refinement of the nutrition learning process

The surveys conducted in Potshini (2007) showed an interesting result: Although people were eating better and had more ready access to a variety of fresh food through their gardening efforts, much of the nutrition knowledge imparted at the original Nutrition Workshop had actually already been forgotten. In general, people were not necessarily selecting the crops they were planting with specific nutrition gaps in mind.

We concluded that:

The Nutrition Workshop was very effective in mobilising people into production by 'creating discomfort' in people's minds about the deficiencies in their families' diets; but the once-off workshop was not enough to create a lasting change in how people were thinking about healthy diets.

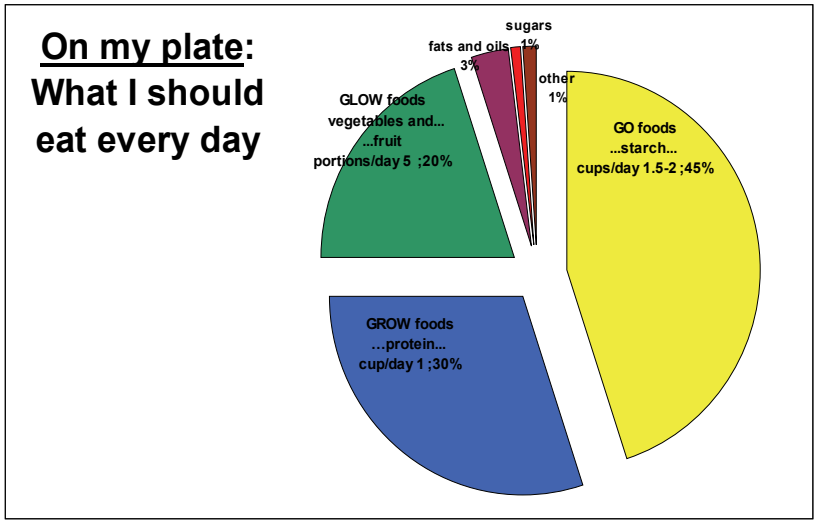
On the production side, we MOBILISED and then go several steps further to establish new habits… on the nutrition side we MOBILISED, but then did not take further steps to establish new eating patterns.

So for the next round of workshops in Potshini we planned to change the learning programme to include something on food in every workshop, for instance:

- Introduce herbs and bring seedlings to plant
- Cook and taste alternative legumes, e.g. dahl, lentils, soya beans, etc.
- Drying of vegetables – demonstrate drying of potatoes, sweet potatoes, brinjals and green pepper.
- Cook and taste greens with new herbs added (parsley, spring onion, coriander, thyme)
- Drying fruit
- Making a preserve and or making jam
- Cook and taste a fortified porridge

In the Nutrition Workshop itself, we included an exercise in recognising symptoms of malnutrition in children, and what people in the area normally do when they find signs of malnutrition.

To help initiate change in dietary habits and nutrition, three household monitoring sheets were designed and introduced to the home gardeners in subsequent trainings in Phuthaditjaba, World Vision and Msogwaba (Nelspruit). The idea is that community level facilitator's assist households that they consider would need a focus on nutrition to fill out these three sheets. This is an intensive process over a period of at least a week, which is repeated again later in the season. It helps to provide a clear focus on the link between nutrition and gardening and supports the facilitator in planning the gardening activities with the family.



Sheet 1: On my plate…

This sheet provides an indication of the amounts and proportions of different foods people need to eat in a day to have a balanced diet. It is colour coded in the same way as the other two sheets so that the household can use these to analyse their food intake and plan their planting schedule.

Figure 2: On my plate

Sheet 2: What we eat every day

On this sheet, people record intensively what they eat every day, for a week at a time. Children under 5 years old, and the elderly or sick, are recorded as separate categories. The household also records on the sheet which food they get from their gardens.

- This exercise is meant to highlight for the family any gaps in their nutrition and also how much of their food they actually harvest from their gardens.
- The exercise can be done for a week at a time, with periods of about 2-3 months in between. Families can then compare how their eating habits are changing.

This exercise was introduced by community facilitators who assisted filling in the sheets and analysing them in the homesteads. They choose one or two households that they considered the most in need of changing their eating habits/diets. The process is still ongoing.

Sheet 3: Planting Plan

On this sheet, participating households design a planting plan that will augment the nutritional gaps that they have analysed in sheets 1 and 2. It is designed for weekly planting of small amounts of crops within the three food groups (Go, Grow and Glow), to ensure a continuous supply of nutritionally balanced food from the garden.

Run-on and bed design learning process

Please also refer to the Run-on description in section #4.3.5 of this report.

Specific outcomes that we wanted from the "Garden layout" theme were the following:

- Participants can analyse where water flows in their yards and can dig a ditch to lead water to their gardens;
- Participants can construct a network of paths/ channels that are mostly level and that can feed the beds in their gardens with the run-on water;
- Participants can mark out the contours in their gardens to decide where to make their paths; and
- Participants understand that this is a process of observation and trial and error. They know that they should not get disheartened if they do not get it right the first time.

The learning process

a. Introduce rainwater harvesting concepts: channel, slow down and spread out, sink in and lead off the excess.
b. Using photos of an existing garden, do small-group work to analyse where water flows, how it can be channelled, where it would sink in, and how and where excess water could be led off to.
c. Then the small groups do a practical, looking at the same elements in the homestead where the workshop is being held.
d. Practical introduction of how to make and use an A-frame for measuring contours. This is done in two groups.
e. Measure the contours in the garden to work out where to make the level paths.

Comments on the learning process

The process worked very well until we had to measure the contours in the garden. There were a few reasons for the difficulties that arose at that point:

- The existing beds and paths were in straight lines in the garden that looked level, but were not actually on the contour.
- The contour lines made rounded and "wavy" patterns throughout the garden as it was in

fact situated on a "double" slope (downwards and to the one side).

- Participants found this exceptionally confusing:
  - Partly as 'level' was initially translated as 'flat' and the differentiation of these two concepts in isiZulu is not very clear
  - Partly as participants then considered level to mean straight, which most people with little experience of working with contours would and
  - And the existing beds and paths were straight...

From the trench bed in the top corner of the garden, a contour line was measured out (note the orange string and pegs). The contour line goes obliquely across the garden.

Refinement of the run-on learning process

The following recommendations can be made for future run-on learning processes:

1. Introduce, as a minimum, the idea of water flow and ditches leading water to specific beds (especially if there is an existing garden). Do not be tempted to design a whole run-on system when introducing the concepts.
2. Check what is happening underneath the surface – where is the ground wet and how deep is the "wetness". This is important! Use sticks or metal rods and promote these observations among participants. They should go home and do this on a regular basis.
3. Experiment; try it! And don't give up if it does not work first time.

We recommend that as a facilitator:

- Do not get too technical; the concept of contours can be left out.....
- Don't just talk, also do it therefore, make very sure that you understand the concept;
- Assist participants to do this in as many gardens as possible; not just one. The system looks different in each garden and people need to get used to this; and

Don't be tempted to leave it out as a concept because people do not immediately get the hang of it.

Household experimentation is central to the learning process selected for the learning groups. It is based on the fact that gardeners have to try out new ideas for themselves before they will adopt them. It gives them the freedom to make adaptations that suit them. The process provides a method and process for food gardeners to choose which new ideas they will try, based on actual issues in their gardens. It further outlines a process for experimentation, for observation and measurement.

The household experimentation learning process

1. The idea of household experimentation is introduced to the learning group, using a handout (in isiZulu) that outlines the concepts and a short case study. Important aspects of this introduction are that new ideas are tried out on a small part of the garden (experimental plot), and that one will need to have a control plot. In this control plot, the gardener plants the same crop as in the experiment, but plants and grows it in their traditional or habitual way. In the experimental plot, one new idea is tested. More than one experimental plot can be made if more ideas are being tested.
2. As a way of emphasising that only one idea can be tested at a time, a short role play called "The Backache," is done with the help of a few members of the group.
3. After the role play, the group discusses what happened and what it means.
4. The participants are then divided into small groups to discuss which experiments they will try at home and to fill out the household experimentation sheet shown below.

Table 8: Small-scale household experimentation plan

SMALL-SCALE EXPERIMENTATION PLAN	
1. What is the problem?	
2. What is a solution to the problem?	
3. Why will this solution solve the problem?	
4. How will I test this solution?	
5. How will I check my results? What will I look for?	
6. How else will I check my results? What will I measure?	
7. How will I measure the results or outcome?	
8. How will I compare my experiments to my usual way of farming?	

In each subsequent workshop session, gardeners report back on their progress with their experiments. Household visits are conducted by the learning group and the facilitation team to follow up on the experiments as well.

Comments on the household experimentation learning process

1. Introducing this process in Potshini worked well. Participants were given the option of working in small groups to design their experiments, or to do ones for them individually. A few participants designed their own, but most worked in groups.
2. This process really helped to cement the need for trying the ideas from the workshop sessions at home.
3. It helped also to instil in the participants an appreciation for the need to observe things more closely.
4. A number of participants started to use terms such as "I tried this idea...", "I looked for...", " I compared this with...", "the plants grew better because.....". This was extremely heartening, as it meant that they had internalised the concept of experimentation and in fact of how to learn things by themselves, rather than waiting for an "expert" to come and tell them what to do!

Further refinement of the household experimentation learning process

We attempted to shorten the handout and leave out the case study of Mr Ngobese's cabbages in a training run for World Vision. This however only served to further confuse participants and it was decided to stick to the original handout and input; even though it takes a while to go through it and for participants to understand. There are a few tables in the handout that make most of the participants "panic" and one has to go through these painstakingly, showing people where in the table you are, what you are referring to, etc. This is hands-on facilitation. You need to walk around the groups and make sure that each participant (including the 70 year granny who cannot read!!) understands what is being explained. Do not try this after lunch!!!

It does not help to introduce this session as a theoretical session if there is no intention, time or provision in the training programme to follow up with participants what they are doing at home. This necessitates a few home visits and they have to be worked into the learning programme. It is possible to visit two gardens before or after a workshop and to take some of the learning group members from close by along for that. This can make the training days quite long and hard, but is definitely a requirement if the process of experimentation is to be "imprinted" on participants' minds as a way of thinking about new things and ideas.

4.2.9 Comparison of the impact of learning approach in different areas

After the nine-month process in Potshini, KZN (June 2006-March 2007), a second round of homestead level training in gardening and water management was conducted in a new location, to:

- Get an indication of the replicability and flexibility of the learning process used; and
- Develop a process and content for the training of trainers/ facilitators.

A comparison of the processes in Bergville and Phuthaditjaba is given below in Table 9.

Table 9: The two processes compared

	Potshini, KZN	Phuthaditjaba, Free State
Situation analysis	- Initial contact with the field staff of SSI (Smallholder System Innovation) and FSG (Farmer Support Group). A need was expressed for training in homestead food production and water management. - An outline and programme was presented to the team that also included the community facilitator and Dept of Agric extension officer for the region. - A needs assessment and learning agenda workshop was conducted with the two already established learning groups in the area. Our team was provided with an outline of training they had already received from Farmer Support Group. Field visits were done to identify pertinent physical characteristics and issues. - All 7 workshops agreed upon were jointly planned and executed (FSG, SSI, Dept of Agric and WRC), with regular meetings, planning and debriefing sessions.	- Initial contact with the extension office in Phuthaditjaba; a meeting was held with the extension officer (Ms Rantai) and her assistant (Ms Mota) to gauge the expressed need, similar trainings done before, and also socio-political issues, related processes and target groups. - On their recommendation, we met the District Head of Extension (Ms Alta Meyer) and the Food Security Officer (Ms Morapeli) close to Harrismith; received their support in principle and go-ahead to continue. Ms Morapeli was to join in the training programme as a co-facilitator. Ms Rantai and Ms Mota were not invited and it was made clear at the meeting that they had no decision making powers. - A further meeting was held at the extension office to outline the training programme, work out criteria for selection of participants and logistical arrangements and support. Here we decided to work with a Home-Based Carer (HBC) in six wards in the area that are within walking distance from each other. Each HBC could choose three of their clients to join them in the training. A programme of five sessions was agreed upon. - A meeting was held at the local clinic to meet the HBC for the area, explain the training and elicit volunteers; six HBC were eventually chosen, although the demand was much higher. - The date and venue for the first workshop was set.

	Potshini, KZN	Phuthaditjaba, Free State
Generic learning content areas	**Ws1**: Nutrition: food gaps, list of plants to fill nutrition gaps **Ws2**: Seedling production: trench bed and seed bed demo, planting of seed, mulching, soil types **Ws3**: Soil fertility: demonstration on organic matter, liquid manure, experimentation **Ws4**: Pest and disease control; garden friends, brews for pest control, pruning fruit trees and comparison of conventional and organic farming **Ws5**: Garden layout and design; topography and rain water harvesting, marking contours, **Ws6**: Irrigation; treadle pump demo, drip kit, water movement in soil, tower garden demo for grey water. **Ws7**: Planting fruit trees; delivery and demo **Ws8**: Evaluation, further learning needs and action plan for learning groups; seed exchange and celebration.	Similar content to Potshini. To test whether the content could be condensed into fewer sessions, the programme was fitted into 4-5 workshops (April-August 2007) rather than 7-8 sessions. Handouts for participants were made available in SeSotho **Ws1**: Nutrition: food gaps, list of plants to fill nutrition gaps, trench demo **Ws2**: Seedling production: visioning, physical planning of garden, rainwater harvesting system (ditches) and soil types. **Ws3**: Soil fertility: demonstration on organic matter, liquid manure, experimentation, frost protection structure **Ws4**: Pest and diseases control; garden friends, brews for pest control, crop rotation, fruit tree pruning and orders. **Ws5**: Fruit tree delivery and demonstration of planting
Learning and action agenda		Focus slightly different due to geographical area, season of planting, learnings from Potshini and planting habits of the local people. - The trench process was changed: so that organic material in the trench is mixed and watered well prior to placing the topsoil mixed with manure back. Do not use subsoil in the trench but place around garden to channel rain water. - Seeds and plants more cold resistant: rape, kale, leeks, broad beans, strawberries, quinces, gooseberries. - Frost protection structures included - Use of herbs and flowers (irises) for windbreak hedges rather than Napier fodder - Seed and seedlings supplied: fennel, rape, parsley, kale, coriander, garlic chives (to hopefully increase chance of survival of the plants) - Added a section on pruning of fruit trees and crop rotation (removed fruit fly traps)

	Potshini, KZN	Phuthaditjaba, Free State
Implementation outcomes	Good success and coherence of the group. Large increase in gardening activity and good adoption of new ideas and gardening techniques.	- Facilitation in three languages: SeSotho, English and isiZulu. - Overall around 20 participants: not much coherence in attendance. A lot of revision and repetition was required. - Vulnerable people (HIV positive) in the group responded well to the ideas, as did others. - Most of the group was literate and the handouts were well appreciated. - Full manuals were given to the HBC, to use as a support with their clients. However, due to time limitations it became impossible to have extra, more intensive learning and facilitation sessions with them. - Social issues such as the general strike in the area hampered attendance. (As did heavy snowfalls) - Some conflict within the Department of Agriculture dampened the process; the Food Security officer is not well integrated on the ground and did not attend the workshops. She does however provide directives to the extension office, which are resented. Overall the leadership feel that initiatives should come from within the Department and flow from the senior to junior people. Pro-active field staff is not appreciated by supervisors.

	Potshini, KZN	Phuthaditjaba, Free State
Recommendations	A way needs to be found to ensure that most participants attend most sessions; otherwise coherence becomes a big problem Make sure that handouts are available in the local language; some people are not literate, but more and more, written material is appreciated The shortened 5-session process used in Phuthaditjaba worked almost as well as the original 8-workshop process used in Potshini, as long as a follow-up and mentoring process for gardeners at their own homes is also included. It is this follow-up that will ensure sustained adoption. Adoption of new technologies just from training input in these two processes has been seen to average at around 0-30% maximum. It is repetition, home visits, community facilitation and an emphasis on the experimentation processes that can increase adoption to as much as 70-80%. Overall, the technologies/ innovations introduced, such as the organic (LEISA) focus, trench beds, run-on ditches, mulching, etc. are **definitely** appropriate and can lead to a dramatic increase in year-round food availability for the homesteads The supply of good quality, cheap fruit trees for sale is appreciated by community members and needs to be attempted, despite the logistical nightmare it creates for the implementer. A focus on inclusion of the vulnerable and keeping them on board is important. If they stop coming to workshops, go and visit them; engage! The supply of seed is a good idea; albeit difficult for trainees to grow unknown crops from seed. To augment this process, some seedlings of the same crops and herbs can be supplied; but do resist the temptation just to give people seedlings. Learners will lose their ability to grow crops from seed and to keep their own seed. They then have to buy seed or seedlings – which makes them dependent and the really vulnerable cannot really afford it. Facilitation of the content needs to be done by someone with a strong gardening background. Without this, a lot of the reasoning for using the specific innovations will be lost and practical advice will be impossible. Also, credibility is lost. This is a difficult issue! Most trainers and community facilitators will not have the organic gardening background required.	

Further refinement of the learning process was conducted with World Vision in the Bergville area. Chronologically, this process was started at the same time as the Phuthaditjhaba process mentioned above. As the learning process was meant to support a number of the World Vision learning groups in the area and the training budget was somewhat tight, it was decided here also to focus on the 5-workshop training course, and to shorten the intervention for each group to around 6 weeks, with further household monitoring and interaction with community level facilitators.

What is of initial interest in this intervention is how World Vision came to the decision to support intensive household food production and rainwater harvesting initiatives. It was based on the following four premises:

1. A baseline study for the area and for their participants that clearly revealed an urgent need for household level support;

2. One of the World Vision participant groups reside in Potshini and the field workers for World Vision in this area were impressed with the impact of the household food production intervention and training there;
3. Community gardens supported by World Vision in the area have been struggling with group conflict, lack of commitment and difficulties in sustaining gardening efforts; and
4. World Vision had been providing support for household gardens in the form of providing seedlings and had arranged some training sessions for the gardeners through the Department of Agriculture. They were now battling with sustainability in these gardens and with the concept of having to continue supplying seedlings for an indefinite period. They also wanted to move away from providing fertilizer to the gardeners.

The overall learning process followed the same outline as for Potshini and Phuthaditjhaba. A significant focus however was the inclusion of learning and mentoring process for community level facilitators that would support the households on a longer term basis, during and after the learning process.

The following components formed part of their learning process:

- The community learning process (most of the 12 volunteers had by then attended the community workshops and other learning processes);
- A further intensive three-day training and exposure visit; and
- A process of mentoring and follow-up, which included a planning and monitoring process for their household visits.

The outline of the community facilitators' learning programme is provided below.

Community Facilitators' Course Outline

The course was held at Ecabazini Zulu Homestead outside Greytown that has a beautiful intensive food production system. The overall programme ran over three days:

DAY 1: Introduction to the Facilitators' Course

DAY 2: Homestead gardening practices

DAY 3: Facilitation

Table 10: Community facilitators' course outline

DAY 1 – INTRODUCTION TO FACILITATORS' COURSE	
10.00-10.30	Tea
10.30-11.30	**Introductions and present situations:** *Each person's name, experience in gardening, and one thing s/he is good at* *Gardening drawing* *Issues in your gardening* *Issues s/he may have when working with people in the area (social, physical, etc)*
11.30-13.00	**Garden visit:** *Observe around the garden with CJ (the owner of Ecabazini)* *Small group report-backs on interesting things*

13.00-14.00	Lunch
14.00-15.00	**Experimentation:** *Input on Experimentation:* Explain the process of experimentation according to handouts given. Important points include only trying one thing at a time, and the need to have a control. Explain that the differences need to be observed and/or measured to get a comparison *Design an experiment for yourself using one of the interesting innovations in CJ's garden, using the form provided*
15.00-16.00	**Introduction to facilitation:** *What is expected of you as facilitators* *Small input on facilitation (include issues and asking questions, referring back to experiments)* *Role play on facilitation*

DAY 2 – HOMESTEAD GARDENING PRACTICES	
08.30-09.30	**Nutrition:** *Introduction to Nutrition*: Each participant names something interesting that they know/ use or do regarding nutrition. Each person offers one comment that is recorded on newsprint. *Group discussions on food that is eaten*: Participants discuss and record for report back in plenary the following topics: -What we eat every week on daily basis. -What we rarely eat -What we would like to eat but do not have access to and -What we feed the young children (ages 1-5yrs) -What is fed to the elderly *Input from facilitators on food groups*: Using the Lirapa manual, facilitators go through the go foods, grow foods and glow foods; this is done through a short introduction and then by participants selecting food items they mentioned in their report backs that fit into those categories. Create categories for diabetes, high blood pressure and weaning foods as well. Include a discussion on different food types and diversification: -Medicinal food -Seed -Leaf crops -Hybrids -Long season crops -Short season crops -Traditional food -Fruits -Go, Grow and Glow foods. *An analysis of gaps in nutrition and how these can be rectified*: Participants analyse their selection of different food groups and look at what they eat regularly. They then offer suggestions of where they may be missing food types that may provide them with a more balanced diet.

09.30-10.00	**<u>Efficient management of soil and water</u>** **Soils – testing water and sausages** *Input on soil structures:* Discussion on soils, using bottle and sausage tests. Check understanding of how different types of soil affect plant growth. Introduce clay, silt and sand as basic components of soil. Discuss the importance of air and water in the soil
10.00-10.30	Tea
10.30-12.00	**Trench demo, mulching, planting of seed, grey water** *Demonstration on how to make a trench garden, mulching and planting of seed* *Input on grey water* *Demonstration on frost protection:* A structure is made from sticks and a large sheet of plastic to cover a bed, it needs to be well anchored into the ground so that it does not blow away or tear.
12.00-12.30	**Photos exercise (run-on) RWH** *Input on rainwater harvesting; ditches to channel water* *Pictures of an existing system:* divide into small groups and discuss what is happening in the pictures; also make use of their report-backs to further discuss the channelling of water *Practical:* Participants walk around the garden: -think through where water runs and where ditches can be placed to channel water to the garden; -report-back to each other; and -dig a ditch in the agreed upon place, with a trench bed below the ditch to "drink" from it
12.30-13.00	**Improved kraal manure and liquid manure**
13.00-14.00	Lunch
14.00-15.00	**Planting** *Diversification, seed production and wind and frost protection* *Companions, rotation and planting calendar* *Exercise: plan also using planting calendar*
15.00-16.00	**Pest and diseases brews** *Demonstration on pest management*

DAY 3 – FACILITATION	
08.30-10.00	**Visioning** *Visioning for themselves* *How to assist a homestead garden (Vision, implement and monitor)*
10.00-10.30	Tea
10.30-11.30	**Garden observation:** *Checklist (input on garden observation)* *Exercise on garden observation (they must go and do an observation):* Group to go into garden and look critically at what is present. Facilitate a discussion about what is seen, what the issues are, potential causes and solution, and possible implementation of ideas covered thus far in training (e.g. Trench, RWH ditches, diversity of crops, windbreaks)
11.30-13.00	**Recording:** Important documentation to be used/recorded by: -facilitators -homesteads
13.00-14.00	**Closure**

The same basic input that is given in community level workshops is repeated here, but in more depth, with an additional aspect of how this information can be facilitated with a group. Participants are also introduced to a number of new ideas, and asked to analyse them in terms of relevance. These exercises are meant to instil a level of critical thinking in facilitators, and to assist them to apply new information in their own situations.

The mentoring process with facilitators consisted of accompanying each facilitator on a household visit and to work with them through the checklists they were given to analyse and consider with household gardeners. One visit would occur quite soon after the training session, and another about 6 weeks to 2 months later.

Comments on the community facilitators' learning process

1. The community facilitators enjoyed the training and the exposure visit immensely. They had long discussions and asked many questions. All gathered as many handouts as they could, to use later in their communities;
2. In the follow up visits in the community, the application of their learning, and the inclusion of these ideas into the gardening activities of the people they were supporting, was much less apparent;
3. They were not rigorous in terms of recording their work with householders, or following and reporting on the checklists given to them; and
4. It became apparent that community facilitators would need a lot more "hand holding" in their field work, until they better understood their role as one of support and motivating householders to intensify and try out new ideas, rather than being a person with a clipboard who tells people what they should do without getting their own hands dirty.

Refinement of this learning process

The inclusion of an exposure visit, that can stretch the volunteer facilitators' boundaries in terms of what they are used to, is essential. As this is a good analysis of the system that has been encountered, aspects of this system can be applied in their own situation.

More emphasis needs to be provided on the role of a facilitator, as opposed to an instructor. This can only be done through practice, and thus a more intensive mentoring process would be required.

It is suggested that community facilitators be required to run a workshop (or a series of workshops) with their community gardeners, where they are accompanied by their mentors, and that they need to prepare well for these. Some form of assessment of their performance would be necessary.

4.2.10 Overall learnings for the household training process and content

1. The group learning events held at people's homesteads worked well, and is an integral component of a more people-centred learning approach.
2. The focus on practical demonstrations is essential.
3. Experimentation carried out by learning group members was a strong component of their learning and eventual uptake of the new ideas.
4. Members really appreciated cross visits to other areas and communities. These visits need to be well managed, to ensure that learning is incorporated into people's systems once they get home.
5. The provision of fruit trees for sale worked well, and was appreciated, as members were very keen to grow fruit trees, but have always battled with access to good quality, affordable trees.
6. The focus on provision of seed, and seed production by the members themselves, is an important element for longer term sustainability and continuity of gardening efforts.
7. The introduction of intensified techniques such as trenches and run-on ditches was appreciated and well accepted by those that have tried it out.
8. Although handouts in isiZulu were prepared for the first three workshops, it became evident that people were not using them, nor found them very useful, and thus the provision of handouts was discontinued.
9. Attention needs to be given to introducing ideas that people can use immediately, as they forget the details of an idea over time. Thus, pruning of fruit trees needs to be introduced in winter, while making of fruit fly traps needs to be done in mid-summer. This has serious implications for how a training program is set up.
10. Having local community facilitators in the area that can do home visits and generally gather people's conceptions, issues and learnings is very useful and helps to "cement" quite a lot of the learning for individuals.
11. A budget is required for the supply of materials for the practical demonstrations. As a general rule, whenever something new is introduced, the materials ought to be provided to learner members; rather than expecting them to take the risk. Thereafter they can be expected to supply their own. For instance, seed of a new type of plant is provided once.

12. In terms of seed though, a number of people did not manage to grow crops from seed the first time (especially granadilla, garlic chives and others that are slightly tricky to germinate and take a while to come up). Therefore, in follow-up home visits they could be supplied with a further small stock.
13. Facilitators of these types of processes need to have a solid understanding both of group processes, individual learning and the theory and practice of the gardening or agricultural content.

4.3. Refinement of Technologies

4.3.1 Introduction

This section reports on the refinement of practices and technologies after participatory evaluation. You are reminded of the "most promising" methods and technologies identified in section #4.2.4 above. Combinations of these technologies were introduced to households and their use evaluated through participatory analyses and where possible, through actual measurement.

This section reports on the introduction, assessment and where relevant, the refinement of some of these technologies, and covers the following aspects in varying depth for the different technologies:

- A description and/or analysis of the method/technology (**what does it entail?**);
- How the method differs from existing local practice (**how is it different?**);
- How has the method been refined or adapted to improve it or make it more suitable (**how has it been refined?**)
- The outcome of assessments with households on how their performance compared to existing local practice (**do people say it works better?**); and
- Measurements (where possible) of the performance of these methods and technologies (**how much better/worse?**).

4.3.2 Uptake of innovations and technologies

Introduction of new technologies to households

This section of the report is an abbreviated discussion on the introduction and uptake of innovations and technologies in garden learning groups, mostly in Potshini. Also included is some reference to the evolution and refinement of the processes and technologies.

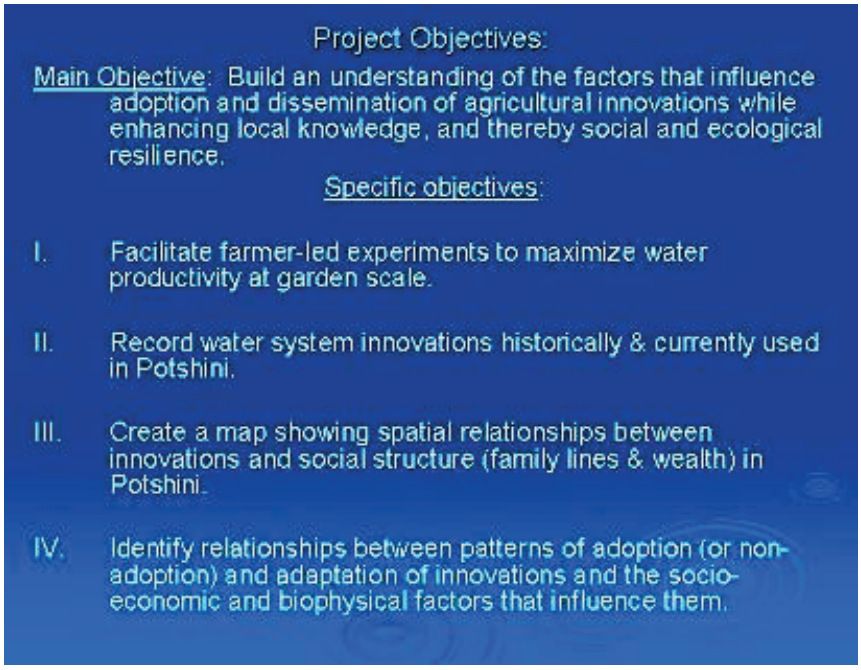
Garden Learning Groups: Workshops and Household Experimentation

Seven **garden learning workshops** were conducted with members of the two **Garden Learning Groups** (64 members in total) at Potshini over a period of 9 months (June 2006-February 2007). A number of different innovations were introduced during the workshops, concurrently with water management innovation **experiments** set up by both the Smallholder System Innovations (SSI) research team from the University of KwaZulu-Natal (UKZN) and the Water Research Commission (WRC) team.

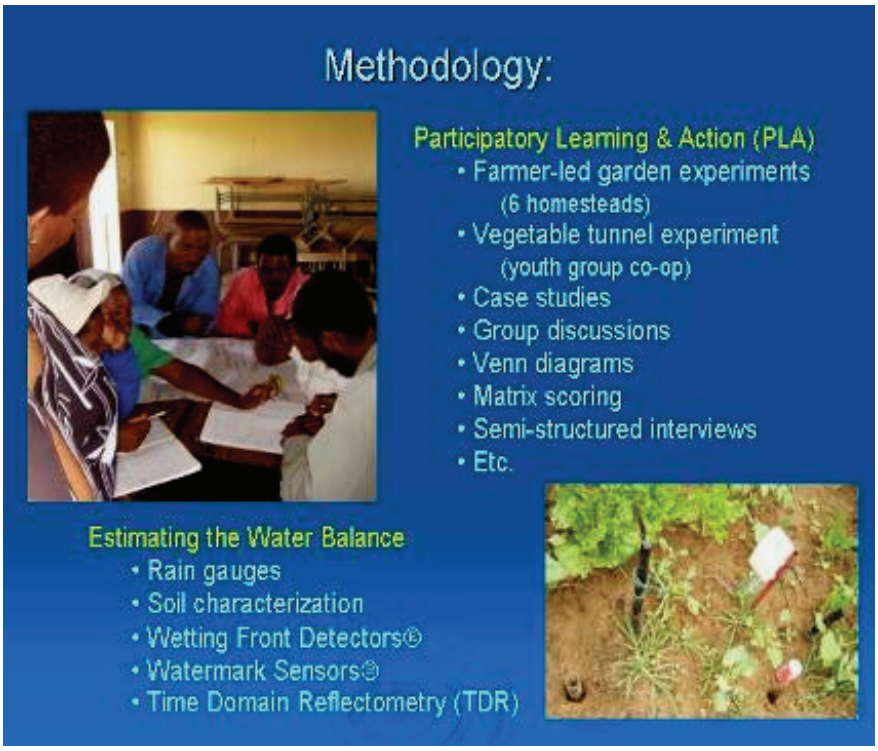
Experiments by Potshini households

Part of the collaboration between the SSI team from UKZN and the WRC training process was the work conducted by an MSc student for the SSI process, Ms Jody Sturdy. She focused her work on adoption of innovations generally, and more specifically in terms of water management at a homestead farming level. Her thesis title is: **"Adoption and adaptation of smallholder agricultural innovations: Building an understanding of innovation adoption processes through farmer led experimentation."**

This slide presents an outline of her overall project objectives.



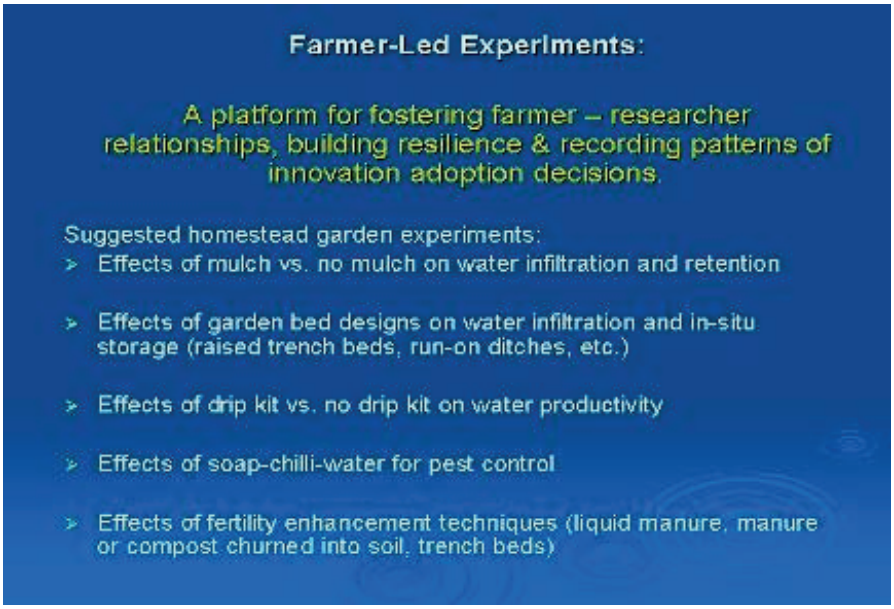
Jody's methodology concentrated on participatory research processes and is summarised in this slide:



Jody Sturdy worked intensively with six volunteers from the learning groups. Each volunteer set up experiments in their garden that they monitored themselves. Jody introduced scientific measurement protocols for soil water to augment and strengthen their results.

A basket of options for household experimentation was jointly designed with the WRC team, so that our objectives and need for results around introduced technologies/ innovations could be met jointly.

The suggested homestead garden experiments are summarised in the slide:



The experiments actually conducted that were well managed and recorded were:

- Trench beds vs. traditional planting (Nelisiwe);
- Run-on ditches vs. traditional planting (Thabani); and
- Trench bed with drip kit vs. traditional planting with drip kit (Sizakele).

The discussions under the headings "How much better/worse?" for the sections on Deep Trenching, Run-on and Drip Kits, are based on the results from these experiments.

Household uptake of gardening

Two reasonably independent processes for assessment of uptake of the innovations were conducted: one by the SSI research team and one by the WRC team. Both processes relied on individual interviews.

In the WRC Survey, a total of **19 learning group members** were interviewed about 4 months after the finalisation of the training. The intention was to see the uptake of **gardening** generally, and more specifically to check on the uptake of different **innovations**. The assumption here was that some people would be gardening partly because others are, and partly because of an expectation to receive a subsidy for a RWH Dam from DWAF. They may however not necessarily be using the innovations introduced in the garden learning workshops.

Both the SSI survey and the WRC survey found that approximately 70% of households currently (2008) gardening in Potshini, started their gardens after the Garden Learning Workshops had begun.

SSI survey: 55 Households were interviewed of whom 28 (51%) were gardening. The graph (Figure 3), below was produced by the SSI team.

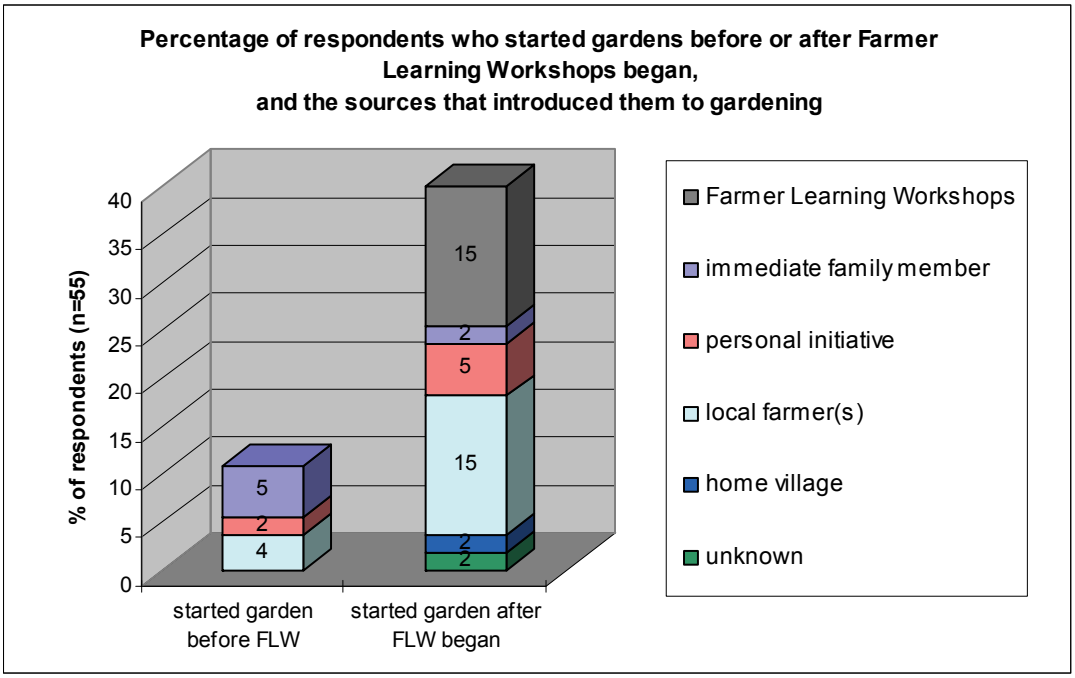


Figure 3: Household uptake of gardening. (Jody Sturdy, 2008)

WRC survey: 19 Learning Group members were interviewed, all of whom were gardening. Six members (32%) had started their gardens before the training, while **16 (84%) started their gardens during the Garden Learning Workshop training.**

In the SSI survey, 6 respondents (11% of respondents, and 21% of those gardening) had started their gardens before the Garden Learning Workshops began. 35% of respondents or **79% of those gardening started their garden after the Garden Learning Workshops began**.

This compares well to the findings of the WRC survey (84%).

Interestingly, only 8 (29% of those gardening) said that they had started their garden as a result of the garden learning group training, rather, they were mostly introduced to gardening by others around them.

Adoption of innovations introduced through the Garden Learning Group

The interview schedule for the WRC process is shown on the following page Figure 4: "Questionnaire for the uptake of water and soil management innovations."

The questionnaire specified innovations introduced in the Garden Learning Workshops and tried to elicit from respondents whether they tried them, and what their impressions were of the technology. The overall question asked, was: "How has the training helped you in your garden?" The respondents answered this question by mentioning their most significant innovations.

Detailed results are shown in "Table 11: Significant Innovations" that follows after the questionnaire on the next page.

SSI Feb-April 2007 Farmer:_____

Individual Farmer Learning Group homestead visits Date:_____

INNOVATION (Gardens)	Tried	Didn't try (why?)	Tried but no longer in use (why not?)	Understands how it is supposed to work?	Adaptations made / comments
straw in kraal manure					
liquid manure					
trench bed					
manure in top few cm					
mulch					
run-on ditches					
drip kit					
TP rolls (for cutworm)					
chilli-soap water					
Fruit fly traps					
peanuts					
Garlic					
rosemary/lemon vr.					
Napier					
Fruit trees					
Jugo beans					
mustard spinach					
growing seedlings					
Other:					

Figure 4: Questionnaire – Uptake of water and soil innovations

- Garden size: _____
- Adaptations made? (is he/she able to adapt innovations?)
- Is farmer trying his/her own EXPERIMENTATION in garden? (describe)
- Who in family is involved in garden? How so? (what have they learned?)
- Improvements in local environmental management? (still killing all bugs & frogs?)

General Questions

1) Did you start your garden before, during or after the training?
2) Are you able to continue gardening now in winter?
3) What successes have you had in your garden thus far?
4) What are your main problems?
5) How many of the training workshops did you attend?
6) How has the training helped you in your garden?
7) Where else to you get information or ideas about gardening?
8) Seed; have you kept any seed from that supplied that you grew? (e.g. peanuts, masihlalisane, carrots, izindlube, garlic chives, spring onions…..) If not why?
9) How do you now find seed/seedlings to plant?
10) Are the fruit trees supplied through the training growing? Any issues?
11) What do you remember about nutrition? (From the workshop or just generally)
12) How does your garden help with food? How much?

Table 11: Significant innovations

INNOVATION (Gardens)	Yes	No	Tried but no longer in use or did not try (why not?)	Adaptations made / comments
Started gardening before training	6			Learnt from Thabani Madondo
Started gardening during or after training	13			Training motivated me to start – 5
Straw in kraal manure	5	14	Do not have a kraal or cattle – 11 Did not know – 2 Still going to do – 1	Good compost/ manure – 3 More manure and makes the soil loose and rich Helped me; got healthy carrots
Liquid manure	15	3	Did not know – 2 No drum – 1	Healthy plants – 8 If your plant is weak liquid manure helps – 1 My spinach grew a lot better – 1 I did not dilute it and it burnt my plants; now I know – 1
Trench bed	14	3	Did not know –1 No reason – 1 Tried but did not see any difference – 1 Still going to try – 1 Hard to dig – 1	Makes soil fertile – 4 Plants grow fast – 1 Plants healthier – 1 Greater yield from trench bed – 2 Good for carrots; they grow deep – 2 Roots go deep – 2 Really works for me – 1 Makes soil loose and good root growth – 1
Manure in top few cm	11	6	Did not know – 2 Heard about it but have not really tried – 2	Good plants – 7 Did not see the need, also using trenches – 1 Spinach grew very fast – 2 Makes soil fertile – 1
Mulch	12	5	Not yet – 3 Attracts chickens – 1 Did not know – 1	Good for seedlings – 1 Water does not evaporate quickly – 9 You don't need to water all the time –1

INNOVATION (Gardens)	Yes	No	Tried but no longer in use or did not try (why not?)	Adaptations made / comments
Run-on ditches	9	9	Did not know about it – 4 My garden is too small – 2 New garden – 1 Could not make it work – 1	I did not have to water in summer – 1 Retains moisture and saves water – 1 Perfect –1 Good results – 1 Easy way to water the garden – 1 You do not need to water when it rains – 1
Drip kit	5	13	Only a few drip kit volunteers	No longer in use, as it did not supply enough water to the plants – 2 Waste of time– 1 It helps if I don't have time – 1 Very good for lazy people – 1
Toilet paper rolls (for cutworm)	7	11	Did not try – 8 Did not work well – 3 No cutworm – 2	Real help with cutworm – 4
Chilli-soap water	14	4	Plants were healthy and did not need it – 2 Did not know – 1 Bought chemicals from Familee Save – 1	Works well – 6 Really chases bugs – 1 Got rid of aphids – 4 Did not work well – 2
Fruit fly traps		17	Did not know – 7 Tried but it did not catch flies – 1 no fruit trees –1 No need – 1	
Peanut seed	10	9	Not at training; did not receive seed – 7	Do not know how to plant; did not get a lot of them – 3 Did not grow – 1 Got rotten – 1 harvested a lot – 3 Kids really liked that –1
Garlic cloves for planting	7	10	Not at training – 7	Grew well, but did not eat it – 4 It dried up – 1 Does not understand how it is supposed to work – 1
Rosemary/Lemon Verbena cuttings	5	14	Did not grow – 5 Not at training – 9	Did grow; do not know how to use –1

INNOVATION (Gardens)	Yes	No	Tried but no longer in use or did not try (why not?)	Adaptations made / comments
Napier	10	8	Did not grow – 2 Not at training – 5 Cattle ate them all –1	Grows well – 8
Fruit trees	12	7	Did not buy trees – 7 was told to get rid of apple tree in the yard – 2	Growing well – 11 Growing slowly; hard soil – 1 growing slowly; goats are eating them – 2 Want more – 1 One is growing; the other 2 dried out – 1
Jugo bean seed	2	12	Not at training – 9 No space – 1	Did not plant them – 1
Mustard spinach seed	7	12	Not at training – 7	Grows well – 6 NOTE: People did not realise the mustard spinach is the same as masihlalisane!
Growing own seedlings	15	4	Do not know how – 1 Still going to try – 1	Saves money – 2 Works well – 1 I do not buy any more – 1 Grow well – 3
Growing during winter	9	10	Livestock a problem– 2 Frost a problem(black frost bad this year) – 4 No water – 4 Fencing is old – 1	Planted spinach, cabbage, onions, carrots, beetroot. Some problems with chickens –1 Yes, but rats are causing a problem – 1
Nutrition: remember and are including that in gardening	3	16	Not at training – 4 Do not remember – 11	Plant different things to get a range of vitamins – 2 We should eat more greens, beans and meat – 1
No of trainings attended			All – 4 Most – 8 Five –2 Four – 1 Three – 2 One – 1	Used to plant but training gave me more information – 3 A lot of information from training – 6

INNOVATION (Gardens)	Yes	No	Tried but no longer in use or did not try (why not?)	Adaptations made / comments
Kept seed	8	11	Harvested peanuts too late – 1 Did not wait long enough – 2 Goats ate everything – 1 Only kept masihlalisane as my garden is too small – 1 Did not think about it – 1	Masihlalisane – 7 Carrots – 5 Beetroot – 1 Peanuts (2 of the 3 ate all their seed as well) – 3 Green pepper (own) – 1 exchange seed with other learning group members
Environmental awareness in the garden: promoting the presence of predators and friendly insects	6	13	Did not know – 6 Heard about it but have not really tried – 4 No bugs or frogs in my garden – 3	More frogs and bugs in my garden – 1 Told my family not to kill bugs and frogs – 1 I do not kill useful insects – 1 We do not kill frogs and bugs any more – 2 I kill frogs, the rest I don't – 1
Own experiments	5	14		Planted granadillas as windbreaks in the garden – 1 (Thabani Madondo) Keeping bees – 1 Use my own muthis for plant diseases – 1 (John Mabaso) Use ash for aphids (Sizakele) Normal planting, making my own compost and burning of manures (Phumzile Mbhele)
Other sources of information	7	12	Trainings only (learnt a lot, able now to plant using different methods) – 8	Farm where I used to work – 1 Thabani Madondo – 4 and John Mabaso – 1 Grandfather – 1 Father who was a good gardener – 1 When I was growing up learnt from my family – 1

In summary:

- **It is clear from Table 11, that many respondents (73%) regarded the trench beds as the most significant change in their gardens!!!** This was almost surprising, as we were under the impression that uptake may be low due to the difficulty of making the trenches and the fact that it takes some time to see results.
- It is also interesting that some found the use of the run-on ditches significant, given that the impact of this innovation is difficult to measure and observe.
- Then the mention of straw in kraal manure, or improved kraal manure is also surprising; mostly because the WRC facilitators have previous experience in introducing the technology in rural areas, with very low success rates. Here is an indication that a good focus on the topic may well be rewarding in terms of uptake. It is considered by the facilitators to be one of the single most important aspects of improving soil fertility in typical rural areas.

Similar questions were posed in the SSI survey (55 respondents), but the latter did not specify whether these respondents were in the learning groups.

Below is a comparative table of the results of the two surveys. The results may not be directly comparable, but are interesting in terms of indicating trends in uptake of innovations/ technologies.

The two surveys found similar trends in terms of which innovations have been the most popular in uptake, with deep trenching the most popular and run-on ditches least popular. In the SSI survey, the uptake of mulching and buying of fruit trees ranked slightly higher than in the WRC survey.

Table 12: Adoption of innovations – SSI survey and WRC survey.

Innovation	SSI SURVEY		WRC SURVEY	
	No of innovators (divided by no of gardeners)	%	No of innovators (divided by no of respondents)	%
Deep trenching	14/28	**50%**	14/17	**82%**
Liquid manure	8/28	**28.5%**	15/18	**79%**
Chilli and soap spray for pest control	10/28	**36%**	14/18	**78%**
Mulch	12/28	**43%**	12/17	**70.5%**
Surface manure (dug into 10-15cm)	8/28	**28.5%**	11/17	**65%**
Fruit trees	13/28	**46%**	12/19	**63%**
Run-on ditches	5/28	**18%**	9/18	**50%**

Source of innovation

Generally it needs to be said that the uptake of innovations through the garden learning process is in fact impressively high! This is indicated by the graph below and table below, Figure 5 and Table 13 respectively.

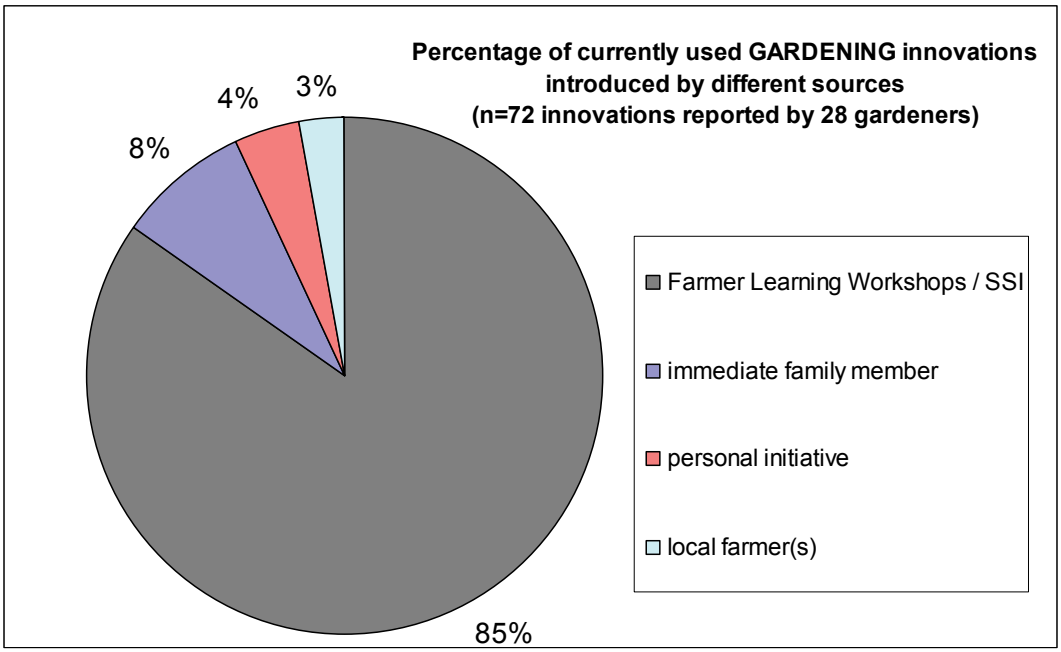


Figure 5: Source of innovation (Jody Sturdy, 2008).

Table 13: Sources of innovation – SSI survey and WRC survey.

Source of the innovation	**SSI SURVEY** [n=72 innovations, 28 gardeners]	**WRC SURVEY** [n=19 gardeners]
Farmer Learning Workshops	85%	63%
Immediate family members	8%	21%
Own initiative	4%	26%
Local farmers (mostly Mr Madondo)	3%	26%

Members of the learning group seemed to have shown more 'own initiative' in terms of using innovations, and had more access to local support from the community facilitator and immediate family members. It is somewhat misleading to ask for sources of information from respondents, as they would rarely get information from one source only. Therefore, the WRC questionnaire asked how many people received their information from the learning group ***only***. The outcome was 8/19 respondents (42%).

Local Innovations

The following local innovations were mentioned by respondents:

- Using ash to control aphids on cabbage;
- Burning manure before using it as a fertilizer;
- Making compost;
- Using their own muthis (traditional plant based remedies) for plant diseases; and
- Planting granadillas as windbreaks; and
- Keeping bees.

Currently practised innovations

An important question in terms of adoption of an innovation is whether the gardener continues to use the innovation after first trying it. The outcome, shown in the graph below, seems to indicate that in Potshini, once a person had taken on an innovation, they generally continued to use it!

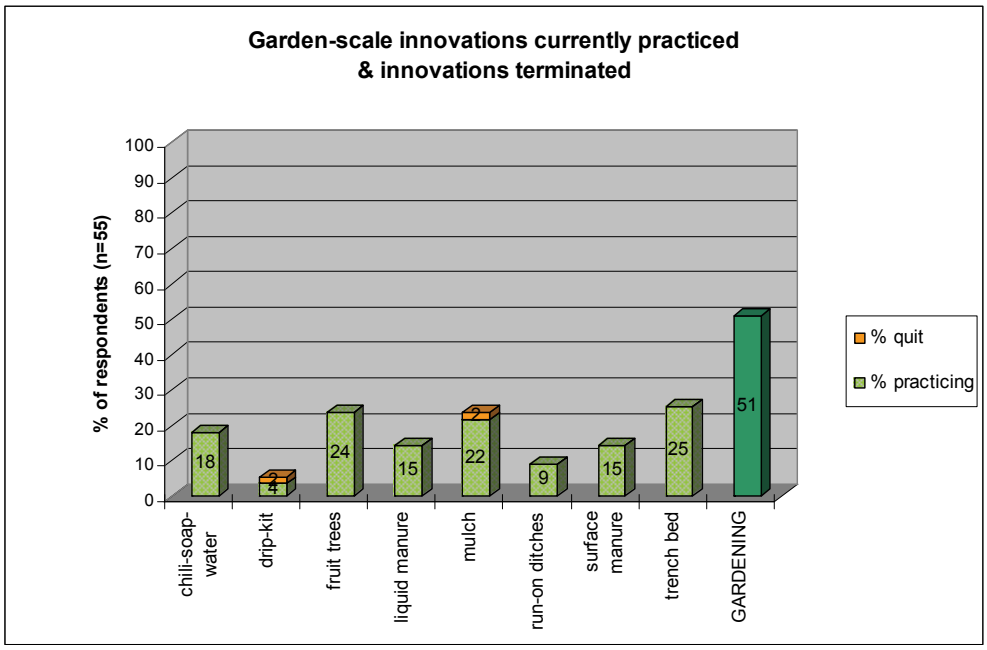


Figure 6: Currently practised innovations. (Jody Sturdy, 2008)

According to the SSI survey, virtually all innovations adopted continued to be used. Innovations that were discontinued by some people, were the use of mulching (2/24=8% of those who tried them) and the drip-kit (2/6=30% of those who tried them).

The WRC survey found similar trends:

- One respondent (1/17=6%) stopped using mulch as it attracted chickens, who enjoyed scratching in the mulch and destroyed the vegetables.
- The WRC survey found that more than half (3/5=60%) of the respondents are no longer using the drip kit.
- In the WRC survey, one respondent also stopped using trench beds, as she claimed she could see no difference in the growth of her plants. The rest of the adopters were enthusiastic about the trench beds, offering comments such as: "it makes soil fertile; plants grow fast; plants are healthier; greater yield from trench bed; good for carrots, they grow deep; roots go deep; really works for me; makes soil loose and good root growth."

4.3.3 LEISA [Low External Input Sustainable Agriculture]

What is it, how is it different and how has it been refined?

LEISA – low external input sustainable agriculture is a farming system that relies to the largest extent possible on natural resources present in an area. The related term "**Permaculture**" is a derivative of the phrase "permanent agriculture", which aims to convey the sustainable nature of these practises. LEISA was re-introduced as a term to offset the steady move towards **high external input agriculture (HEIA)** systems which rely heavily on fertilizers, pesticides and herbicides, as well as on hybrid seed and mechanisation. LEISA is discussed in detail in Chapter 1 of the Resource Materials.

HEIA has certain advantages such as short term increase in production and cash income, uniform production processes and lower labour costs. However, it also has many disadvantages:

1. Limited applicability to dry and risk prone farming areas;
2. Negative impacts on water, air and human health;
3. Tendency to erode soils, genetic resources and local knowledge;
4. It cannot be applied by many poor farmers in poor areas;
5. It under-utilizes available local resources and over-utilizes non-renewable resources such as fossil energy and phosphorus; and
6. It increases the dependency of farmers on bought inputs.

These and other disadvantages have stimulated interest in developing sustainable farming practices. New approaches have emerged such as **organic farming**, **Permaculture** and **Ecological farming**. LEISA in our modern world implies a farming system with a small environmental footprint that costs less to implement and maintain than HEIA systems.

Virtually all the "most promising" methods and technologies identified through this research could be categorised as LEISA. The rest require only **once-off** (like Rain Water Harvesting (RWH) Dams) or **very limited ongoing** external input (like treadle pumps).

Aims of Low-External-Input and Sustainable Agriculture (LEISA)

LEISA systems depend primarily on resources from the farm, village and region and are characterized as follows:

- It aims to integrate soil fertility management, arable farming and animal husbandry;
- It makes efficient use of nutrients, water and energy, and recycles them as much as possible, thus preventing depletion and pollution;
- It uses external inputs only to compensate for local deficiencies;
- It involves site-specific farming practices;
- It aims at stable and long-lasting production levels; and
- It incorporates the best of all known farming practices in an area.

LEISA principles

The following principles underpin LEISA production systems:

Mimicking nature: Most natural ecosystems without human disturbance manage to accumulate nutrients. This happens in a number of ways:

- Living plants form a continuous soil cover;
- A layer of decomposing plant material and leaves covers the soil;
- Roots of different plants are distributed throughout the soil at different depths; and
- Most nutrients are retained in living plants or animals.

Seeking diversity: Natural ecosystems consist of many different plant and animal species interacting with one another. These develop over a long period. In the LEISA farming system, food gardeners and farmers try to develop similar processes, by diversifying the species of animals and plants that grow and interact with one another. This gives strength to the system, enabling it to resist disturbances such as erratic rainfall and attacks of pests and diseases.

Living soil: One of the most important components of soil is soil life including bacteria, fungi, protozoa, nematodes, beetles, centipedes and earthworms. This plays a major role in nutrient availability and recycling and thus agricultural productivity. Farmers have to create favourable conditions for soil life. Organic matter must be provided.

Cyclic flow patterns: In a natural ecosystem hardly anything is lost. In LEISA losses are minimized through cover crops, deep rooting species that recycle nutrients, erosion control and improved collection, storage and application of wastes from crops (residues), livestock (manure and urine), and the kitchen (water and food wastes). Similarly, water flows are managed so that optimum use is made of available water.

LEISA innovations/ practices introduced through the Potshini learning process

The innovations below were introduced through the garden learning workshops, and are listed here in accordance with the LEISA principles outlined above:

Mimicking nature:

- Environmental awareness; promoting the presence of natural predators for pest control;
- Fruit fly traps;
- Improved kraal manure;
- Chilli-soap mixtures for pest control; and
- Toilet paper rolls for cutworm control.

Seeking diversity:

- Planting herb cuttings for diversification and pest control;
- Planting Napier fodder for windbreaks and animal fodder;
- Planting garlic (pest control and condiment); and
- Grafted fruit trees.

Living soil:

- Trench beds;
- Mulching beds; and
- Digging in manure into the top 10-15cm of soil.

Cyclic flow patterns:

- Use of run-on ditches;
- Use of liquid manure; and
- Making available seeds of various crops for diet diversification (incl. peanuts, jugo beans, mustard spinach, carrots, beetroot and others in smaller quantities – tree tomatoes, granadilla, fennel, parsley, coriander, garlic chives, spring onions...).

Do people say it works better?

More specific innovations and their adoption

1. Seedling production

Seedling production was introduced so that people could grow their crops from seed and also so that they could keep their own seed and could be more independent in terms of their gardening activities. Seedling production is discussed in detail in Chapter 4 of the Resource Material.

The overall outcomes of this process were very encouraging. The following extracts from the interviews give an indication of this. It also shows people trying to garden during winter, which was previously not attempted, but which was promoted in this learning process.

Table 14: Significant innovations (extract) – Seedling Production

Innovation	Yes	No	Tried but no longer in us or did not try	Adaptations made/ comments
Growing own seedlings	15	4	Do not know how – 1 Still going to try – 1	Saves money – 2 Works well – 1 I do not buy any more – 1 Grow well – 3
Growing during winter	9	10	Livestock a problem – 2 Frost a problem – 4 (black frost bad this year) No water – 4 Fencing is old – 1	Planted spinach, cabbage, onions, carrots, beetroot. Some problems with chickens – 1 Yes, but rats are causing a problem – 1
Kept seed	8	11	Harvested peanuts too late – 1 Did not wait long enough – 2 Goats ate everything – 1 Only kept masihlalisane as my garden is too small – 1 Did not think about it – 1	Masihlalisane – 7 Carrots – 5 Beetroot – 1 Peanuts – 3 (2 of the 3 ate all their seed as well) Green pepper (own) – 1 exchange seed with other learning group members
Peanut seed	10	9	Not at training; did not receive seed – 7	Do not know how to plant; did not get a lot of them – 3 Did not grow – 1

Innovation	Yes	No	Tried but no longer in us or did not try	Adaptations made/ comments
				Got rotten – 1 harvested a lot – 3 Kids really liked that – 1
Jugo bean seed	2	12	Not at training – 9 No space – 1	Did not plant them – 1
Mustard spinach seed NOTE: People did not realize the mustard spinach is the same as masihlalisane	7	12	Not at training – 7	Grows well – 6

From Table 14 above it can be seen that quite a few of the learning group participants kept seed. They were most successful at keeping the Masihlalisane seed. These plants seed easily and quickly. More than half of the respondents successfully grew peanuts from the seed provided, but only 3 of the 10 respondents managed to keep seed. Jugo beans, which are a traditional crop that was re-introduced on request from the participants, showed a surprisingly low uptake (14%). Learning group members that were asked said "it is an old thing" and that they had taken the seed for their grannies, but had no real intention to grow it. They do not eat it anymore.

Further, learning group participants who took some of the fruit (tree tomato) and herb (spring onions, garlic chives, fennel, parsley) seed, battled to grow them. These are mostly more specialized and require more attention to germinate and grow. Only 2 participants that the facilitators are aware of managed to grow fennel and granadilla respectively. For future interventions a different approach would be required. Seedlings and small plants will be provided instead of, or as well as seed.

2. Pest and disease control

A process of organic pest and disease control was introduced. This relies a lot more on working with natural processes and creating a balance of forces in one's garden; both of which are very new concepts to participants who have become used to the idea that there is a "one-poison-kills-all" remedy to any problem. Processes are described in detail in Chapter 4 of the Resource Material.

Assessments were made of whether participants observed natural processes more and were trying to work with elements in nature. Organic brews for control of specific pest outbreaks were introduced, as well as some physical barriers such as toilet paper rolls. The Napier fodder is included here. This was primarily introduced as a windbreak, but also as a physical barrier to pests and a preferred habitat of maize stalk borer. The grass is a good fodder for cattle. Below is an indication of how this went:

Table 15: Significant innovations (extract) – Pest and Disease Control

Innovation	Yes	No	Tried but no longer in us or did not try	Adaptations made/ comments
TP rolls (for cutworm)	7	11	Did not try – 8 Did not work well – 3 No cutworm – 2	Real help with cutworm – 4
Chilli-soap water	14	4	Plants were healthy and did not need it – 2 Did not know – 1 Bought chemicals from Familee Save – 1	Works well – 6 Really chases bugs – 1 Got rid of aphids – 4 Did not work well – 2
Fruit fly traps	0	17	Did not know – 7 Tried but it did not catch flies – 1 no fruit trees –1 No need – 1	
Garlic cloves for planting	7	10	Not at training – 7	Grew well, but did not eat it – 4 It dried up – 1 Does not understand how it is supposed to work – 1
Rosemary/Lemon Verbena cuttings	5	14	Did not grow – 5 Not at training – 9	Did grow; do not know how to use – 1
Napier	10	8	Did not grow – 2 Not at training – 5 Cattle ate them all – 1	Grows well – 8
Environmental awareness in the garden; promoting presence predators and friendly insects	6	13	Did not know – 6 Heard about it but have not really tried – 4 No bugs or frogs in my garden – 3	More frogs and bugs in my garden – 1 Told my family not to kill bugs and frogs – 1 I do not kill useful insects – 1 We do not kill frogs and bugs anymore – 2 I kill frogs, the rest I don't – 1

As expected, the use of the chilli-soap mixture, as a pest remedy, was taken on and used by learning group members with little difficulty (77%). The growing of the Napier fodder and use as a windbreak and fodder also went well (55% uptake). A few respondents did not manage to grow it (11%), but generally it is easy to grow, robust and prolific. In garden visits, facilitators

had to start cautioning the gardeners to thin out and move their clumps of Napier, which were starting to grow large and thick.

The introduction of cuttings of herbs did not go that well. This was done as an alternative to planting seed, but it turned out that participants found it almost impossible to keep their cuttings alive. Cuttings need to be in a sheltered place in well drained medium, be kept wet continuously and not be disturbed for quite a long period; a combination of factors that gardeners found very difficult to maintain.

The Fruit fly traps were a resounding failure; most people asked had forgotten about them; as they were introduced in July and fruit flies only become a problem around November-December. This gives emphasis to the point that **innovations need to be introduced in season to deal with an immediate problem**.

What is surprising is that around 32% of the respondents actually tried to encourage pest predators in their gardens (by not killing them!). From previous experience, this point has often been dismissed by participants as a bit "wacky" and not worth considering. Also, many women fear frogs, lizard, rodents and insects and do not want these creatures around them. They are killed for this reason more than any other.

4.3.4 Deep trenching

What is it, how is it different and how has it been refined?

Methods of trench bed construction

There are various ways in which trench beds can be made. A number of small pamphlets and published material are available from for example Lirapa (Care-Lesotho), Seeds of Learning, Peace Gardens, Eco-link, Production without Destruction, and Sequence from Lesotho Council of NGOs. Some examples of these materials are given as appendices to this document. Trench beds are discussed in some detail in Chapter 4 of the Resource Material.

Similarities in the proposed methods include:

- Digging a trench 60cm or deeper. It is usually about 1m wide (to provide easy access, without having to step on the bed) and can be as long as one likes, straight or curved;
- Separating the topsoil and subsoil in piles while you are digging;
- Placing a layer of tins or branches at the bottom of the trench to help with aeration and also with supply of some nutrients; and then
- Filling the trench with a range of organic materials before replacing the top-soil.

Differences in the proposed methods include:

- How the trench is filled:
    a. Some methods propose filling most of the trench with **a mixture** of organic matter (including grass, manure, kitchen waste, weeds, bones, some paper and cardboard, lime, etc) and then adding layers of manure and topsoil on top of that, or that the top soil and manure should be well mixed. Subsoil is not used.
    b. Other methods suggest that the subsoil should be placed on top of the

organic matter and mixed in (with a fork), before replacing the topsoil

c. Yet other methods suggest layering of materials such as grass-top soil-manure-top soil-ash-top soil, etc. as a process for filling the trench. This is almost like creating a compost heap underground. In these methods the layers are a lot thinner than for a and b above.

- Watering: some methods mention wetting the organic material well before replacing the soil over the bed and some others do not. In our experience it is imperative to ensure that the "filling" is wet, because when dry it would tend to absorb water from surrounding soil and plant growth would be less than optimal.

Management Required for Creating or Maintaining Favourable Chemical Conditions in Soils

There are mainly two soil chemical conditions that have strong adverse effects on plant growth and crop production, namely (Laker, 2007):

- High soil acidity (low pH); and
- Salinity/sodicity.

Soils with ***high acidity*** are found in high rainfall areas. The high acidity has developed due to the high degree of weathering and leaching experienced by the soils under high rainfall. Some of the problems associated with strongly acid soils include the following:

- Aluminium toxicity: This is a serious problem on some strongly acid soils. It causes stunted root growth and consequently poor plant growth and production. Roots that are affected by aluminium toxicity are typically very short with thick dark tips. It is relatively easy to distinguish between these and roots that are affected by soil compaction.
- Strong fixation of phosphorus into forms that is unavailable to plants, leading to serious P deficiencies.
- Deficiencies of calcium and/or magnesium due to strong leaching of these basic cations.
- Deficiencies of various trace elements, notably molybdenum and zinc.
- Low activity of favourable bacteria, e.g. nitrifying bacteria that convert nitrogen to nitrate, the most important form in which N is taken up by plants.
- Increased activity of some soil-borne fungal diseases of crops, e.g. club root of cabbage.

All these problems do not occur in all strongly acid soils. High soil acidity is corrected by liming the soil to a favourable pH. Amelioration of high subsoil acidity is a major problem in conventional agriculture because the lime does not leach well from the topsoil, where it is incorporated, into the subsoil. In the case of trench vegetable gardening, lime can be mixed into the soil layer-by-layer as the trench is filled up (or 'packed').

The amount of lime required to correct the pH of a soil differs widely between different soils. A general recipe cannot be used. Strongly acid clay soils, e.g. in KwaZulu-Natal, can require more than 10 tonnes of lime per hectare to obtain the desired effects. On the other hand, application of more than two tonnes per hectare lime on poorly buffered sandy soils can be harmful, e.g. with respect to causing traces element deficiencies.

Much research has been done on soil acidity and liming in the areas in South Africa where high soil acidity is a problem. From this and local experience with different soils, ball park figures for lime requirements can be estimated if analytical data cannot be obtained for a specific case.

Addition of large quantities of organic matter to soil also helps to reduce acidity. The results below were obtained from measurements at households in Potshini, KZN, and provides some comparison of the effect of deep-trenching, normal planting (shallow incorporation of manure in the planting holes), and the 'do nothing' option.

Table 16: Acidity in trench bed vs. normal planting vs. no till option.

Potshini - 6 March 2007 (Jody Sturdy)

Sample location	Depth	Exch acidity (cmol/l)	Total cations (cmol/l)	Acid sat %	pH (KCl)
Sizakele's trench bed	30cm	0.02	13.8	0	6.67
	0cm	0.03	13.77	0	5.49
Sizakele's normal bed	50cm	0.92	4.17	22	4.29
	20cm	1.23	6.1	20	4.09
	0cm	0.01	12	0	6.41
Dladla's normal garden	50cm	1.03	3.38	30	4.26
	0cm	0.1	6.68	1	4.99
Khethiwe's trench bed	0cm	0.05	7.21	1	4.87
Khethiwe's normal bed	0cm	0.09	6.9	1	5

Analysis by DoA Fertilizer Advisory Service

most favourable conditions

least favourable conditions

Note: This KZN laboratory uses the less common "cmol/l" as a unit, but the values are useful to indicate relative differences between beds and depths.

- In the 'do nothing' option (Dladla's normal garden), acidity was high throughout the root zone;
- In the beds with manure incorporated into the topsoil (Sizakele's normal bed), pH was almost neutral on the soil surface (0cm), but just as acidic as the 'do nothing' beds from 20cm and deeper; and
- In the trench beds, pH was close to neutral throughout the profile (i.e. at all depths) after one production season.

Repeated high doses of chicken manure, several seasons in a row, can increase soil acidity. Mixing chicken manure with other types of manure reduces the danger of acidification through overdosing (more detail on this follows later).

Salinity and/or sodicity problems are found in some soils in dry areas, as well as in soils on lower slopes on some parent materials. It is usually too expensive and difficult to ameliorate saline and sodic soils, although application of high organic matter levels can in some cases give positive effects.

Growing of crops that are tolerant to high salinity is an effective way to overcome the problem. Vegetable crops with high salt tolerance include garden beets, spinach and

asparagus. There is a wide range of vegetable crops with medium salt tolerance. The most noticeable one with low salt tolerance, i.e. which cannot be grown on such soils, is green beans.

Management Required for Creating or Maintaining Optimum Soil Fertility

Creating or maintaining optimum soil fertility is very important in an intensive production system like deep trench vegetable production. Soil fertility management usually deals only with the three major plant nutrients, namely nitrogen (N), phosphorus (P) and potassium (K). It is important to look also at other nutrients that are often deficient. Zinc (Zn) deficiencies are, for example, widespread in South African soils.

A few of the most important points in regard to the three major plants nutrients will be mentioned here.

- ***Phosphorus (P)***: Almost all virgin soils are highly deficient in P and crop production cannot succeed without adequate P applications. With the exception of light grey sandy soils, phosphorus does not move in soils, not even in red or yellow sands. In the red sandy soils at Vaalharts it was found that some soils contained excessive P levels in the plough layer (decreasing crop yields), but immediately below the plough layer the P level was even lower than in the virgin soil. This was despite intensive heavy flood irrigation over more than 30 years. Thus, it is essential that P must be incorporated physically to the required depth. Deep trench cultivation affords the opportunity to incorporate P to considerable depth, whether it is applied as inorganic fertilizer or organic material, such as manure.

  Phosphorus is the major plant nutrient for which "nutrient capital building" is possible. This means that by applying a high amount of P fertilizer (or manure), benefits can be obtained for a number of years – up to 5-10 years. In Brazil it has been found that this approach, together with small maintenance applications and sound agronomic practices, gave rates of return as high as 96% on the investment. This approach is especially valuable on high P-fixing acid clayey soils. In South Africa it was also found on the eastern Highveld of Mpumalanga that a once-off P application gave higher maize yields over a five year period than the same total amount split over five smaller equal portions. This is again an ideal scenario for deep trench cultivation. Such an approach is less effective on sandy soils with low P-fixing capacities, however.

Table 17: Phosphorus in trench bed vs. normal planting.

Potshini - 6 March 2007 (Jody Sturdy)

Sample location	Depth	P (mg/l)
Sizakele's trench bed	30cm	72
	0cm	86
Sizakele's normal bed	50cm	8
	20cm	8
	0cm	66
Dladla's normal garden	50cm	1
	0cm	23
Khethiwe's trench bed	0cm	98
Khethiwe's normal bed	0cm	42

Analysis by DoA Fertilizer Advisory Service

most favourable conditions

least favourable conditions

These results from Potshini, KZN, show the effect of organic matter on P:

- ❖ Very low in deeper soil layers in all non-trenched beds;
- ❖ Better in surface layers where organic matter has been incorporated; and
- ❖ In deep-trenched beds, P is high throughout the soil profile

➢ ***Nitrogen (N)***: The situation with nitrogen is totally different from that of phosphorus, in several respects. The plant-available nitrogen contents of soil are very variable over short periods of time. Nitrogen is strongly affected by microbial activity. Nitrogen in organic material is mineralised by soil microbes into inorganic forms in which it can be taken up by plants. The final product is nitrate. Since it is an anion, it is not adsorbed in soils and leaches out very quickly during heavy rains or excessive irrigation. Compost and manure are good sources of N, especially chicken manure. Annual applications of these in the cultivated layer can be very effective. The quantity of cattle manure applied by small-scale farmers in their maize fields is usually too small to supply adequate N, however. It should be kept in mind that in cattle manure, most of the nitrogen is in the urine, with very little in the solids. This makes preservation of N in the manure quite tricky. This is discussed in more detail later.

There is a misconception that inclusion of grain legumes (beans, peas) in a crop rotation will provide N for a non-legume crop that follows it in a rotation. The fact is that such legumes remove more N in the grain than they fix in the soil and actually need small N applications themselves. Even soybean, which has a high N-fixing capacity, concentrates N in the pods, adding little to the soil.

➢ ***Potassium (K)***: Many South African soils are well supplied with potassium, but some of the highly weathered soils in high rainfall areas have potassium deficiencies. Most vegetables require potassium fertilization to ensure a good quality crop. Potassium also increases the tolerance of crops to various diseases. Cattle manure has a high K content relative to N and P, with almost all of it originating from the urine. In contrast, chicken manure is low in potassium (K) relative to N and P.

Table 18: Potassium in trench bed vs. normal planting.

Potshini - 6 March 2007 (Jody Sturdy)

Sample location	Depth	K (mg/l)
Sizakele's trench bed	30cm	595
	0cm	602
Sizakele's normal bed	50cm	309
	20cm	484
	0cm	595
Dladla's normal garden	50cm	223
	0cm	323
Khethiwe's trench bed	0cm	470
Khethiwe's normal bed	0cm	452

Analysis by DoA Fertilizer Advisory Service

most favourable conditions

least favourable conditions

Results for K from the Potshini study follow a similar pattern to those for P: trenching provided the best effect throughout the soil profile.

In summary, for the three main plant nutrients, the results above have shown that deep trenching in Potshini has:

- ❖ Provided high P throughout the soil profile, which should suffice for a 5-10 year period.

This is an important advantage, because trying to add P later is made more difficult by its lack of mobility through the soil profile.

- Improved the levels of K, probably mainly through the incorporation of ash during trench packing/construction. K dissolves readily and can therefore move through the soil profile, but is not a volatile as N, and can therefore accumulate in the soil for use over longer periods.
- The N-levels, which reduce more dramatically within and between seasons, can be 'topped up' very effectively between plantings, by adding chicken manure (if available), or goat or cattle manure, or liquid manures prepared as described in the section on LEISA above. Topping up of N is more feasible, as it moves more easily through the profile than P.

The role and effects of organic matter was clearly shown and is discussed in more detail in Table 19 below.

Table 19: Summary of Management Required for Different Types of Soils (Laker, 2007)

Type(s) of soil	Improvement required	Management required	Remarks
Soils with: -"***Normal***" subsoils; -***Dense*** subsoils; or -***Layered*** subsoils	Creation of a deep, uniform, loose/friable soil for development of deep, effective root systems, good aeration and good water movement into deeper soil layers.	Deep trenching with thorough mixing in of large quantities of organic matter and phosphate fertilizer (superphosphate or bone meal) throughout the total soil depth.	Large quantities of organic matter must be applied. The organic matter must be mixed throughout the soil and must not be left in distinct layers.
Clay subsoils with: -***Prismacutanic*** ("beer can"); or -***Peducatunic*** (big blocks) structure	Creation of a deep enough layer of topsoil on top of the unfavourable subsoil.	Ridging of topsoil. Mixing of large quantities of organic matter into the ridges.	It must be ensured that no subsoil is included in the ridges. Flat ridges wide enough for two rows of crops are recommended.
Soils with ***water-logged*** subsoils	Removal of excess water by drainage. Creation of a deep enough layer of topsoil on top of the unfavourable subsoil.	Implementation of an effective drainage system. Ridging of topsoil and mixing of large quantities of organic matter into ridges.	It must be ensured that no subsoil is included in the ridges. Flat ridges wide enough for two rows are recommended.
Soils with strongly ***acidic*** subsoils	Correction of the high soil acidity. Creation of a deep, uniform, loose/friable soil for development of deep, effective root systems, good aeration and good water movement into deeper soil layers.	Deep trenching with thorough mixing in, throughout the total soil depth, of: -Lime; and -Large quantities of organic matter and phosphate fertilizer (superphosphate or bone meal).	Appropriate quantities of lime must be applied, according to the lime requirement of the soil. Large quantities of organic matter must be applied. Lime and organic matter must be mixed uniformly throughout the soil.
Saline and/or ***sodic*** (brack) soils	Removal of excess salts (saline soils). Removal of excess sodium (sodic soils).	Implementation of an effective drainage system. -Leaching of salts (saline soils). -Application of **both** gypsum and large quantities of organic matter and leaching of sodium (sodic soils).	Gypsum alone cannot reclaim sodic soils. Solubility of gypsum is too low to create the required conditions for leaching. Organic matter alone will create the required conditions for leaching, but cannot release sodium into solution.
Soils with very ***favourable*** subsoils	None	None	Fertility management required.

How to make a trench bed (refined method)

Introduction

A trench bed is a way to increase soil fertility and water holding in your beds and garden. It is an intensive way of providing good soil for vegetables production on a small scale. It involves digging a hole and filling it with organic matter, so that your bed can be fertile for a long time (around 5 years).

The Method

1. Dig a trench 60cm or deeper. It is usually about 1m wide (to provide easy access, without having to step on the bed) and can be as long as one likes.

2. Separate the topsoil and subsoil in piles while you are digging. If your sub-soil is very infertile it is not used in the trench. Spread this soil around the garden to help channel water towards your bed.

Mandla (in Phuthadjithaba) is digging his trench bed and placing the topsoil on one pile (darker soil with more organic matter) and the subsoil on another (usually lighter soil with little or no organic matter).

3. Place a layer of tins or branches at the bottom of the trench to help with aeration and also with supply of some nutrients. The tins need to be squashed before putting them in the hole. Make a layer of tins about 3 tins deep. If there are no tins use thin branches instead.

4. Fill the trench with a range of organic materials and top soil.

- First add dry grass or weeds (about 10 cm deep)

- Then add manure (about 2 cm deep)

- Add also some wood ash (a thin layer, less than 1cm deep).

- Then add a layer of top soil (about 5cm deep)

- Mix these layers with a fork
- Stamp them down by walking on them
- WATER the mixture well!

Then start the process again.

A trench bed in Phuthaditjhaba being filled, mixed and stamped down. Notice the mixture of manure, grass and soil.

A trench bed in Potshini being filled and mixed. Here the top soil is being added back into the trench. Notice the yellow subsoil on the one side. It is not being used.

You can also add other organic matter like green and dry weeds and vegetable peelings, card board, paper and bones.

5. Continue to place the organic materials into the trench until it has reached ground level again.

6. Now build up the trench bed to about 10-15cm above soil level. Use a good mixture of topsoil and manure and or compost.

Right: A recently completed trench bed.

The organic material in the trench needs to decompose for about 2-3 months before planting.

7. The other option is to use your trench bed as a seed bed. In this way, when your seedlings are ready to be transplanted, the trench bed will be ready to be planted.

Growing seedlings from seed needs a well prepared bed. The roots of the small plants do not go down deep. The materials in the trench can decompose while the seedlings grow on top.

Right: Carrot and onions seeds are being planted in a seed bed in Potshini. This trench had just been prepared.

Note: Fine soil is being used to cover the seeds in the rows. This is because the seeds are small and in this way they can germinate better.

In this picture a number of trench beds have been prepared in a garden in Potshini. The owner has used two of these trenches as seed beds. They are covered with grass to hold the moisture in the soil while the seeds are germinating. This grass will be removed when the seeds come up.

The middle bed is shaped like a horse shoe. This is a nice design that makes it easy to reach all sides of the bed. It also allows run-off water to run into the middle of the shoe and soak into your bed. Here the owner has planted Swiss chard seedlings. They grew well; despite our fears that the decomposition of the organic matter in the trench bed may interfere with their growth.

In this picture carrot seeds were planted in the smaller trench bed in the far corner. There are also two tubs of seedlings being produced.

In the foreground is a recently completed trench bed into which bought cabbage seedlings have been planted. Again these grew well and did not show any negative effects from the decomposing material in the trench.

8. It is very important that the trenches are watered well while they are being made and afterwards. The organic material in the trench cannot decompose if it is dry.

Different ways of watering are possible; as long as a lot of water is given!!!

In this picture, drip irrigation is going to be used to water a trench bed.

The Result

Later in the season (picture below) the cabbages in the trench bed with drip irrigation are growing well. And so are all the other crops planted in trench beds and watered with buckets.

Do people say it works better?

It has already been shown that **many respondents (73%) regarded the trench beds as the most significant change in their gardens.** This was surprising to the WRC team, as we were under the impression that uptake may be low due to the work involved in making the trenches and the fact that it takes some time to see results.

Respondents were asked: "How has the training helped you in your garden?" and they responded by mentioning their most significant innovations. The detailed results of the survey are shown in "Table 11: Significant Innovations" earlier in this document. Extracts are shown below.

Table 20: Adoption of innovations (extract) – Deep trenching

Innovation	SSI SURVEY		WRC SURVEY	
	No of innovators (divided by no of gardeners)	%	No of innovators (divided by no of respondents)	%
Deep trenching	14/28	**50%**	14/17	**82%**

Table 21: Significant innovations (extract) – Deep Trenching

INNOVATION (Gardens)	Yes	No	Tried but no longer in use or did not try (why not?)	Adaptations made / comments
Trench bed	14	3	Did not know – 1 (No reason – 1) Tried but did not see any difference – 1 Still going to try – 1 (Hard to dig – 1)	Makes soil fertile – 4 Plants grow fast – 1 Plants healthier – 1 Greater yield from trench bed – 2 Good for carrots; they grow deep – 2 Roots go deep – 2 Really works for me – 1 Makes soil loose and good root growth – 1

Judy Sturdy and Sizakele in her trench bed garden

How much better/worse?

Deep trenching increases soil water content

To investigate the effect of trenching and run-on on the soil water content, tensiometer readings were taken in trench beds vs. normal beds, and in normal beds with and without run-on ditches (see results for run-on in that section). Readings were taken at 20cm, 40cm and 80cm depths. Wetting front detectors were also installed at depths of 20cm and 40cm. The results for **trenched beds vs. normal beds** are shown on the left. These experiments are discussed in detail in Chapter 6 of the Resource Material.

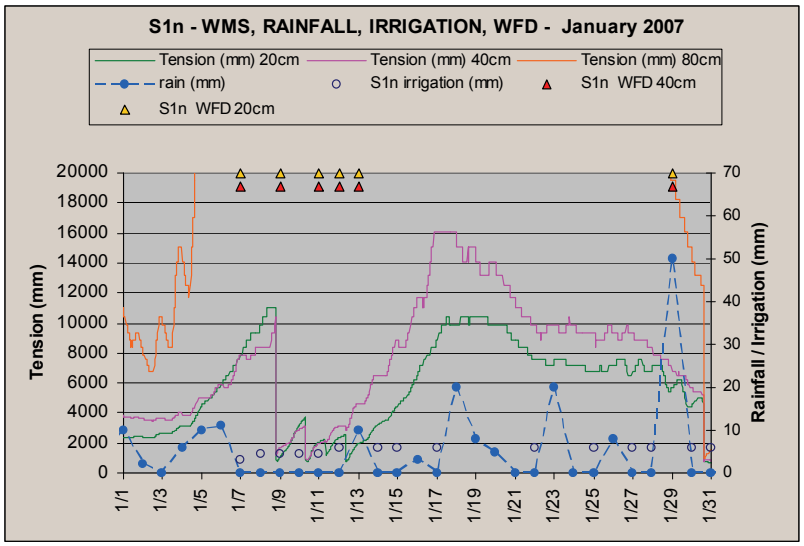


Figure 7: Sizakele's normal bed (S1n) – rainfall and irrigation (Jody Sturdy 2008)

Even though the same irrigation practises were used, and the same amount of water was given to each bed, the retention and availability of moisture in the two beds were very different.

The higher the tensiometer reading, the drier the soil. In the graph above (Figure 7), the deep subsoil (depicted by the red 80cm line) was drier than the shallower soil layers (pink-40cm and green-20cm), throughout the season. The conventional bed (S1n) dried out considerably, and was above 6 000mm tension – at all measured depths – for more than half the month. At 80cm depth, the soil was even drier. The red line dropped below the 6 000mm line only on the 31st of January, when the effect of a large rainfall event (50mm) two days earlier, finally got through to these deeper soil levels (Figure 7).

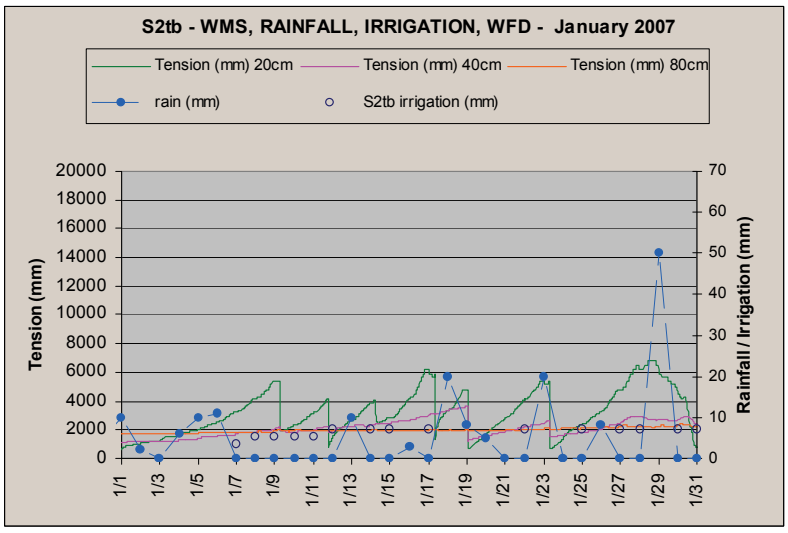


Figure 8: Sizakele's trench bed (S2tb) – rainfall and irrigation (Jody Sturdy, 2008)

In contrast, at all three depths (20cm, 40cm and 80cm), soil water content was much higher in the trench bed (S2tb, graph above), compared to the normal bed (S1n, graph above). This means that the full depth (or profile) of the trench bed remained moist throughout the month of January 2007, and the plants in the trench bed experienced no water shortage at any time.

Soil at all depths in the trench bed remains loose and crumbly due to the high organic matter content. All rainfall and irrigation water is thus easily absorbed – much less would run off and evaporate. Also, **water** *and* **oxygen** can move easily through the soil profile, meaning that plant roots can extract water at all depths.

4.3.5 Run-on

What is it, how is it different and how has it been refined?

Turning 'run-off' into 'run-on'

Run-on is 'automatic irrigation when it rains.' The soil in the garden is shaped to automatically catch the rainwater where it falls, slow it down and lead it gently to where it is needed; there it is then held back to seep into the planting beds (deep trenched beds). Excess water is allowed to escape before it can do damage (cause erosion) to the planting beds or the channels themselves. This excess can either be channelled to a storage structure for future use, or released into the veld to continue on its natural course downstream to the river.

This innovative technology (discussed in detail in Chapter 5 of the Resource Material) is based on the work and experimentation of MaTshepo Khumbane, who has a beautiful working system at her present homestead near Cullinan. The remnants of a similar system in her former homestead plot near Tzaneen of some 20 years ago, still nourishes the fruit trees, even though the present owners are unaware that there is a system at all. This system is the product of years of experimentation and refinement of practises in rainwater harvesting and storage and has been studied and documented, so that it could be used as an innovation that could be introduced to other householders in other circumstances.

Basically her run-on system (which is a sub-system of her larger homestead water management system) consists of the following elements:

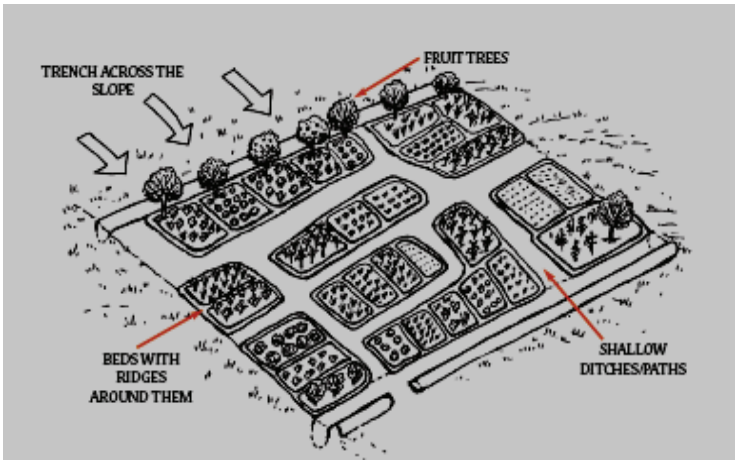
- A **cut-off trench** at the top of the garden to collect and infiltrate run-off water from the veld, road, or any other collection surfaces.
- **Deep-trenched raised planting beds**, with level surfaces and ridges around their edges to enable even water distribution across the bed. The beds and ridges are soft and porous and contain a lot of organic matter which acts as a sponge that soaks up water.
- To get water from the cut-off trench at the top of the garden to a position from where it can soak into the deep-trenched beds, a system of (i) collector pathways and (ii) shallow overflow ridges across the pathways, and (iii) the soft ridges around each trenched bed, work together as follows:
  - Water runs from the cut-off drain along the **collector pathways**, which are level sunken paths, stepped down according to the natural slope throughout the garden, and compacted so that they absorb minimal water, but rather act as channels.
  - These collector pathways lead the run-on water along to surround each trench bed, but the water is prevented from running straight onto the bed surface and causing damage, by the **soft porous ridges that form the edges of each bed**. In other words, the water soaks through the soft ridges and into the deep-trenched beds, never overtopping the ridges.
  - The contact time of water with the soft edges, and thus the amount of water that can soak into the trench, is prolonged by **shallow overflow ridges** that are made at various intervals across the collector pathways, which encourage temporary ponding in the collector pathways. These shallow overflow ridges are lower than the soft edges surrounding the trenches; therefore excess water can escape across every successive overflow ridge before overtopping

the soft edges and washing onto the bed surface, which would cause erosion of the trench bed and damage to the plants.

- For large rainfall events, during which excess water may flow over the last overflow ridge and out of the garden, two further elements are of interest:
  - Another **larger ditch**/drain is dug along the bottom edge of the garden, which ponds water along the bottom edges of the last row of trenches, providing a further opportunity for water to soak into that line of trench beds; and
  - **Escape routes** are made that can lead excess water elsewhere; either to a water storage container, another portion of the garden, or any other place where it could be useful.

The drawing and illustrated pictures below show the elements mentioned above. These illustrations are used to introduce the idea of run-on to learning group participants.

This diagram and the pictures below show the detail of MaTshepo Khumbane's system at her home near Cullinan.



In this picture the yellow arrows depict the run-off that is used as run-on in the collector paths (blue lined areas).

The blue areas depict the run-on along the compacted collector paths, and infiltration through the soft porous edges into the deep-trenched beds. The bed edges also help to hold back rainwater that falls directly onto the trench beds.

Do people say it works better?

Adoption of innovations introduced through the learning group

One volunteer, Thabani Dladla, took on the run-on ditches as an experiment. However, he did not plant the same crops in his control plot and his experimental plot, so that direct comparison was not really possible.

Participants in the learning workshops felt that they would need guidance and assistance in their gardens to set up a run-on system at their homes. A few did go home and dug a ditch or two to lead water to some of the beds in their gardens.

Table 22: Adoption of innovations (extract) – Run-on Ditches

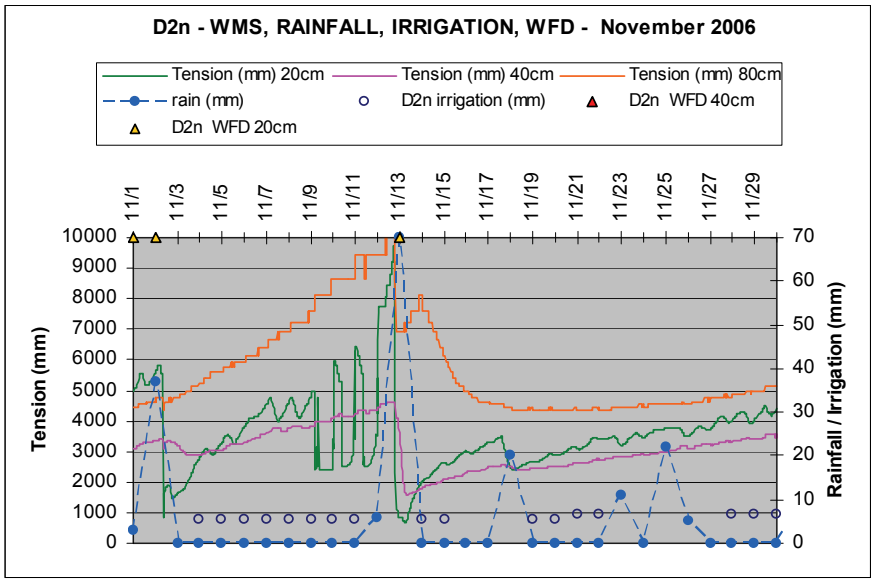
Innovation	SSI SURVEY		WRC SURVEY	
	No of innovators (divided by no of gardeners)	%	No of innovators (divided by no of respondents)	%
Run-on ditches	5/28	**18%**	9/18	**50%**

Table 23: Significant innovations (extract) – Run-on Ditches

INNOVATION (Gardens)	Yes	No	Tried but no longer in use or did not try (why not?)	Adaptations made / comments
Run-on ditches	9	9	Did not know about it – 4 My garden is too small – 2 New garden – 1 Could not make it work – 1	I did not have to water in summer – 1 Retains moisture and saves water – 1 Perfect – 1 Good results – 1 Easy way to water the garden – 1 You do not need to water when it rains – 1

How much better/worse?

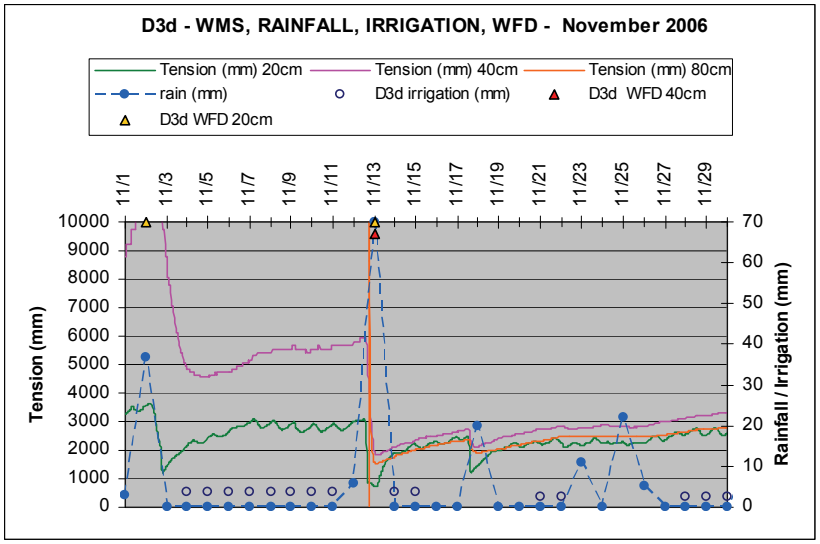
Run-on increases water content in the root zone



To investigate the effect of run-on and trenching on the soil water content, tensiometer readings were taken in normal beds with and without run-on ditches. Readings were taken at 20cm, 40cm and 80cm depths. Wetting front detectors were also installed at depths of 20cm and 40cm. The results for **normal beds with and without run-on** are shown.

Figure 9: Thabani Dladla's normal beds (D2n) – rainfall and irrigation (Jody Sturdy, 2008)

The run-on ditches **increase water flows** to the beds during rainstorms, and allows water to **pond** around the planting beds, so that there is more time for water to **seep** into the soil.



The higher the tensiometer reading, the drier the soil. In the graph on the left, the deep subsoil (depicted by the red 80cm line) was drier than the shallower soil layers (pink-40cm and green-20cm), throughout the season.

Figure 10: Thabani Dladla's beds with run-on ditches (D3d) – rainfall and irrigation. (Jody Sturdy, 2008)

In Thabani Dladla's garden, the bed without run-on (Figure 9) started the month with a wetter profile than the bed with run-on ditches (Figure 10). However, the rainfall on January 2nd had more effect on the bed with run-on: see how sharply the green and pink lines dipped, while only the green line (20cm depth) moved down slightly in the bed without run-on. Still, the effect was not large enough to reach the deeper layers (the red line) in the bed without run-on continued to dry out (rise) at almost the same rate as before, while the soil at 80cm depth was still so dry, that no red line was visible in the bed with run-on.

The next rainfall event was very large, almost 80mm over two days (10-11 Jan). This time there was not much difference between the two beds in the reaction of the shallower soil layers (green and pink reacted much the same). However, the effect on the deep soil layers (red line) in the **bed with run-on** was much more **immediate** (it was thoroughly wet on the very same day, while the bed without run-on only started showing an effect a few days later), and much more **dramatic** (the tension dropped to below 2 000mm in the bed with run-on, while in the bed without run-on it came down to only about 4 500mm).

Therefore, despite having started the month with a much drier profile, the bed with run-on ended the month with a wetter profile at all soil depths than the bed without run-on.

The bed with run-on clearly benefitted more from the effect of available rainfall than the bed without run-on.

4.3.6 Raw water storage in Rain Water Harvesting Dams

What is it, how is it different and how has it been refined?

A special coordination meeting was held between WRC and Department of Water Affairs and Forestry (DWAF) in the early stages of this WRC research project and collaboration was agreed between this WRC project and the DWAF Rain Water Harvesting pilot programme. Good synergy was achieved in the following respects:

- DWAF provided funding as part of its Pilot Programme for the construction of 17 RWH Dams at various of the WRC research sites for this study, including Phuthaditjaba, Potshini, Umbumbulu, Ndonga and Ngcobo (Jumba);
- The WRC team also used the results of other Pilot Programme sites (a total of more than sixty sites in four provinces) in its analysis for the WRC reports;
- The development of RWH Implementation Guidelines for the DWAF RWH programme drew on lessons learnt through the WRC research; and

- ❖ It is intended that the WRC training material developed through this research project will be used as the basis for future household training in the DWAF RWH programme. This implies immediate uptake and dissemination of the WRC results within an institutionalised framework.

How does raw water storage fit into a household water management strategy?

In recent years, the concept of Multiple Use Systems (MUS) has been introduced into water management planning. This moves us away from a singular focus on purified piped water at RDP levels as a basic requirement for all, to recognition that different water sources and systems can be used for different family needs. In reality, a household needs relatively small quantities of (expensive) drinking-standard water, but also need larger quantities of water – with varying quality requirements – for other domestic uses (such as body washing and laundry) and particularly for productive purposes (such as food gardening, animal watering, brick making, etc).

Raw water storage for home food production captures run-off from the soil surface during rainstorms, and stores it for use during dry periods, usually in underground tanks, now often called Rain Water Harvesting (RWH) Dams.

This RWH Dam fills from surface run-off, and has a safe overflow structure in the foreground. Notice the good quality roofing material with a sturdy trap door back right.

The concept of raw water storage for home food production follows on from, and is best used in conjunction with the practices of deep trenching and run-on:

- ➢ As described in the sections above, deep trenching and run-on enables considerable **intensification** by concentrating water and plant nutrients in the plant rooting zone in the soil, in an affordable manner.
- ➢ Raw water storage is an **additional strategy** which provides **water security** as follows:
  - ◘ In *dry spells during the rainy season*, thereby providing security against food losses for the family; and
  - ◘ By enabling production during the *dry season*, thereby providing a source of food to the household during the off-season period when production was traditionally not possible.

In most parts of South Africa, storage of roof run-off in above-ground tanks does not contribute to food production, for two main reasons:

- Roof run-off provides very much less water than surface water, meaning that the tank does not fill up regularly enough to enable sufficient water for food production; and
- Roof run-off is generally clean enough for drinking. In rural areas, drinking water remains scarce and unreliable, meaning that most households would nurture the water in such above-ground tanks for that purpose, and would not readily use it for production.

Gogela, EC. Roof run-off tanks provide too little water for food production. This household, like most others with roof run-off tanks, save this water for drinking and cooking.

Raw water storage for home food production therefore focuses on the storage of relatively large volumes of water (typically 20 000-30 000 litre) in underground tanks; whereas roof run-off is stored for drinking purposes in above-ground tanks (typically 2 000-5 000 litre). The underground RWH Dams are thus typically six times the size of roof run-off tanks for drinking water.

Do people say it works better?

Introduction

Field visits were conducted in Eastern Cape in September 2007, to assess the effects at DWAF RWH Demonstration Households whose RWH Dams had been constructed in early 2006 (approximately 18 months earlier). A total of 27 gardens were visited, of which 21 had 30 000 litre underground RWH Dams. The villages visited were in Qumbu (North of Mthatha), Gogela (Kokstad area), several villages in the mountains surrounding Port St Johns, Jumba area near Ngcobo, and several villages in the Ndonga area near Queenstown.

1	T	GH	FH
2	T	GH	FH
3	T	GH	FH
4	T	GH	FH
5	T	GH	FH
6	T	GH	FH
7	T	GH	FH
8	T	GH	FH
9	T	GH	FH
10	T	GH	S/FH
11	T	GH	FM
12	T	GH	FM
13	T	GH	FM
14	T	GH	FL
15	T	GM	FH
16	T	GM	S/FH
17	T	GM	FM
18	T	GL	FH
19	T	GL	S/FH
20	T	GL	FM
21	T	GL	FM

The following results show a clear trend of households that were poorer, and thus more dependent on their gardens for food FH, were more likely to maintain high gardening GH activity. This was true for households with and without RWH Dams.

Households with Rain Water Harvesting Dams

The utilisation of Rain Water Harvesting Dams was relatively high:

- Of 21 demo sites with RWH Dams, 14 (67%) were still maintaining a high level of gardening activity GH, about 18 months after their RWH Dams were completed. One of these is a school with high food needs S/FH.
- Of the seven demo sites with medium GM or low gardening GL

activity, two are schools, and three households had other interests and income, and thus had medium FM to low food needs FL from their garden. One was very poor and the tank roof had blown off (see below). Finally, in one household garden which we rated as medium gardening activity, there was in fact thick cabbage stems remnant from a previous crop, and the household had already placed heaps of manure all over the garden to prepare for the next planting; during our visit, the household was using the tank water to add a room to the house.

- One homestead where the RWH Dam is not being utilised, is situated right on the watershed, so that little run-off flows into the Dam. As this household has alternative sources of income, it has not been a high priority for them to try to maximise flows from the roofs into the RWH Dam. This confirms the guideline that the most important factor that determines the positioning of the RWH Dam is availability of flows into the Dam.

Low income households were more dependent on, and committed to, food gardening:

- Of 14 households with high gardening activity, 9 (64%) had high food needs from gardening, while only one had low food needs from the garden (i.e. had enough other income sources to buy food).
- Only one each of households with medium (#15) and low (#18) gardening activity had high food needs from gardening.
- The single case (#18) where a household with high food needs from their garden had low gardening activity, the tank roof had blown off. She is a single parent, very poor, and was in hospital for the birth of her second child during the field visit. The roofing material was safely stored at her mother's house some distance away.
- Of the two schools that had medium and low gardening activity, one (#19) had a problem with the tank roof having blown off, while the other school had just finished construction of their tank a few days prior to the field visit (#15).
- Half of the households with low gardening activity had only medium to low needs for food from their garden, as they had alternative sources of income (#20, #21).

Households without Rain Water Harvesting Dams

22	NT	GH	FH
23	NT	GH	FH
24	NT	GH	FH
25	NT	GH	FL
26	NT	GM	S/FH
27	NT	GL	S/FH

- Of four households with no RWH Dam, but with high gardening activity GH, three (75%) were highly dependent on their gardens for food FH. It seems that only one of these avid gardeners (#25) was not motivated into production by a need for food, as it appears that he could comfortably have bought food from other income FL.

T=Tank means the households has a rwh tank

NT means the household has no rwh tank

Comments from Rain Water Harvesting Demonstration Households

Representatives from RWH Demonstration Households were asked whether and how the RWH Dams have made a difference to their household. Most significantly, even experienced gardening households were upbeat about the difference they felt: two households who had both been dedicated home food gardeners for more than ten years, stated that in the past winter they have had complete peace of mind about food, as they could now grow food even in the dry season. Also, they were confident that they were now secure from crop losses due to dry spells during rainy seasons.

Asked whether they would change anything about the design of their RWH Dams, no-one wanted to change anything, with two exceptions:

- Zwelake School, near Port St John's, wanted to change the trapdoor in their RWH Dam's roof to provide easier access to the water for the children. The trapdoor on this roof was too far from the edge, necessitating the children to climb onto the roof to extract water. (Also see further discussion of this situation at Zwelake school in the section on "Treadle Pumps and other manual pumps" below).

The grassed run-off channel (left) leading to this silt trap (above) is very effective in removing impurities. The silt trap has an overflow to the right of the picture above, leaving a limited pool of stagnant water after a rain event.

4.3.7 Bag Gardens and Tower Gardens

What is it, how is it different and how has it been refined?

Introduction

'**Bag gardening**' is a specific gardening technique that provides a small intensive food garden at the kitchen door, which can use grey water, and is easy to maintain once constructed. It became known in South Africa through contact with Kenyan examples. Bag gardens are discussed in detail in Chapter 4 of the Resource Material.

In its simplest form, it is an upright 'gunny bag' filled with a fertile soil mixture, with a porous core made down the centre to ensure even water distribution throughout the soil mass. Vegetables are planted through holes made in the sides of the bag, and on the top surface.

Right: A recently planted bag garden. Another two weeks, and the cloth would be almost completely hidden by the extent of the plant growth in this bag! Note the sticks protruding from the centre of the bag to create a porous core for even water distribution.

In mountainous Lesotho, which has an effective growing season of only about three months, women carry their 'gunny bag' gardens indoors at night and during cold spells. This provides them with vegetables when crops planted outside cannot survive the severe climate.

Two further variations of bag gardening is found in South Africa, namely:

- The larger upright bag garden, in South Africa this is called a '**Tower Garden**'. Instead of a single bag, several bags are sewn together, or other suitable cloth like shade-netting is used, if available. The porous core is constructed of flat rocks. Tower gardens can increase the planting space fourfold compared to conventional ground level gardens;
- The horizontal or '**Flat Bag' Garden**, which is filled like the gunny bag, but placed down flat on its side. This obviates the need for a porous core; instead, it is watered by inverting a two-litre plastic cool drink bottle in the centre of the bag. The bottle is left in place for up to a week to supply a slow trickle of water to the bag garden. Up to fifteen spinach plants can be grown in each Flat Bag, which shows the intensive nature of production in these bag gardens.

Below: Mrs Mahangu, Ndonga, with her Tower Garden in its third year of production.

Right: This Flat Bag garden belongs to Mrs Linda Ngatsane, Female Farmer of the Year 2007, and Shoprite/Checkers Woman of the Year. Note the upturned bottle for slow, continuous irrigation of up to a week!

Bag Gardens and Tower Gardens can be made anywhere conveniently close to a home, for instance outside the kitchen door. This makes it easy to water them with grey water from the kitchen, and makes it possible to pick vegetables even during the cooking process! Anyone can make these gardens, but they are particularly useful for older or vulnerable people, as one does not need to walk far, nor bend down a lot. A well-maintained tower garden could yield vegetables winter and summer for at least three years. However, one must ensure that goats and chickens cannot get to the tower garden and destroy it.

Making the most of grey water

Grey water refers to water that had already been used for domestic purposes; such as washing of dishes and clothes. In many cases, water has to be carried from the nearest stand-pipe in plastic containers, not for the purpose of gardening, but for cooking and washing. This water can successfully be re-used for growing vegetables. This is a way of saving water, especially as water is very scarce in most areas.

Although gardeners were initially very sceptical that vegetables could be grown successfully with soapy water. However, the results speak for themselves and once they mastered the management of the system, the results were good:

- Gardeners were convinced: Vegetables can grow successfully with soapy water!
- Every day, the available grey water is poured into the Tower or Bag Garden. The soapy water is cleared out of the system by pouring two buckets of clean water into the column, once a week.
- One can also reduce the soap in grey water by spreading some wood-ash on the water surface and leaving it in a container overnight to settle before using it for the plants.

This is lazy gardening

One of the main attractions of the method is that little labour or attention is required and this appeals to all busy gardeners. Once people have become familiar with the Tower Gardens, they prefer to position them right at the back door so that it is easy to pour the wastewater into the tower.

It is difficult to predict how much water is required: in full production, two to three 20 litre buckets will be needed, while one bucket should suffice in winter. If water forms a puddle around the bottom of the tower or bag, it is an indication that too much water is being applied and the obvious answer is to make a second tower!

What vegetables can be grown?

Bag and Tower Gardens are ideal for leafy crops, typically the various varieties of **spinach**, which are planted through holes made in the sides of the bag or cloth. Ideally, the holes should not be directly above one another, but should be staggered diagonally for more sunlight and space for root development.

Tomatoes and **onions** can be planted in the top layer and, if crops require trellising, this can be provided by extending the vertical uprights and joining them with wire or string.

Where possible, companion crops should be grown for biological control of disease and pests. **Garlic** and **onions** are particularly useful.

Left: Participants in Potshini are planting spinach into the sides of the newly prepared tower garden. Tomatoes and onions will be planted on the top surface.

Right: Note how taller-growing crops have been planted on the top surface of this Tower Garden (i.e. at about waist height).

An unexpected benefit is the way in which the vegetables have **thrived in severe heat wave conditions** that have proved too much for conventionally planted gardens. The reason for this is not quite clear. Possible factors are the free air circulation, lower soil temperature and the better moisture status of the soil.

It is not claimed that towers would be able to provide all the food a family needs, but the contribution made to nutrition and eating pleasure is very considerable.

Do people say it works better?

Makuleke

Tower gardens were first introduced in South Africa in 2003, in Makuleke village, in the far Northern parts of Limpopo Province. Some of those households still use Tower Gardens today, almost five years later.

Potshini

In Potshini, the Tower Garden was introduced in two homesteads (Mrs Benghu and Mr Mdakane). Both are elderly people with a physical handicap. It took some effort to construct the towers. They require a lot of manure, flat stones and ash. Oddly, it was the hardest to find enough ash. In Potshini, the poorer people no longer use firewood as it needs to be bought in and costs too much. Wood ash is therefore not easily available. The poorest often do not own cattle, therefore manure has to be found elsewhere. The Tower Garden relies on bought inputs, in this case, shade cloth from which the tower is constructed. This has been a real limitation in terms of other learning group members taking on the idea. No-one else has tried it. They all said they would need the shade cloth before they could do it.

The comments from the two implementers were very positive. Mr Mdakane and his wife reported being very happy with the tower garden and were impressed by how well the plants grew and how long they could harvest spinach from the tower. Their tomatoes were so lush that they actually crowded each other out, and Mrs Mdakane mentioned planting less next time. They also mentioned that water sometimes seeps out the bottom, and realised that this was when they had overwatered their tower. They used it as a way to manage how much to water.

Cala 60 towers

In a rural area in Eastern Cape, some distance from the town Cala, some 60 tower gardens were constructed during 2005. The village where it was constructed is extremely remote: there was no road for the last 1.5km to the village. The Tower Gardens were constructed by households after training was provided from extension officers who were trained by us beforehand at Ndonga. The material for the Tower Gardens was provided by the East Cape Development Association (ECDA) under the Siyazondla programme.

The initial success was very significant and when they took the local Mayor there to show him he was so taken aback by the poor accessibility of the village that he organised for a road to be built to the village.

Unfortunately, after three years we could only find one Tower Garden still in operation. All the others were built in their fenced off grain growing area. During summer it was no problem, but during winter when the maize was off, the goats were let in to graze as usual. This of course finished off any greenery on the Tower Garden in no time! As was mentioned before, when a Tower Garden is left to dry out, it is very difficult to get it going again.

The main problem of these gardens is that they were not built in the right position and were not well protected. The single surviving Tower Garden in this village was different, in that it had been built close to the house, and had its own fencing, made of abandoned steel bed bases.

A few other places also had some introduction to tower gardens. Some of these were visited at Kokstad. Unfortunately none of what we saw were operational. They were made with plastic – woven fertiliser bag material and were too big in girth, making it difficult to tend the crops planted on top.

We concluded that the facilitators or extension staff were not adequately exposed and trained in the successful construction and operation of the system.

How much better/worse?

No measurements were taken in terms of yields, but one of the families that implemented this technology successful over more than four years reports that they harvested Swiss chard continuously over this time. Sometimes a plant lasted up to a year before it was replaced. Thus 40 plants yielding spinach on a continuous basis provided more than enough of this vegetable for an average family.

4.3.8 Treadle pumps and other manual pumps

What is it, how is it different and how has it been refined?

A Hose for All

The conventional hosepipe is used wherever water is available through taps and under pressure. With a hosepipe, water can be delivered to any point without the need for laying pipelines or making furrows. So far, this versatility has been denied to rural dwellers that do not have free access to water under pressure. The treadle pump can fill this gap, no matter what purpose there is for using this water.

The hose/treadle pump combination can be used for distributing domestic water supply from a container filled at a tap or hand pump to dwellings, garden beds and clothes washing areas, obviating the need to carry water. It would also be possible to draw water from springs and streams without having to clamber down into the streambed, and to deliver the water into drums or other containers at a higher level. The combination would be eminently suitable for irrigating community gardens, where providing water under pressure is seldom possible.

With a water supply at one end and a hosepipe at the other, the possibilities of treadle pump are endless.

What is a Treadle Pump?

Treadle pumps are mostly operated by one person at a time and, because they depend on human power, they pump relatively small amounts of water compared with motor pumps.

They are therefore suitable for users who do not need as much water as a motor pump produces or who cannot afford a motor pump, or do not have cash to pay diesel, petrol or electricity for pumping. When a family produces food mainly for own consumption, they try to limit cash expenses as much as possible, as the food production activity itself does not generate cash.

A standard pressure treadle pump can generally lift water 20 meters vertically, or drive it at least 200 meters horizontally, depending on the pipe diameter. The number of litres that a treadle pump can pump depends on the strength, age, fitness and gender of the person operating the pump, and on the height to which the water must be raised. It averages out at 0.4 litres per second. This means that it takes much less time and effort to pump the water than to collect it in another way, such as carrying it in buckets. The table below shows how long it would take to pump the water required for a household of five people, or for irrigating various sizes of land.

Table 24: Pumping times for household and irrigation water requirements

Household water, 25 ℓ/d for 8 people = 6 kl/month	Volume litre (ℓ)		Number of 10-liter buckets	Pumping time (hh:mm) at various pumping rates		
				0.4 litre/s	0.8 litre/s	1 litre/s
Daily	125		12.5	00:05	00:03	00:02
Weekly	875		87.5	00:36	00:18	00:15
Weekly irrigation requirement (mm)	**Area (m^2)**	**Volume (litre)ℓ**	**Number of 10-liter (ℓ) buckets**	**Pumping time (hh:mm) at various pumping rates**		
				0.4 litre/s	**0.8 litre/s**	**1 litre/s**
1mm	1	1	0.1	2 sec	1 sec	1 sec
Baseline (above): One litre of water is needed to put 1 mm irrigation on 1 square meter. *This would take 5 seconds with a treadle pump at 0.2 litre (ℓ) /second pumping rate.*						
25mm	1	25	2.5	00:01	00:01	00:01
	10	250	25	00:10	00:05	00:04
	50	1250	125	00:52	00:26	00:20
	100	2500	250	1:44	00:52	00:41
	150	3750	375	2:36	1:18	1:02
	250	6250	625	4:20	2:10	1:44
	500	12500	1250	8:40	4:20	3:28
	1000	25000	2500	17:21	8:40	6:56
Highlighted example (above): *A person would need to pump 52 minutes per week (e.g. **10 minutes per day** for 5 days out of a week) to supply 25 mm of irrigation to a **100 m^2 home food garden**, using a 0.8 litre/second pump.*						

Applications and Specifications

It has not yet been generally appreciated that the specification of the pump must be seen in relation to its particular application before a new pump design can be developed, and even before purchasing a pump from an available range. A pump must be capable of lifting the water to the desired level and have the right flow rate. It must be strong enough to cope with the conditions but, if circumstances require portability, e.g. if it needs to be stored in a safe place, it must be portable. There may be a requirement for high output for short shifts, or for longer operation with minimum physical effort. This places a premium on modular design and the facility to cater for the development of alternative models.

Because there is a limited tradition of irrigation, South Africa does not have a 'natural market' for treadle pumps. This requires more attention to the role of the pumps under the wide range of circumstances encountered in practice. The following questions need to be considered to form a picture of what households in a particular community are presently doing:

- *Are they watering gardens now, when, what with, how much, how frequently?* If the people do not water their gardens now, there is probably either no water available, or people in the area feel irrigation is out of their reach, or irrigation is not considered because it had not been practised in the area before.
- *What is the water source, access to potable water (the first priority), distance, suction height, and pumping height?* If the water source is not accessible by treadle pump, there is no point in promoting it.
- *Will attention have to be given to water sources, spring protection, small dams, wells in dry stream beds, wetland protection, household rainwater harvesting dams, etc?* If the water source is accessible by treadle pump, the water source may need to be modified in order to make it suitable for pumping.
- *What limits irrigation – fenced land, or water, or time and effort to get the water distributed?* If the limits to irrigation cannot be overcome, there is no point in promoting treadle pumps or food gardening.
- *Will the pump be communally owned or shared or individually owned; must it be locked up at night?* If the pump must be shared or locked up at night, it must be portable.
- *Who will be doing the pumping, and when, and will this vary?* For example, if the pumping will be done by children on Saturdays, the pump must be light to operate and there must be storage for the water so that other people can use the water during the week.
- *What irrigation method/s are envisaged: furrow, basin, bucket from drum storage, mini sprinkle, drum/drip etc?* The answer to this question affects the flow rate of the pump that must be recommended, the length of hosepipe that is necessary, and how the water should be stored.
- *How would the pumps be distributed and sold – through local stores, hardware channels, NGOs, etc?* This affects planning and costing for warehousing, advertising, training and representatives.
- *Price, credit, spares back-up?* These also affect planning and costing for warehousing, advertising, training and follow-up.

In trying to answer these questions, it becomes apparent that it could be less than ideal to try and fit an existing pump to the requirements; ideally, an appropriate pump should be designed according to local requirements.

This raised four other very interesting and important questions.

1. **What are the actual crop irrigation requirements?** When one studies this from research results and field observations and from using the simulations available from SAPWAT, it becomes evident that there is probably a tendency to over-estimate the water that is required, and that probably most people give far more water than is really necessary, which can be detrimental. In this case, it means that the capacity of the standard pump is may be too high.
2. **Is it necessary to have a two-cylinder pump?** There are good reasons for having two cylinders, such as getting a uniform flow and evening out the treadling action, but if smaller flows are required, a single-cylinder unit may suffice. This has

been developed in Kenya recently and, because of the fewer components that it uses, particularly valves and pistons, it cuts the cost very significantly.

3. Taking it further, one starts to wonder: **Is it really necessary to have a treadle pump at all?** Possibly a more conventional hand-operated pump, stirrup pump with a single cylinder or hand-operated diaphragm pump would be adequate for most of the purposes for which the pump is likely to be used. In some cases this may bring the cost down considerably.
4. **Will there be more use for the treadle pump in the household for potable water supply than for irrigation?** If so, this must be taken into account in pump design and supply.

The treadle pump market in South Africa is still relatively undeveloped, which dampens possibilities for dew designs. Good quality units imported from Kenya are currently more affordable than locally manufactured units.

Do people say it works better?

A number of units of the Super Money-maker treadle pump were imported from Kenya and introduced in Athol in Bushbuckridge and in Strydkraal in Sekhukhune. Hand-operated diaphragm pumps were introduced in one of the WRC sites, namely Jumba area.

Several manual pump types and uses in Strydkraal

In Strydkraal, a range of pumps have been made available informally over the years, starting with some units of the South African developed Kit Treadle Pump. Local artisans were trained in the assembly of the Kit Pump. Later, one unit of the newer, single cylinder Hip Pump was introduced, followed shortly afterwards by the introduction of the Super Money-maker.

The Super Money-maker has so far been the preferred pump among those introduced in Strydkraal.

Treadle pumps were introduced in Strydkraal primarily to simplify water extraction from Rainwater Harvesting Dams which the households themselves had constructed some two years previously. The WRC team was surprised to observe that there was limited enthusiasm for the pumps once they arrived. When the households were probed about this, they said that they had become so used to extracting water by bucket, that they did not consider this a major problem at all. However, once they became used to the pumps, they were used regularly and were much appreciated.

The need for the treadle pump was much greater for Emily Masha, whose garden and RWH Dam are separated by a fence, a situation which had previously required her to walk around the garden to extract water from her dam.

There was much banter between Emily and her husband, who sometimes borrowed her pump and carted it down to the river to pump water for sale to builders, and for emergency domestic water when the municipal system was down.

Some experiences with diaphragm pumps in Jumba area

Elucwecwe Clinic

Right: Determined and committed: volunteer members of the Home Based Carers group at Elucwecwe in Jumba area and their vegetable garden below. The RWH dam, diaphragm pump and drum are visible in the back below.

The members of the Elucwecwe Home Based Carers group are extremely busy, and have little time to discuss their garden, before the one or the other needs to be excused to conduct a counselling session, or provide some other related service in support of vulnerable households in their area.

But lack of time to discuss their food garden does not mean that it is unimportant to them: every morning before children go off to school, these women use vegetables from their garden to prepare meals at the homes of some 38 local families – especially for clinic patients who must eat before they can safely take medication, whether for TB, HIV/AIDS, or other ailments.

For them, gardening is a means to an end in their very busy day schedule, and therefore they find the diaphragm pump and drip irrigation combination too time consuming: currently, someone had to take the time to pump water into the overhead drum, which would then slowly trickle out onto the plants, and thereafter someone had to return to the garden to pump and so refill the drum. This causes conflicting demands on their time, and hampered them in their movements around the village to tend to their caring duties. It also increased their travel costs.

They were seeking advice on a more suitable arrangement for them that would enable them to complete this task more quickly. They felt they needed to extract water more rapidly from their RWH Dam, and be able to apply it more quickly to the plants. They contemplated whether they would be able to siphon into open drums and irrigate by bucket if they shifted their cropping lower down in their garden plot.

Sisipho Palaza

Left: Mr Sisipho Palaza operating his diaphragm pump. Water is pumped from his RWH Dam in the background, into a 200 liter overhead drum (see picture below). This water is supplied via a drip system to crops in his mini-tunnel (on the right in the picture below), and to his trench beds (on the left in the picture below).

Below: Mr Palaza keeps a record of rainfall and vegetable sales in what he calls "my book of water, my book of life." In his first production season, he recorded 498mm rainfall, and sales of R662.

Mr Palaza finds the diaphragm pump a suitable solution for his circumstances in his homestead vegetable garden. He fills the overhead drum, and while this slowly trickles out onto his crops, he can carry on with any of a number of tasks in and around his home: tending the plants, animals, children, or people arriving to buy some vegetables.

Some applications for the innovative Pipe Pump

The WRC team has developed an innovative low cost pump, which is simple to assemble from off-the-shelf components. Called the Pipe Pump, it has not been implemented and tested widely, but has raised considerable interest among gardeners and even a remote rural school.

Demonstration in Potshini

Left: Mr Mabaso in Potshini demonstrates his simple but reliable method to pull water from his RWH Dam, using a bucket on a wire.

Below: Johan van Heerden of the WRC Team demonstrates how the Pipe Pump fills with water by moving it up and down. On the down stroke, the water enters the pipe by pushing the non-return foot valve open. The foot valve closes – and thus keeps the water in the pipe – on the upstroke. More water enters the pipe on the next down stroke.

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Zwelake School in Port St John's rural areas

This remote rural school in the mountains surrounding Port St John's has enthusiastically applied many of the concepts conveyed in the WESSA Eco-Schools initiative. Not only did they establish a large organic food garden tended by the school children, they also recycle water from their large underground RWH Dam by using it to clean the school, before using it in the garden.

Left: Note the RWH Dam and the heavy mulching on these recently planted beds!

Below: The Pipe Pump could enable the children to extract water for school cleaning from the RWH Dam directly over the fence, without having to walk all the way around to the garden gate.

Home fruit garden in Ndonga

Left: Mother and daughter at their home in Ndonga, Eastern Cape. They are standing in front of their RWH Dam, which is right next to their fruit trees, an ideal position for the use of a Pipe Pump.

Right: Chris Stimie of the WRC Team demonstrating the use of the Pipe Pump to this household. The water can either be poured into a bucket or carried where it is needed, or poured from the Pipe Pump directly into the basin around the fruit tree.

4.3.9 Drip kits

What is it, how is it different and how has it been refined?

Technical description of drip kits

Small-scale drip irrigation has been around in Africa for at least 30 years. It is usually called bucket-drip irrigation or drum-drip irrigation, depending on which water storage container is used. Water poured into the bucket or drum, slowly trickles into the soil around the plants via dripper pipes that run from the bucket or drum, which is placed with its bottom at least 1m above ground level to provide pressure for the water to drip out. The water passes through a fine filter to prevent the drippers getting blocked. Small-scale drip irrigation is often supplied as a kit, with all the components packaged in the drum itself – from there the term 'drip kit'.

This type of drip irrigation differs substantially from large scale or conventional drip irrigation, where the system is operated on a time basis – the drippers are carefully operated at their design pressure to ensure that the correct quantity of water is distributed as evenly as possible to all the plants in a field. Instead, a bucket- or drum-drip system is operated on a volume basis – the container is filled to a fixed level, and allowed to drain completely. Despite the fact that the drippers operate at only about 10 to 15% of their design pressure, sufficiently uniform water distribution is still achieved because the dripper lines are very short.

Drip irrigation enables the farmer to make use of limited amounts of water and fertiliser, and allows precise application of the water and fertiliser, directly to the root zone. Completely dissolved fertiliser can be administered through the drip kit – either inorganic fertiliser, or home made liquid fertiliser, made from kraal manure or plant extracts.

Two bucket kits (costing around R100 each) can produce enough vegetables for a family of seven, and can last over five years. The system is most suited to kitchen gardens. In addition to the complete kit, a grower needs a few strong poles to make a support structure.

Drip systems require clean water to avoid blockages; therefore surface water needs to be filtered before it can be used. A simple in-line garden filter can be used in most applications. The drip lines must also be flushed weekly to prevent soil particles from building up in the pipes.

By not wetting the full surface, drip irrigation reduces weed growth, and minimises losses due to evaporation, runoff and percolation. Thus the system reduces the labour required to irrigate and weed the crops. This is seen as potentially important for vulnerable people, whether they are aged, disabled or weakened by the effects of HIV/AIDS.

However, although it is popularly viewed as one of the most water-efficient types of irrigation, the soils in large parts of SADC are not suitable for drip irrigation, notably coarse sands and severely crusting soils. Drip kits are somewhat more flexible and can be used in more difficult soils than conventional drip irrigation, since drip kits can give very small amounts of water on very short cycle times, even twice a day.

The drip kits are generally viewed as low-cost and easy to assemble and manage. There have been high returns in an arid part of Kenya by combining RWH into farm ponds with bucket or drum drip irrigation kits.

In summary, drip irrigation allows precise application of small amounts of water directly to the root zone. It is thus believed to save water and is seen as an appropriate intervention in areas where water is scarce.

The table below provides a summary of some of the main features of drip kits. The table expresses the general assumptions that water is saved, greater productivity is achieved and yields are increased.

Table 25: Summary of main features of bucket and drum drip irrigation kits[1]

Uses	Precise application of irrigation water to plant root zones
Necessary conditions	Dry area or growing season, and relatively small amount of water available; perception of water scarcity Reliable source of clean water within carting distance Wheelbarrow, treadle pump or similar, to enable transport of water for distances up to 300 metres Soils suitable for drip irrigation (for example not too coarsely sandy) Access to good output markets may increase the returns, but the kit can be used to produce own-use vegetables Reliable supply of spare parts. A local trader should be identified who is willing to stock the necessary spares Availability of skilled installation and repair services An effective programme of promotion and support, i.e. good technical and agronomic advice and training. This would probably entail donor/NGO support for five years or so to establish a sustainable programme Support on cropping techniques, including cropping calendars and irrigation scheduling Pest control using cheaper traditional methods or integrated pest management
Advantages	Raises productivity of water, land and labour; reduces loss of water In principle very low cost, robust and simple Some versions – fertilizer can be combined with irrigation water Can be targeted to poor, women, disabled people Available in different sizes, from 10 m^2 up, so can be adapted to land and water Usually portable and easy to share — they can be moved or kept at home Higher yields, better quality crop, shorter maturity which should enable higher profits
Disadvantages	Currently no effective examples of programs targeted to poor farmers in SADC Insufficient local manufacturing capacity Poor support—tend to be distributed for emergency relief which by their nature suffer poor sustainability Dirty water can cause clogging Inadequate institutional support Are, in most countries, either not available or too expensive Do not have easily and reliably available spare parts Do not have easily available repair expertise Require at least some cash outlay, which makes it difficult for poor farmers to adopt them in most SADC countries

While there are numerous individual food gardeners and farmers in Africa who have benefited from low-cost bucket and drum drip kits, there is no evidence of successful implementation on a larger scale. This is in contrast to South Asia, where there has been considerable success, both in terms of market-driven systems aimed at relatively better-off farmers, and in terms of targeting poor farmers.

Do people say it works better?

Potshini: Three types of drip kit tested

In Potshini, drip kits were introduced because they were seen as a potentially useful technology to manage the use of water – in particular to save water and reduce the labour required for irrigation. Three different drip kits were tested in Potshini:

- A 200 litre drum kit (introduced through the SSI programme from UKZN);
- A 25 litre bucket drip kit (introduced through the WRC team); and
- A 20 litre disposable micro-kit (introduced through the SSI programme from UKZN).

Overview of people's comments on drip kits

From the table below, it can be seen that people found the drip kits somewhat tricky to manage. The idea that they provide a given amount of water every time is potentially a good one; except that here experimenters felt that the kit did not provide enough water:

Table 26: Significant innovations (extract) – Drip Kits

Innovation	Yes	No	Tried but no longer in us or did not try	Adaptations made/ comments
Drip kit	5	13	Only a few drip kit volunteers (9 disposable kits and 2 others)	No longer in use because it did not supply enough water to the plants – 2 Waste of time – 1 It helps if I don't have time – 1 Very good for lazy people – 1

A personal observation of the facilitator is that the way the kits are laid out is also restrictive and people tend to place a plant per dripper. The "desert syndrome" creeps back in: – a little manure is placed in a small cup-shaped planting hole. The rest of the soil is hard, unprepared, walked on and barren. Even if plants were getting enough water, they certainly would be battling with food…

The idea that it saves time is only really true if one can fill the drip kit's reservoir in a less labour intensive way. Mr Madondo for example could use his underground tank and treadle pump – then it did save time.

Potshini Example 1: A 25 liter bucket drip kit (Sizakele)

Right: Sizakele installing her dripper lines with the help of the local community facilitator, Mr Thabani Madondo.

The 25 liter bucket drip kit is a system for which all components are readily available from local hardware stores. It is theoretically possible to build this system to suit any circumstances.

Description

This kit consists of a 25 litre bucket placed on a stand, at least one meter above the beds. An inline filter is installed below the bucket. Six dripper lines (laterals) of about 2m long can be linked to the system. Drippers themselves are screwed into holes punched into the mainline pipes at the gardener's own discretion. The distance between drippers can thus vary according to the gardener's own preference.

The pipes are standard irrigation piping and the joints are standard connectors.

Experience

The application of water for this system was not a problem and Sizakele felt that enough water was applied to her beds. There were very few problems with drippers or lines clogging.

There was, however, an issue with the joints leaking quite badly. This took some time to rectify, as Sizakele felt unable to fix this herself. She waited for the community facilitator to come and assist. He in turn, tried to tighten the joints and when that did not work, waited for the engineer who had installed the system to come and give advice.

Left: A picture of the joins between the main dripper line and the leading lines after it was fixed.

Advice given included using larger connectors, as the holes in the pipe were now too large for the original ones; and using silicone in the joins to seal them. This necessitated two different trips to town to buy the materials, and a somewhat time-consuming process of supplying the money for that. It thus took about 2 months in total to sort out a very simple problem of leaking joins. Sizakele had to go and collect water for the drip system from a stand pipe around 300m away. She filled the bucket twice a day.

Advantages

- The drip kit provides a system of measured irrigation without much fuss;
- It saves time, in that once the water has been fetched, it can be poured into the bucket, the tap switched on and the rest can happen automatically;
- It is flexible, in that distances between drippers can be gauged by the gardener him/herself;
- Bed preparation is flexible, and as a system, the drip kit can be used on any type of bed, including (with some reservation) on trench beds;
- The system is robust and withstands general wear and tear and weather conditions;
- It is cheap and technically relatively easy to install; and
- This system can save time.

Disadvantages

- The gardener did not feel confident to maintain the system herself;
- The source of water was a bit far from the homestead;
- It is debatable whether this system does in fact save water, as the same amount of water, or more even, was applied to this bed as to others watered more conventionally with buckets;
- As gardeners are not thinking about where the water goes and little of it is visible on the surface, over-watering can be a common problem. Obviously this is not a problem with the drip kit itself, but with the way that people habitually make decisions around irrigation scheduling; and
- It is unlikely that gardeners will expand their drip system by themselves.

Potshini Example 2: A 200 litre drip kit (Thabani Madondo)

The 200 litre drum-drip kit was installed in Mr Madondo's garden through the SSI programme (UKZN) around 2005.

Description

The drum is large and placed on a 1m high platform. The mainline and laterals cover an area of 10mx 20m. The laterals are spaced from 10cm through to 50cm apart, to accommodate different crops and spacing. Drippers themselves are moulded into the laterals.

Right: Mr Madondo's 200 litre drip system in the winter of 2005.

Right, below: Onions and spinach planted in the drip irrigated area. The different spacing of the laterals can be seen.

There is an inline filter below the drum in the mainline.

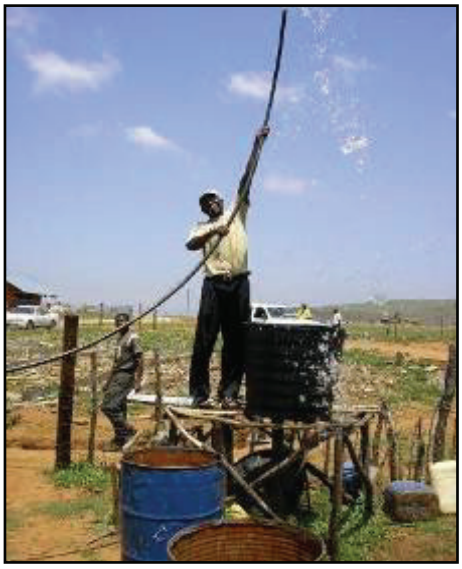
Below: A view of the in-line filter.

Experience

Mr Madondo, as with most people using drip kits, prepares the soil for planting without taking up the dripper lines again; therefore only shallow incorporation of manure is done in the proximity of the drippers. He plants one seedling per dripper. The overall effect is somewhat of a "desert effect" – plants seem to be spaced far apart and have too little nutrition. The soil in the drip area is compacted and hard, and looks dry.

Water for the 200 litre drum used to be obtained from a standpipe across the road. With each trip he could carry two 25 litre buckets, necessitating 4 trips, twice a day. Usually watering was done only once a day, and often not every day.

Later, he was able to start using his new underground rainwater harvesting tank to provide water for the drip kit tank. It was still hard work pulling the water out of the underground tank, into the containers and then wheeling them over to the drip kit tank in the wheelbarrow. The installation of a demonstration unit of the treadle pump by the WRC assisted greatly in easing the task of water supply to his drum-drip system.



Job Rotich from SSI was demonstrating how high the treadle pump could push water into the air. He is standing on top of the tank stand, and water is gushing out about 4m above his head.

A view of the surface wetting circles after irrigation. Little holes in the ground are visible where an auger had been used to check the movement of water underground. The whole area was wet underground (Sept 2006).

Advantages

- For this system, saving of time was seen as a definite plus by Mr Madondo. Being a larger system, a larger area is irrigated all at once. Mr Madondo, as the local community facilitator and development champion, was also an exceptionally busy person. It was a great advantage to him that he could fill the tank and continue with other work.
- He did not over-irrigate as most other smallholders with drip kits tend to do; probably more for the sake of expediency than any other reason – i.e. he did not always get time, or remembered to water every day or twice a day.
- The layout of different spacing allowed planting of different crops, which made it more flexible as a system.

Disadvantages

- The drippers often got clogged up, and a lot of maintenance time was required unblocking them. Mostly this consisted of opening the stoppers at the ends of the laterals and flushing them. Drippers needed to be replaced often. Mostly this was done by the SSI students, rather than Mr Madondo himself.
- Again, soil preparation in the area of the drip kit was a bit lacking and crops did not grow that well.

- The concept that the water is provided under the ground and that all the soil under the drippers do actually get wet, was difficult even for Mr Madondo, to use positively. One plant per dripper seems an absolute standard, although much denser planting would be possible, given that underground, the soil does in fact get wet right through. Most often, the drip systems are promoted in this way by extension staff and manufacturers. It leads in a smallholder environment to a lot of bare soil. Gardeners also tend not to do mulching in these areas.
- Being a slightly larger system can also be a disadvantage when time and availability of water could lead to under-irrigation.

Potshini Example 3: A disposable 20 litre drip kit (Thabani Madondo)

The 20 litre disposable drip kit was imported by the SSI researcher, Job Rotich, from India. They are made from cheap materials as a disposable kit that is meant to last only one season.

An example of a disposable kit being rigged up in a garden.

Description

The kit consists of a 20 litre bag made from sacking and lined inside with thin black plastic, which is hung on a frame about 1.5m above the ground.

The mainline and four laterals are tape-piping and the drippers are small tubes.

With these four laterals, the kit irrigates a 2mx5m area.

Experience

These kits were not very robust, got blown around in the wind and generally were damaged very quickly. The tape-piping was hard for gardeners to manage and manoeuvre. It was also exceptionally difficult to get the water into the bag, as a large bucket had to be tipped into

the bag at head height. This led to a lot of spillage. Nine volunteers tried them out, but not one continued to use the system for the whole season.

A disposable drip kit bag blowing in the wind at a volunteer's homestead. The piping is knotted and trampled on the ground.

In an attempt to lay out the lines in a way that they would remain in place, gardeners often placed rocks and clods of earth on the pipes. This may have had an effect on the operation of the lines.

Volunteers who used these kits all commented that it provided too little water to their plants even while irrigating twice a day as recommended. This was the primary reason for discontinuation of these kits.

It also became difficult for the SSI researcher to source another batch of the kits. The idea has thus been discontinued.

Advantages

- The kit is cheap and disposable.
- The little tube drippers work well, do not get clogged too easily and add some flexibility to the design.

Disadvantages

- The kit provides too little water; according to the gardeners whose crops wilted and dies.
- It is difficult to fill the bag with water; as it is flimsy and hangs at head height.
- The whole system is not robust enough; bags got torn quickly, the piping would not lie evenly on the ground and mostly the whole system got blown around in the wind.

Right: Mr Madondo's kit when it started collapsing. Again the "desert syndrome" is visible in the spinach and cabbage; plants are small, widely spaced and wilting.

4.3.10. Recommendations for further research

In every research project more issues, problems or gaps are discovered during the course of the project. This is not different for this project. There are also those issues that could have been addressed more fully.

Selling of excess produce from homestead production is a natural progression for many, but not all, households. Entrepreneurial opportunities and marketing systems appropriate to homestead produce could benefit from more attention than was possible in this project.

It is also recommended that the Water Research Commission approves an evaluation and monitoring project to support the uptake and dissemination of this material through the various institutions that have already shown interest in utilising the material to develop training courses for their own purposes.

5. Proposed dissemination and implementation

5.1 Dissemination

Four popular articles were prepared for publication, namely:

1. The first popular article was written by Mr CT Crosby with the title: *Water harvesting and intensive gardening can make a difference*. This was published in the quarterly newsletter of the South African Institute of Agricultural Engineers (SAIAE) in 2006.
2. This article was written and presented by the Tshwane University of Technology at the International Symposium on the Nutritional value and Water Use of Indigenous Crops for Improved Livelihoods, held on 19 and 20 September 2006 at Pretoria. The title is:

   Towards a holistic understanding of urban home gardening in poverty contexts

   The authors are: Coetzee, MM, Van Averbeke, W & Likuwane, and I.M from the Tshwane University of Technology.
3. ILEIA magazine, June 2008 'LIVING SOILS' edition, titled "Food and water for the soil provides good results in family food security in Potshini, South Africa", by Erna Kruger, Jody Sturdy and Marna de Lange.
4. Rural 21 magazine, June 2009 edition with the theme 'Water and climate change', titled "Water harvesting for home food security" by M de Lange, E Kruger and C Stimie.

5.2 Proposed dissemination

There are a range of existing initiatives and potential opportunities for the dissemination of this material. It has already received publicity in several stakeholder consultations and popular articles as mentioned above.

A mutually beneficial collaboration process evolved between the WRC project team and **UNISA's Human Ecology Department.** UNISA are expanding their courses at various levels on household nutrition and food security facilitation. In agreement with WRC, the two teams are collaborating on two initiatives:

1. A joint initiative of UNISA and the South African Institute for Distance Education (SAIDE), with funding from the Kellogg Foundation, for development of learning material for Household Food Security Facilitators. Regular contact and collaboration made it possible for these projects to complement each other.
2. UNISA is also considering introducing further short courses, and intending to use this material as a resource for the development of those courses.

The **University of KwaZulu-Natal (UKZN)** have been involved from the start with this WRC project. Because of lack of resources on their side, they could not assist with material development, but several interactions took place. Beneficiaries of this project's capacity building programme have undergone a facilitator's course at UKZN. Once the training material is available, it is very likely that the UKZN will institute it as an elective as part of their diploma range.

The **Department of Water Affairs and Forestry's (DWAF) Integrated Water Resources Management program** has requested to use this material in their Integrated Water Resources Management (IWRM) implementation projects with households in rural villages. This is an effective grassroots initiative, which is supported with EU funding.

The **Department of Agriculture** intends to use this material to develop courses at various skills levels in support of its newly approved Agricultural Education and Training (AET) strategy.

The **Tshwane University of Technology (TUT)** has indicated that they intend to use this material for short courses to be presented at this institution.

Agricultural Colleges have also expressed interest in this material through their representatives at APAC.

The research team would like to suggest that UNISA be approached to consider broadening their planned training of tutors for the upcoming UNISA course for Household Food Security Facilitators, as a wider opportunity to expose potential trainers to the material.

5.3 Institutionalisation of facilitator training

5.3.1 Introduction

The participatory development of training materials for water management in homestead farming systems assumes a target group of community householders. As these people often have a low level of literacy and education and a low level of command of English, it is assumed also that their learning will be facilitated in some way. This facilitation may take place through community development facilitators employed through the Government or non profit sectors.

The target group for the training materials will therefore primarily be community development facilitators. As such, one avenue for the development of training materials is to embed the learning in a formal course or learning programme. NQF level 5 is considered an appropriate entrance level for such a learning programme. There is an opportunity at the University of KwaZulu-Natal to offer this learning as an elective module within an existing qualification known as the Certificate in Education (Participatory Development) (CEPD). This will have the advantage of providing a broader development context for this module, which at the same time provides access to Higher Education.

5.3.2 Introduction to the CEPD

The Certificate in Education – Participatory Development (CEPD) is a two year part time mixed mode (contact and distance education) qualification offered by the Centre for Adult Education, within the School of Adult and Higher Education at the University of KwaZulu-Natal.

The programme targets adults experienced and currently involved in community development, who are motivated to learn and study further, and who have at least a matric certificate (STD 10 or Grade 12). Preference is given to applicants from rural and disadvantaged areas. (If applicable) Recognition of prior learning procedures is used for access to this programme. The access processes include a placement test to assess development experience, and English and numerical proficiency. This provides the basis for a coherent case to the University Senate for the admission of non-matriculants.

The qualification (128 credits) is a foundation course and provides entry into the Diploma in Education and is an access qualification to Bachelor in Education, Bachelor in Social Science and Bachelor in Community Development. Modules offered for this qualification can be

taken by students towards other qualifications in this and other higher education institutions provided that all the prerequisite requirements are met. If the qualification is upgraded to a Diploma, which was scheduled to happen in 2006, articulation options will increase and become easier.

The course consists of a first year curriculum that covers generic core skills in participatory development facilitation (Lifelong Learning, Introduction to Adult education, Introduction to Development and Introduction to Project Management). In the second year students choose from a range of electives that focus their development service area and also undergoes a service learning component (Development in Practice). Presently they can choose from the following; Entrepreneurship, Adult Basic Education and training, Peace Education (Conflict Transformation), Leadership and Management of NGO's, Local government, Economic Literacy and LandCare.

Students presently attend class for 1 full day per week and complete self study and assignments at home. Week long blocks will be considered if there is a demand.

An elective module in Water Management in Homestead Farming Systems

The suggestion of offering a module in Water Management in Homestead Farming Systems as one of the electives of this course is being considered. It is interesting and potentially useful for a number of reasons including that:

1. It will provide a training opportunity for community development workers focussing on households and concentrating on water and agricultural related issues. As such it will be ideal for the Municipal Community Development Facilitators, the Community Health Workers and facilitators/ field workers from NPOs (Non Profit Organisations) and CBOs (Community Based Organisations)
2. It will provide an institutional focus for training materials developed through the Water Research Commission supported research initiative " *Participatory Development of Training Material for Agricultural Water Use in Homestead Farming Systems for Improved Livelihoods*" and
3. It will provide a broader choice of current issue electives to CEPD participants.
4. It can provide an opportunity for **community level capacity building** for the implementation of the **DWAF pro-poor rainwater harvesting household subsidy**

5.3.3 Introduction to UNISA process

A number of discussions with Mrs FM Ferreira (Coordinator of Discipline Human Ecology, Department of Agriculture, Animal Health and Human Ecology, School of Agriculture and Life Sciences, UNISA) and her team were conducted. A collaborative process in the design of a generic package for facilitators was agreed upon.

This collaborative process provides the WRC team the opportunity to contribute towards general capacity building of postgraduate students as well as the more specific goals of providing opportunities for filling gaps in the research and curriculum development process as it stands. Specifically relevant here are issues around nutrition, food processing and value adding. This work can also contribute significant and relevant case studies to the materials being developed.

For UNISA this provides an opportunity to work in areas where the emphasis and interventions are at homestead level and focused on improved livelihoods through homestead farming

and water management. The water management and water harvesting in particular will add value to their present research processes.

Research Approach

We are looking at providing an integrated set of themes that can be explored by a number of students in different communities. There are aspects that can be monitored by students in an ongoing way, jointly with community members. These will be set out so that they are not too technical and can be monitored by students with household members, or even by household members themselves with support from the students.

Monitoring aspects that could be included:

- Household decisions and availability and access to resources;
- Water management for productive use;
- Crop production in terms of quantity and consumption(kg's produced, kg's consumed, kg's sold/given away/exchanged;
- Crop production in terms of nutrient contribution;
- Irrigation; practices and efficiency; and
- Food processing; also related to use of water.

Monitoring of all these aspects across different communities will provide the research and curriculum development teams with qualitative data to provide comparative comment.

6. Conclusion

The Chapters contained in the Resource Material follow a logical pattern, based on key questions the WRC research team had to ask itself.

On household facilitation:

Acknowledging that, while more and more households are starting home food gardens, many others don't believe it is either possible or worthwhile, the research team asked itself:

> "How can the significance of food gardening become a reality in people's minds?"

The research team developed and field tested the Nutrition Workshop, and found it a very effective method to 'create discomfort' – which we know is where all changes in habit spring from. The Nutrition Workshop enables the household to analyse their own diets, discover the gaps, and choose crops to plant in their home gardens to fill those gaps.

On 'need-to-know':

Deeply aware of the bewildering amount of information on organic production methods, family nutrition, irrigation and water management, the researchers asked themselves:

> "What is the minimum, essential knowledge a household would need to successfully grow an intensive, worthwhile home food garden? And then, what does the facilitator need to understand to accompany these households on that journey of discovery?"

The Resource Material contains much more than the essential information, but enables a facilitator to select what is appropriate to any specific garden learning group.

On cash-scarcity:

Recognising that these households are growing their own food precisely because they have too little cash to buy enough nutritious food, the research team asked itself:

> "How can we select the methods included in this resource material to be appropriate to the cash-scarce context they will be used in?"

Because of the reality of cash-scarcity, the research team believes that the Low-External-Input Sustainable Agriculture (LEISA) farming system works best for homestead food gardening. Therefore, LEISA principles form the basis for production methods included in the Resource Material.

The research team is grateful to the Water Research Commission for the opportunity to do this research and put together this 'resource material for facilitators'.

The research process itself has helped to raise general awareness of homestead food production, and has drawn together and helped to build working relationships between a range of practitioners in this field. It has also brought tangible benefits to participating households in the villages, through the establishment of new home food gardens, food gardening training on a diverse range of topics, and for some households also water harvesting storage infrastructure.

The following remarks can be made about the material. The research team believes that:

- The material succeeded in drawing widely from local and international materials and experience;
- The material is based on practical experience and field testing;
- The material has proven to be useful in practice, also when used by facilitators who were not part of its development; and
- It can be drawn on by a variety of stakeholders to develop course material for their own purposes, or by practitioners as a resource to draw from.

There is a ready demand for the material, with UNISA aiming to use it in several short courses, to be presented at various NQF levels.

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