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IDENTIFICATION OF INDICATORS FOR RAINWATER HARVESTING TO SUCCESSFULLY IMPROVE HOUSEHOLD FOOD SECURITY

By

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A research report submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Masters of Management (in the field of Public and Development Management)

June 2010

ABSTRACT

Large proportions of the South African population remain poor and food insecure. The use of rainwater harvesting (RWH) is becoming increasingly important due to scarcity of water and the costs associated with bringing water for food to poor communities in rural areas. Transferring technology to communities is also exceptionally difficult.

The research examined the present policy, research and technology environment and specifically identified indicators that addressed aspects of input, output, outcome and impact required for the use of RWH to successfully improve household food security.

The research considered information found in the literature, obtained opinions of experts and government officials elicited through key informant qualitative interviews; and studied a case where RWH is successfully being used to improve household food security.

Indicators identified referred to the comprehensive input required such as increased political will, consolidated and co-ordinated governmental effort and enthusiasm; outputs required such as a co-ordinated consolidated policy framework; outcomes such as successful use of RWH for household food practices while impact indicators described longer term effects on peoples' lives such as improved nutritional status, health and quality of life.

DECLARATION

I, Magdalena Elizabeth Ligthelm, declare that this report is my own unaided work. It is submitted in partial fulfilment of the requirements of the degree of Master of Management in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in any other University.

_____

Magdalena Elizabeth Ligthelm

June 2010

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LIST OF ACRONYMS

AgriSA	South African Agricultural Farmers Union
ARC	Agricultural Research Council
ARC-ISCW	Agricultural Research Council - Institute of Soil Climate and Water
CASP	Comprehensive Agricultural Support Programme
CB:WHIG	Community Based Water Harvesting Interest Group
CCAWs	Co-ordinating Committees for Agricultural Water
DoA	Provincial Department of Agriculture
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
FANTA	Food and Nutrition Technical Assistance
HH	Household
IFSS	South African Integrated Food Security Strategy
IRWH	In-field rainwater harvesting
IWMI	International Water Management Institute
MB:WHIG	Municipal Based Water Harvesting Interest Group
MDGs	Millennium Development Goals
M&E	Monitoring and Evaluation
M&E&R	Monitoring and Evaluation and Reporting
MIG	Municipal Infrastructure Grant
NAFU	National African Farmers Union
NDA	National Department of Agriculture
PAR	Participatory Action Research
RSA	Republic of South Africa
RWH	Rainwater harvesting
SADC	Southern African Development Community
SARPN	Southern African Regional Poverty Network
TSFC	Tswelelopele Small Farmers' Co-operative
UNDP	United Nations Development Programme
WRC	Water Research Commission

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CHAPTER ONE
INTRODUCTION

1.1 Introduction

Millions in South Africa remain poor and food insecure, despite sixteen years of freedom and continued commitments by government to improve the plight of the poor and hungry. This research focused on the best (efficient) use of harvested rainwater to increase household (HH) food security in the immediate future in South Africa.

As will be evident from the research presented, successful use of water for HH food security is dependent on many types of activities exercised by various government departments, other organizations and individuals. Indicators are regarded as a very useful tool for determining success in such circumstances as ratings of activities could be based on observable performance which can in addition be evaluated by more than one person (Carefoot, 1997:2). The performance could be rated using research methods such as review of written documents, interviews and observations and an indication could be derived on how successfully the activity is progressing towards a specific set goal.

The research will thus focus on determining the different types of activities required to ensure success, and to identify the associated indicators.

The research report consists of the background; purpose and value of the research; the research problem, the objectives set to solve it and the associated main research questions; the theoretical framework and literature review; a description of the research methodology, the research results and the conclusions reached. Qualitative methods would be used and would consist of interviews and a case study of a successful HH food security activity. The case study was conducted in villages in the Thaba 'Nchu district near Bloemfontein in the Free State. The position of Thaba 'Nchu is indicated in Figure 1.

Figure 1: Map indicating the position of Thaba 'Nchu



Source: http://mapsof.net/thaba_nchu/static-maps/gg/thaba_nchu-map-v

1.2 Background

1.2.1 Poverty and food security worldwide

Poverty and food insecurity are found worldwide and about 800 million people go hungry every day (Williams, 2004:4). Commitments were made by the global community in 2000 to reduce this number by half by 2015 (the Millennium Development Goals, Goal 1, Target 2).

1.2.2 Water and food legislation, and poverty in South Africa

1.2.2.1 Introduction

Despite being amongst the 20 most water scarce countries in the world (Seckler as cited in Fairclough, 1999:117), South Africa is a major food crop producer. Commercial agriculture contributes 2.5 per cent to the GDP (www.southafrica.co.za) (a continuing decline from 9.1 per cent in 1965 should however be noted) while a contribution from upstream and

downstream industries increased the value to about 12 per cent (www.southafrica.co.za). At the moment imports are, however, exceeding exports. The agricultural sector is nevertheless well developed, healthy and thriving, and contributing well to the economy of the country.

Most food in the country is, however, produced on large commercial farms with some 60 000 commercial farmers occupying approximately 87 per cent of the total agricultural land and producing more than 95 per cent of the marketed output (Nieuwoudt and Groenewald, 2003:3). Of importance is that African smallholder farmers use about 13 per cent of the agricultural land and are found mostly in the former homeland areas (Nieuwoudt and Groenewald, 2003:3). The food production on commercial farms does not, however, ensure HH food security for the larger population (DWAF, 2006a:7.1). In fact, about 43 per cent of the population in SA is still food insecure and live below the poverty line (NDA, 2002:23).

The situation of poverty and hunger found worldwide is still largely experienced along racial lines in SA. Furthermore, since 1994 the large divide between the poor and rich, and an even larger divide related to use of water along racial lines have not been eliminated. All indications are that it has deteriorated (Gumede, 2005:97) despite more than 80 per cent of the backlog in domestic basic water supply and about 40 per cent of basic sanitation backlog having been removed (DWAF, 2005:46). South Africa continues to face an immense task to achieve “some for all forever”.

Cognizance also needs to be taken of the fact that agricultural activities can lead to deterioration of water quality and that insufficiently addressing this aspect can compromise its sustainable use and expansion. This is seen as one of the greatest threats to the sustainable use of soil and water resources (Scotney and van der Merwe, as cited in Nieuwoudt and Groenewald, 2003:153).

The aspect of potential deterioration of water quality associated with agricultural activities, together with optimum use of a scarce resource for

agricultural production are worldwide concerns. It was found that if the present trends in water usage for food production continue unaltered for the next fifty years, the world will "run out of water" to produce food for the growing population (IWMI, 2007:1). Action to improve water use in agriculture is thus critical. Linked to this is the use of water to improve HH food security, and it is therefore important to establish water use efficiency practices.

It is of the essence that the foundation legislation to ensure that the imbalances of the South African past are corrected (including skewed use of water and HH food security), was promulgated as the South African Constitution, 1996 (Act 108 of 1996). Access to sufficient food and water are rights in terms of section 27 and "(T)he state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realization of these rights" [section 27(2)].

1.2.2.2 Constitution of the Republic of South Africa (1996) and related legislation

Some sections in the Constitution (1996) relevant for this research are the Bill of Rights (Chapter 2) and the chapter containing requirements on co-operative government (Chapter 3). Different spheres of government are regarded as distinctive, interdependent and interrelated (Chapter 3, section 40) but are required to co-operate with each other to attain national priorities (Section 4(d), Intergovernmental Relations Framework Act, 2005). Where water use for food security is concerned, the Constitution (1996) indicates that water resource management is an exclusive national competency; while agriculture and soil conservation are concurrent national and provincial legislative competencies (Schedule 4 of the Constitution, 1996). Departments and spheres involved would be the Department of Water Affairs (DWA), agriculture (national and provincial offices), co-operative governance, land affairs, public works, education and municipalities.

The Bill of Rights (Chapter 2, Constitution, 1996) includes rights to human dignity, freedom of trade, occupation and profession, environment, property,

health care, food, water and social security, education and just administrative action.

The Intergovernmental Relations Framework Act, 2005 (Act 13 of 2005) provides for the drafting of protocols (in terms of Chapter 3) to govern these relationships. The Act specifically provides for the drafting of implementation protocols to ensure the co-ordinated implementation of a policy. The implementation protocol must describe, amongst other actions, challenges in implementation, how they would be addressed, roles and responsibilities of participants, determining of indicators to measure the effective implementation of the protocol, and required and available resources. Formalisation of relationships across government departments and spheres to ensure their successful participation in harvesting rainwater for HH food security could be done in terms of this Act.

1.2.2.3 Departments of Water Affairs and Agriculture

a) Water Affairs

Many governmental policies, legislation and guidelines are available on equity in water use, agricultural use of water, and food security. Numerous evaluations and reviews have been conducted. The principles of meeting basic needs, equity, sustainability and good governance were identified and addressed in legislation such as the National Water Act, 1998 (Act 36 of 1998), which provides for the security or reservation of national water to meet basic human and environmental needs (section 1).

A departmental regulatory framework is also in place for municipalities to, free of charge, provide the basic human needs of citizens for water. The Act also provides for the provision of financial assistance by the Minister to water users (sections 61 and 62). Specifically a grant for rainwater tanks for family food production and other productive uses (DWAF, 2004a and b: 6&7) is available**.** The implementation of this grant on a pilot scale through the construction of rainwater tanks is at present being done in various parts of the country.

b) Agriculture

A national guideline (National Department of Agriculture, NDA, 2002) drafted by the DWA and the NDA is being finalised and provides clear direction to achieve the principles for sustainable agricultural water use. Co-ordination of this use will take place in the provinces through Co-ordinating Committees for Agricultural Water (CCAWs). Co-ordination between government departments and spheres for rainwater harvesting (RWH), can probably take place at these committees. Other actions described in the document include the building of capacity on smallholder agriculture at local level and the request for the inclusion of a chapter on agriculture in the provincial Integrated Development Plans (IDPs); provision of training credits and markets for high quality produce of small-scale agricultural water users; emphasis that especially women and the youth would be supported; and that enough resources would be made available to implement the policy.

The National Department of Agriculture also developed an integrated food security strategy (IFSS) for South Africa in 2002 (NDA, 2002), which was approved by the SA Cabinet as different aspects of the strategy have to be implemented by different government departments. The document addresses HH food production and identified this area as a high priority (NDA, 2002:28). These aspects will be discussed in more detail in the literature review.

Operational policies and guidelines, specifically on rainwater harvesting, have not been developed in SA but the literature review provides information on the detailed research that has been ongoing for the last ten years to facilitate and assist in the development of such policies and guidelines.

1.2.3 Household food security and associated indicators

HH food security generally means that the HH is sure how they will meet their food needs as they are able to produce enough food themselves, and/or they have enough money to buy food, and/or the food is sufficiently nutritious (Williams, 2004:4).

As will be indicated in this research, ensuring HH food security is a multifaceted process with many variables contributing to its success. It is proposed that when addressing the above the processes should be formalized, co-ordinated and progress measured regularly to ensure success. Such simplified, streamlined and flexible approaches and tools to monitor progress towards achieving desired results are readily available (UNDP, 2002:1).

Performance indicators form part of these tools and their development, implementation, monitoring, evaluation and subsequently instituting corrective actions where necessary, can contribute significantly to ensure success – not only for individual HHs, but also for the much sought continued improvement of citizen quality of life and growth in South Africa. Such indicators are thus required when setting performance targets and assessing progress towards achieving them (World Bank, 2004:6).

The global community involved in food aid provision has notably developed indicators to measure the status and progress being made in improving food security. These provide for food security at a continental, regional, country, HH and individual level (Saad, 1999:5). The indicators relate mainly to availability, access and utilization of food.

Due to the prevalence of HH food insecurity worldwide and the efforts being made to address it, examples are available of the successful use of water to secure food for HHs under conditions similar to those in South Africa. South Africa can also learn from lessons in general from worldwide efforts. One of these examples is the implementation of RWH in arid parts of China and more detail on these practices is provided (section 2.2.5).

In conclusion: at an international level, one of the Millennium Development Goals states that worldwide the proportion of people who suffer from hunger has to be halved by 2015. South Africa itself is a water-scarce country and about 43 per cent of the population is still poor and food insecure. The

country has, however, indicated its commitment to promoting food security by declaring access to it a human right in its constitution with rights of access to water and food enshrined in the document. HH food security and the harvesting of rainwater to promote equality and equity are resultantly regarded as high priority by government and are described in legislation and policy documentation. The NDA developed a strategy on food security and the DWA established the legal framework to ensure provision of a subsidy for RWH for HH food security. The roll-out of the subsidy to communities is still being tested before large scale roll-out can take place.

The Intergovernmental Relations Framework Act has been promulgated to govern intergovernmental relations and provides tools for integration and co-ordination of mandates of different government departments to achieve common goals.

Should a concerted effort be made to use agricultural activities to improve food security for the millions that are food insecure, the potential water pollution aspect needs to be addressed to ensure sustainability. In addition, warnings have been issued that the world is running out of water for food security if not used more efficiently (IWMI, 2007:1).

It is important to know that the cause for HH food insecurity is not only related to availability and access to water and food. Poverty is in general the primary cause (Klohn, 2004:1). Measures that address poverty in the country more generally broadly would thus also contribute to improvement of food security for HHs.

1.3 Research problem

SA has a healthy agricultural sector with food mainly being produced on large commercial farms. About forty per cent of the population is however food insecure, poor and are mainly living in rural areas.

Although more than 80 per cent of people have now been supplied with the basic volume of the required quality of water for domestic use (DWAF, 2005:46), limited progress has been made to improve HH food security through use of water.

Small volumes of water through harvesting rainwater could successfully be used for HH food security and thus contribute to alleviating poverty. Establishing successful and sustainable water use in HH food security could also position producers to expand their agricultural practices should opportunities emerge.

The slow progress of the above in SA is most likely related to the complexity of the process, in which numerous primary and secondary activities need to take place. It would be crucial to determine the performance indicators required to signify what exactly is required to increase the success of such activities and how they are being achieved, and to concentrate resources in order to achieve HH food security for the greater part of the South African population still in need.

1.4 Purpose, value and objectives of the research project

1.4.1 Purpose and value

The purpose of the research is to identify which indicators related to input, output, outcome and impact are required to improve the success rate of HH food security (and ultimately poverty reduction) when using harvested rainwater. This will be developed for the different categories of activities required to achieve HH food security in South Africa. The research will add value by contributing to better understanding of processes and providing indicators that could guide such processes. This can ultimately contribute to improving the quality of life of people - especially the poor in rural areas.

1.4.2 Objectives

The objectives of the research are as follows:

- Determine contributing aspects that are required for using harvested rainwater for food security;
- Determine what is required to make these factors successful in producing HH food security;
- Relate the above to inputs, outputs, outcomes and impacts.

Objective setting will also be based on the secondary questions raised in the next point.

1.5 Research questions

1.5.1 Primary research question

The **primary research** question is:

> What are the critical variables (expressed as indicators) required for successful use of harvested rainwater for HH food security? And, what can be considered input, output, outcome and impact indicators for success regarding these?

1.5.2 Secondary research questions

From the literature it was found that at least the following aspects had to be addressed in the research. These constituted the **secondary questions**:

- Is there an enabling policy and legislative environment? This is regarded as the political, policy and legislation aspect. It would have to be determined whether, due to the multidisciplinary nature of rainwater use for HH food security, co-operation between spheres of government and different departments is achievable and how it can be achieved.
- Is there HH buy-in into the processes and what role does communication play? This is perceived as an important consultative and participatory aspect.

- Are processes led by proficient (formidable) teams? This aspect relates to the managerial, administrative, training and empowering practices, and the role that learning from successful practices can contribute. Are effective and efficient agricultural extension services, for instance, available? Have the appropriate training / empowering / capacity building aspects been identified and is provision made for meeting these needs?
- Are there appropriate organizations and associated committees that can manage processes?
- Are there appropriate technologies that could be used and that would contribute to success?
- Are markets available and do HHs have access to loans and credit?

CHAPTER TWO
THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 THEORETICAL FRAMEWORK

2.1.1 Introduction

This framework or "structure" (Merriam, 1998:45) of the research identified the relevant theoretical information on policy development and implementation, and the specific scene set in South Africa. This section also addressed the purpose and value of using indicators (as part of monitoring and evaluation, M&E), and what would constitute success. Essential concepts are briefly described in the next section.

2.1.2 Description of terms

"Indicators" are the variables used to measure progress towards a goal. The Oxford dictionary describes an indicator as "[A] thing, especially a trend or fact that indicates the state or level of something; a device for providing specific information on the state or condition of something (UNDP, 2004:3).

"Rainwater harvesting (RWH)" is defined as ".. the process of concentrating rainfall as run-off from a larger catchment area to be used in a smaller target area. This process may occur naturally or artificially. The collected run-off water is either directly applied to an adjacent agricultural field (i.e. stored in the soil-root zone) or stored in some type of on-farm storage facility for domestic use and as supplementary irrigation of crops" (Oweis, Hachum and Kijne, 1999 in WRC, 2008a:4).

"Food security" is defined by the World Health Organisation and the Food and Agriculture Organisation of the United Nations as "the access of all people to the food needed for a healthy life at all times". Food insecurity correlates with

"poverty". "Poverty", the state of being poor, is a condition of deprivation and lack of means to attain adequate subsistence (Klohn, 2004:2).

"Food security, therefore, implies the provision of safe, nutritious, and quantitatively and qualitatively adequate food, as well as access to it by all people". It also implies an optimal uptake of nourishment, due to a sustaining diet, clean water and adequate sanitation, together with healthcare (Boon, 2004:3).

These, as well as variables for success as identified by Kerzner (1989:504-517), were investigated to establish the extent to which they are relevant for use of harvested rainwater for HH food security. These variables that could contribute to successful practices include aspects such as strong leadership from government, availability of managerial and technical expertise in teams, acceptance by customers, and practices fitting well within existing cultures.

2.1.3 Theoretical framework

The theoretical framework mainly touches on relevant public policy theories, the essence and process of public policy development and implementation, and monitoring and evaluation. Reference is also made to what would be required when carrying out public policy research to enhance its uptake by politicians and government officials.

2.1.3.1 Public policy: introduction

The research is conducted within the South African governmental arena and it is expected that whatever government chooses to do or not do, i.e. public policy (Dye, 1995:18), will be fundamental in contributing to success in RWH for food security. Public policy indicates intent or a purposeful course of action or deliberate non-action by government, to achieve economic and social goals as set by its political leadership. Public policy furthermore brings different elements of a complex activity into an efficient relationship in a logical and consistent manner, where the components are ranked according

to authority, and where instruments or tools are specified to achieve intent of government on a specific topic or aspect (Ligthelm, 2007:4).

Of importance for policies to be successful is that there should be compliance with them as well as effective enforceability - with sanctions or penalties linked to non-compliance (Cloete, Wissink and De Coning, 2007:10).

In South Africa, national goals set in terms of public policy include economic growth, involvement of marginalized citizens in economic activity to ensure sustainable livelihoods, and performance of the state. The term "development state" is used to describe the development of appropriate policies and the associated setting and achievement of these goals. The concept is described in more detail in the next section. Attainment of all these will, to a greater or lesser extent, contribute to success in rainwater use to achieve HH food security.

While this research primarily considers those policies relevant to harvested rainwater and agricultural HH food security, the point that a wide spectrum of policies affects food security is made by Stamoulis and Zezza (2004:1),

2.1.3.2 Policy theories and models

In the introduction, the very close link between public policy and government was stated. Government institutions should, to a large degree, give effect to public policies through their arrangements, structures, legal powers, rules and procedures. In fact, government could be structured to facilitate certain policy outcomes and to obstruct other policy outcomes (Dye, 1995:9). These aspects form the basis of the **institutional theory**. The theory evolved over time to progressively address challenges of the reality on the ground. There was, for instance, a risk that important and necessary procedural values associated with institutions, such as expeditiousness, administrative efficiency, expertise, participation and representation could dominate processes, while substantive values such as social equity, equality, liberty, privacy and ecological balance were neglected (Gromley, 1987:155-156).

Advanced institutional theory incorporates these additional aspects and indicates that both institutions and actors within institutional settings influence and facilitate certain policy outcomes and impacts. Government thus actively shapes its environment by giving effect to policies. Importantly, it should not merely adapt to it (Thoenig, 2002:131).

Successful use of water for HH food security would have to be addressed on a political and policy level but would probably not depend on a single government department or sphere, or even only government itself to give effect to it. Although crucial, and these relations and functions are considered extensively in this research, institutional theories and their variants could not sufficiently contextualize the theoretical framework required. **Network theory** adds the other crucial aspects that need to be considered for success. It contemplates the shift from government to governance with "multi-level governance" involving civil servants, citizens and private sector actors in networks that are formed (Maarten, Hajer and Wagenaar, 2003:8). The latter provides for a larger variety of value preferences and improved problem-solving and is increasingly applied in fields such as the environment, food and technology (Maarten, *et al*., 2003:3). This is important in view of the multiple numbers of stakeholder groupings such as government (different departments and spheres), research organizations, organized agriculture, informal agricultural groupings, and – in the specific case of HH food security – individual HHs that need to partake successfully. Network theory also more appropriately describes the relations that are required for success than, for instance, the social interaction model, which merely considers aspects such as participation, negotiation and conflict resolution (Cloete, *et al*., 2007:40) but not the multi-level governance that is required.

As alluded to, the abovementioned theories have been "institutionalized" in South Africa where the political leadership is promoting the country as a developmental state – a term coined to describe the progress made in countries such as Japan, Singapore and South Korea. It is defined as "a state that puts economic development as the top priority of governmental policy and is able to design effective instruments to promote such a goal. The

instruments would include the forging of new formal institutions, the weaving of formal and informal networks of collaboration among the citizens and officials, and the utilization of new opportunities for trade and profitable production" (Bagchi, 2000:398). More importantly, such a state actively influences the direction and pace of socio-economic development by directly intervening in the developmental process, rather than relying on the unco-ordinated influence of market forces in the allocation of resources. Thus, government drives development but also puts in place multi-faceted interventions for the upliftment of people (Southern African Catholic Bishops' Conference, 2007:1).

The above discussion mainly centred on models and the South African state that would best encompass success for harvested rainwater use in HH food security. The policy process is described in the next section. Planning, designing and implementing policies would, however, have limited value if measures are not in place to determine whether intended outputs, outcomes and impact targets have been achieved, and if not, by what margin they have been missed or exceeded. This assessment process is generally referred to as the monitoring and evaluation stage of the policy process (Patton and Sawicki, 1986:63). The theory of this, as well as the crucial element of development of indicators, is also described in the next section.

2.1.3.3 Public policy process

As indicated, public policies are statements of intent of government in their commitment to serve the public. Policies should contain specific goals to provide the services, but would also contain the principles that inform the policy process. The processes through which policies are developed can differ in scope and phases, but should usually contain the formulation of the problem that requires the development of a policy; development of clear goals and objectives to be attained; establishment of evaluating criteria and the usage of these to develop alternatives to reach the goals; analyzing and comparing these alternatives (or options); implementation of the chosen alternatives; and monitoring and evaluation of implementation (Cloete, *et al*.,

2007:126-127). All of the above steps or stages would be informed by the established basic principles. Various iterations take place during the process and the different steps cannot be implemented in strict isolation from each other. Extensive literature is available on what should or could take place during each of the steps mentioned and a comparison of different processes as proposed by different authors are provided by Booysen (2006:167). The steps are briefly discussed below.

Defining the problem and determining goals and objectives:
These first steps are crucial and should be done circumspectly – a problem well-formulated is a problem half-solved. The problem should be stated unambiguously and should focus on the central critical factors. This should take into account the past and the present as it is developing. This is especially relevant in South Africa where fundamental changes that took place in 1994 are still progressively being implemented.

When determining goals and objectives the sources and constraints in the environment within which the policy is to be developed should be taken into account. The goals and objectives should be prioritized and criteria can be developed to assist in this process.

Establishing the evaluation criteria:
In this step cognizance should, for instance, be taken of the technical, economic, financial and political viability, and the administrative operability of the organization/s that would implement the policy. These could include cost and net benefit, effectiveness, efficiency, equity, equality, administrative ease, legality and political acceptability (Patton and Sawicki, 1993:57 and 65). Choices made in determining the criteria can also be grouped according to value (precision, strong normative arguments, multidisciplinary perspectives), method (cross-validation, cross-national search and holistic analysis) and institution (informal reforms and catalytic controls or incentives) (Gromley, 1987:162).

Generating and comparing alternatives or options:

These steps would require critical, clinical and objective consideration of policy-relevant information, while creativity and imagination could assist considerably in finding new solutions to old problems. Information could be gathered through, for example, literature reviews, surveys, comparison of case studies (real-world experiences) and brainstorming. Various approaches and methods could be used in generating alternatives. In most cases, a single approach or method is seldom appropriate and a mixture of elements or degrees of different ones is usually used. Models include the **rational-comprehensive model** which implies full knowledge of all facts relevant to a specific case; the **incremental model** that proposes that policy should be redefined on a continuous basis (compared to radical, expeditious and comprehensive changes) (Dye, 1995:21-32); and the **mixed-scanning model** which integrates relevant characteristics of the previous two models. General techniques that could be used include problem structuring (such as stakeholder analysis and argumentation techniques), forecasting and judging such as the Delphi technique and scenario development. It is recommended that policy developers should not try to find a single perfect policy option and that too many options that are too general and all-inclusive are not desirable (Cloete, *et al*., 2007:140-164).

Policy implementation:

This stage is as critical as the previous ones to ensure successful public policies in a country. In South Africa at present, the criticism is often made that excellent policies have been developed but that elements thereof, or whole policies, are not being implemented. This step entails the implementation of the best alternative or option developed in the previous step and would set out the actions required to attain the goals as stated. It usually indicates actions, relevant actors and their interests, required resources and who might provide them, facilitators and barriers likely to be encountered, and reasonable time frames. A good implementation plan will also have indicators that are required for Monitoring and Evaluation.

Brynard and De Coning (in Cloete, *et al*., 2007:194-203) identified critical variables for policy implementation (the 5-C protocol). These can be grouped as content, context, commitment, capacity, clients and coalitions. Content refers to the nature of the policy, whether distributive, regulatory or redistributive. Context refers to the institutional context within which the policy will be implemented as well as the larger context of social, economic, political and legal realities of the system. Commitment refers to different levels of the different participants or partners involved in implementation. Capacity refers to the availability of tangible (such as human, financial, material, technological, logistical) as well as intangible resources (such as leadership, motivation, commitment, willingness, courage and endurance). Clients and coalitions refer to the main key stakeholders affected by the policy and interest groups, opinion leaders and other outside actors who can actively support an implementation process. Each one of these variables would be critical when considering implementation of a policy on using RWH for HH food security.

Monitoring and evaluation of implementation:
Due to its importance for this research (the development of indicators as part of M&E), this aspect is described in more detail in the next section.

The policy process will thus give effect to the intent of government through the development of a set of principles to be used in decisions, the setting of prioritized goals and objectives, the identification of the best option to be implemented and the strategy to be used in implementation. A specific process that would contain at least the steps described above should be followed in its development.

2.1.3.4 Policy monitoring and evaluation (M&E)

Evaluation is a judging process to compare policy results (outputs, outcomes and impacts) with goals and objectives set – progress towards achieving these can thus be measured. The evaluation process is value-based (Patten as cited in Van Dyk-Robertson, 2007:4) and contributes to improving

decision-making, resource allocation and accountability regarding public policies. It provides an excellent tool for learning from past experience and to improve processes.

The evaluation process consists of designing the process, collecting and analyzing data and packaging results to enhance use. Data collection could include focus group discussions, observations, open-ended interviews and expert judgement. Criteria for effective policy evaluation include impartiality, credibility, balance, clarity and ease of understanding, relevance, significance, originality, legitimacy, reliability, validity, objectivity, timeliness and usability (OECD, 1998:27; UNDP, 2002:100; Cloete, *et al*., 2007:259). Development of indicators is an integral part of a monitoring and evaluation (M&E) system.

M&E takes place at two distinct but closely connected levels: input/output and outcome/impact. These concepts and the associated indicators and their implication for the research are briefly discussed below.

- ***Outputs*** are regarded as the specific products and services that emerge from processing ***inputs*** through programmes – thus the final goods and services produced. Examples of ***inputs*** are the experts required, equipment, and funds used, while examples of ***outputs*** are studies completed and people trained (UNDP, 2002:6).
- ***Outcomes*** are the changes in the final social and economic results of programmes and represent a strategic exercise based on national priorities (UNDP, 2002:10). ***Impacts*** are regarded as the eventual effects (often diffuse) of different ***outcomes*** on (the overall improvement of) people's lives in the longer-term and on national-level development change (UNDP 2002:10). Examples of ***outcomes*** are increased income and jobs created, and of ***impacts*** are improved health conditions and increased longevity (UNDP, 2002:6)
- ***Goals*** are the objectives a country or organization wants to achieve; they are often expressed in non-technical, qualitative terms such as "reduce poverty". ***Indicators*** are the variables used to measure progress towards a goal. ***Targets*** are the quantified levels of indicators

that a country wants to achieve at a given point in time. ***Outputs*** differ from ***outcomes*** because they are fully under the control of the agency that provides them (Prennushi, Rubio and Subbarao, 2002:108 and 110).

- ***Impact evaluation*** is a type of evaluation that focuses on the broad, longer-term impact or results, whether intended or unintended, of a programme or outcome (UNDP, 2001:101). It assesses the changes in well-being that can be attributed to a particular programme. "Information generated by impact evaluations informs decisions on whether to expand, modify or eliminate a particular policy or program and is used in prioritizing public actions. It is a decision-making tool for policy makers and increases public scrutiny of programs" (Prennushi, *et al.,* 2002:117).

Development of indicators is a useful instrument to help reveal trends and "draw attention to occurrences that require further analysis and possible action". They cannot be used on their own but have to be supplemented and interpreted within context (Bentley and de Leeuw, 2005:5). If correctly determined, they should especially be useful to indicate that processes or practices are successful or unsuccessful. Indicators can also indicate whether best practices are implemented at a micro or small scale such as at HH level.

2.1.3.5 Variables for success

Variables to determine success (as related to project management) were found in Kerzner (1989:504-517) and are summarised in Box 1. In many cases, these variables can also be related to rainwater use in HH food security initiatives. The variables identified relate to the four aspects indicated.

Box 1: Variables identified to determine success

Predicting success

- Top management (TM) support: TM acknowledges the problem, supports the way forward enthusiastically, provides resources, administrative support and an external buffer;
- Skilled (technical, human and administrative) and empowered (project) managers are available;
- Judicious and adequate (not excessive) planning, controlling and communication systems are done;
- Roles and responsibilities are well defined from the start;
- Realistic goals are established;
- Enough time is allowed to do the preparatory and groundwork;
- Conflict resolution mechanisms are provided;
- Responsibility, performance and rewards are tied together;
- Planning is done well in advance for the end of the project.

Effectiveness

- Credibility: Sound decisions are made; Success is made visible; The emphasis is on facts rather than opinions; Credit is given where due;
- Priority: The importance of the project is sold to top management and clients; What is necessary to achieve success is emphasised; "Spin-offs" that may result from projects are emphasised; Testimonial support from others is secured;
- Accessibility: Communication is made directly to concerned parties; Facts are weighed carefully; Pros and cons are explained; Presentations are logical and polished; Curiosity is made to work for you.
- Visibility: Be aware of the amount of visibility that is needed; Use available publicity media.

Expectations

- Total accountability for success or failure is assumed;
- Effective reports and information are provided;
- Interpersonal problems are handled effectively;
- Expectations from top management are met and include the following: They provide clearly defined decision channels; facilitate interfacing with support departments; assist in conflict resolution; provide sufficient resources; give advice and strategic direction; provide protection from political infighting; define expectations clearly.

Analysis of the driving and restraining forces during the life cycle of a project. There is:

- Personal drive, motivation and leadership. These include a desire for accomplishment; interest in the project; group acceptance; common objectives; assistance in problem solving; team builder; effective communication; clear roles;
- Team motivation including good interpersonal relations; desire to achieve; expertise; clear role definition; project visibility and rewards;
- Management support including sufficient resources; proper priorities; clear direction;
- Functional support including setting clear goals and priorities; proper planning; adequate task integrators
- Technical expertise such as ability to manage technology; good track record;
- Project objectives set and include clear goals, expectations, responsibilities, and a workable plan;
- Financial resources including the necessary financial resources; financial control capabilities;
- Client support and commitment such as good working relations; clear objectives; timely client feedback; regular meetings/reviews; client support and commitment; help and concern.

Source: Adapted from Kerzner, 1989:504-517

The variables found in the literature and included in Box 1, as well as the information described in the Literature Review on what could presumably contribute to successful use of rainwater for HH food security, was further analysed in the interviews conducted and the case study examined as part of this research.

2.1.3.6 Uptake of public policy research

It is important that the public policy research of this project should be taken up by politicians and government. However, the uptake of research results in public policies is generally low, and particular aspects that can improve uptake are briefly discussed here.

It has been found that public policy research is very much a two-way process and that it is shaped by "multiple relations and reservoirs of knowledge". Effective research requires a detailed understanding of the policy-making process, the nature of the evidence to be collected – which should be accurate, objective, credible, relevant, rooted in reality, practical and operationally useful – and an understanding of the stakeholders involved in the policy arena (Overseas Development Institute, 2005:1).

Evidence-based policy-making refers to a process where policy-making is informed by available evidence and a rational and systematic approach (Sutcliffe and Court, 2005:ii).

It has been found that the uptake of research-based evidence in the public policy sphere does not usually lead to or influence policy changes. It was found that this is mainly due to four aspects: the political context within which the research is being done (political and economic structures and interests, institutional pressures, cultural differences, etc.); the evidence brought by the research (credibility, methods, relevance, use, how the message is packaged and communicated, etc.); the links between policy makers and other stakeholders through, for instance, relationships and networks; and external influences such as socio-economic and cultural influences (Court and Cotterrell, 2006:2; Start and Hovland, 2004:7). The Overseas Development Institute (ODI) conducted extensive research on the subject and developed tools on how the various aspects could be covered in research to improve its subsequent uptake (Start and Hovland, 2004). They recommend, for instance, that the researcher should determine whether there is demand for

the ideas to be researched, determine what sort of evidence would convince policymakers, what links and networks are relevant and what the prevailing socio-economic and cultural influences might be.

The Institute also developed tools for M&E of policy research (Hovland, 2007:vii) where five performance areas associated with the research process are identified (strategy and direction; management; outputs; uptake; outcomes; and impacts) and approaches for M&E are provided.

This research had to take into account the above aspects as identified that would enhance uptake of the results.

2.1.3.7 Conclusion

The theoretical framework for the research was described and indicated what public policies are and which theories best describe what is required for successful use of harvested water for HH food security. The theories described included variants of institutional theory (indicating the required effectiveness and efficiency of government as well as considering substantive values such as social equity and equality) and network theory that describes multi-level governance on the horizontal level of policy. Policy decisions have to be taken within networks of policy stakeholders, both inside and outside the public sector. In addition to a well-developed policy, it also has to be implementable and has to subsequently be implemented. Reference was also made to South Africa as a developmental state that can give effect to the required government and governance required since 1994.

The public policy process was discussed in general. Important aspects are a well-formulated problem for which the policy would be required, the principles that will inform the policy process and the goals to be attained. During the public policy development process, different options or alternatives are generated and models appropriate for this include the rational-comprehensive, incremental and mixed-scanning models. The 5-C protocol (content, context, commitment, capacity and client, and coalitions) describes

the critical variables needed for policy implementation. M&E of implementation is crucial and more detail of indicator development that forms part of this is provided. Development of indicators could be used to determine to what extent goals are being reached, and thus whether processes are successful. A well-developed and implemented M&E system can thus be expected to contribute to the success of public policy implementation. Information on what constitutes success was also described.

The next section contains the literature review and includes discussions on the role of RWH in water management, requirements for HH food security, whether policies and associated frameworks have been developed and what they entail, research done in SA on use of RWH for HH food security, and then specifically identifying in the literature which factors were found to contribute to implementation of RWH to successfully improve HH food security. Special attention is also given to the situation described in China where RWH has been used successfully to improve rural household lives in arid areas.

2.2 LITERATURE REVIEW

2.2.1 Introduction

The literature review provides the context for the study and documentation available on RWH and HH food security public policies and associated M&E systems, as well as a review of related documentation on South Africa and internationally.

Water and food security requirements for all HHs are regarded as high priorities worldwide and in 2000 leaders put their commitments into a declaration and a timeframe for the achievement of goals by 2015, known as the Millennium Development Goals (MDGs). Associated high-level indicators have been developed (United Nations Millennium Declaration, 2000).

RWH has been a common practice for about four thousand years in many civilizations where the water was used for drinking and agricultural purposes.

As water became cheaply available and easily accessible, many of these practices were abandoned and water wastage often increased (Qiang, Yuanhong and Chengxiang, 2007:193). Especially after droughts, the practices are being re-invigorated and re-investigated in an effort to improve the life of especially the rural poor in arid areas.

Importantly, an International Rainwater Catchment Systems Association, consisting of scientists and practitioners, was established two decades ago to promote RWH and offers technological know-how and informal person-to-person contact.

Water harvesting is increasingly being seen in South Africa as an important tool to improve especially rural HH water and food security, and thus quality of life. Not many historical indigenous RWH practices could be identified, but extensive research has been done by the Water Research Commission (WRC) and Agricultural Research Council (ARC) during the last 10 years (WRC, 2008a). The practices have been found to be effective in contributing to HH food security in rural areas under specific bio-physical and socio-economic situations.

RWH is also successfully being used in China for HH food security. Except for this international example, not many instances could be found where policies and legislation govern the practice of using RWH to improve HH food security.

The literature is evaluated in terms of the primary and secondary questions posed as part of the research.

2.2.2 The international environment

Ministers of various countries identified water related priorities, including aspects of meeting basic needs in water and sanitation, food security (securing the food supply especially for the poor and vulnerable through the more effective use of water), the protection of the resource, and equity in water use are prominent and in that order on the list. Progressively

achieving the different priorities are probably prerequisites for wise and sustainable governance of nations (Hague Ministerial Declaration, adopted March 2000).

The same elements also featured in the MDGs and targets set for 2015. Goal 1 provides for the eradication of extreme poverty and hunger with Target 2 the reduction by half of the proportion of people who suffer from hunger. Goal 7 provides for ensuring environmental sustainability. Importantly RWH can play a primary and secondary role in achieving all of the eight MDGs (UNEP, 2009:10). An example is that RWH interventions improve gender equality and income group equity by reducing the time spent by women gathering water for domestic purposes (MDG Goal 3: Gender equality).

South Africa has already reached some of the targets (such as the halving of the population without sustainable access to safe drinking water – Target 10) and was on track to reach all the targets stated (RSA, 2007:5).

2.2.3 Household Food Security

2.2.3.1 Introduction

In South Africa, more than 14 million people are vulnerable to food insecurity, 43 per cent of HHs suffer from food poverty and the development of about 1.5 million or about one quarter of the children under the age of six has been stunted by malnutrition (Human Sciences Research Council, 2004:3 and 25). Female-headed HHs are also considerably poorer than male-headed HHs (NDA, 2002:23).

This research will not consider improving food security of HHs in general - this is directly related to peoples' poverty situation - but will focus on using harvested rainwater for HH agricultural food production. The literature review will also concentrate on those aspects.

An excellent review on food security in Southern Africa was produced in 2005 by the Southern African Regional Poverty Network (SARPN, 2005). The paper provides a regional perspective on what is required for food security from an agricultural perspective, including food security at the HH level. The researchers took the important position that "food is the most basic necessity for all human beings and providing sufficient food of adequate quality for everyone …. should be the first development objective of every government" (SARPN, 2005:3).

The paper researched food security and food-sufficiency: self-sufficiency emphasises domestic production and internal food sufficiency, while food security also incorporates other variables such as food imports and food aid, which are both related to economic interdependence in a country or region (2005:9). This research (SARPN, 2005) was the best summary found on the subject and describes issues and proposed solutions also found in numerous other reports. Mainly information found in the report is thus discussed in this review.

The broader context and the changes in agriculture, land and the economy in South Africa since 1994 are presented by Nieuwoudt and Groenewald (2003), whose book considers the historic legacy, present problems in SA, and also provides some planning and action for the future regarding land distribution, agricultural marketing, agriculture and international trade, and finance. One chapter (Chapter 10) considers food security and specifically provides case studies of rural livelihoods in the Eastern Cape. The authors of the chapter (Fraser, Monde and van Averbeke) refer to "exchange mappings" that describe the network of exchange relations used by people to ensure their food security (2003:173). In rural areas production of their own food will constitute such an exchange relation that HHs will have with nature. They concluded that "[T]he challenge is to develop policies and programmes capable of supporting what poor people already do, which will require a multi-disciplinary approach with well co-ordinated and targeted interventions" (2003:182). They also indicate that food security is too complex to be dealt with by the Department of Agriculture alone and that it requires better

collaboration across sectors, disciplines and organizations. They further emphasised that when addressing food security there is a need to invest in human capital, targeting women in particular (2003:183).

2.2.3.2 Causes for food insecurity in South and Southern Africa

The main cause of HH food insecurity within especially the African population in SA can be attributed to colonial and apartheid systems that systematically crippled and debarred African farming and entrepreneurial activity, while white farmers and industrialists were enabled and entitled to become leaders and chief beneficiaries of industrial development (NDA, 2002:18). This industrialization process was the driving force for poverty and food insecurity as presently experienced. The Integrated Food Security Strategy (IFSS) developed by the Department of Agriculture addresses national, and more importantly for this research, HH and intra-HH food insecurity (NDA, 2002:18).

The SARPN paper considered the causes of food insecurity and self-insufficiency in the region due to the remnants of colonial rule and practices (SARPN, 2005). The author clustered the causes of food insecurity in the Southern Africa region into 12 groups with the most fundamental cause seen as the structural characteristics of production, consumption and exchange patterns (SARPN, 2005:9-14). This consisted of the predominance of only subsistence and commercial activities, lack of diversification, ill-adapted technology, fragmentation of the economy, a neglected informal sector, “lopsided development due to urban bias of public policies”, weak institutional capabilities and inappropriate government policies.

The second group is associated with wrong sectoral policies and inappropriate agricultural policies. According to the author, national governments have a consistent anti-agricultural bias showed through offering of low prices to farmers, reliance on food imports (especially food aid), emphasizing cash crops rather than food crops, and not recognizing women’s pivotal role in the food sector.

The third group is called the politics of food, which poses that food production is not a priority at central government level and that during the colonial years, labour, land and other resources were diverted towards the production of raw materials, and where agriculture is concerned, industrial products such as cotton, tobacco, coffee and cacao. This practice is continuing in most countries. The author indicates that policies should place a country's food and nutritional problems, along with other aspects of development, on a scale of priorities. He indicated that "(F)ood policy has to define and plan the implementation of measures that give the national producers the economic and social incentives and the security they need to go beyond subsistence farming and help meet the needs of the country as a whole" (2005:10).

The next group is the "cash-crop syndrome". In this case, policy decisions profoundly undermined the viability of indigenous food systems and promoted the production of cash crops (produced for external markets) that provided quick ways to generate revenue for colonial governments. Pricing and marketing policies disadvantaged producers of food by keeping prices paid to producers very low (compared to prices fetched on markets), and by causing a highly skewed distribution of marketing and storage facilities, extension services and technological inputs.

Related to the above are food pricing policies that are more political than economic orientated and that favoured consumers in urban areas more than producers and the rural population.

Other groupings include population growth and urbanization, where population growth is higher than agricultural output production growth and increased urbanization results in people consuming more food but not contributing to producing it. Food security thus declines. Inadequate food production is the result of the low level of scientific and technological application in the agricultural sector, low technology adoption by small-holder farmers, lack of diversification in crop production, the unrecognized role of women in production, the non-improvement of rural infrastructure and some

of the aspects mentioned in the other groupings. The issue of infrastructural deficiencies and how that affects food production in low-income HHs is also discussed in the HSRC report (HSRC, 2004:43). Infrastructure refers to roads, transport, irrigation and water and electricity services. The HSRC report further refers to access to soft or institutional infrastructure such as research and development, extension and training, and credit (HSRC, 2004:45).

Food aid generally has adverse effects on domestic food production in that it contributes to keeping food prices low and "dulled" the political will to develop agriculture. The role of women as producers is not recognized and they are constrained by not having sufficient access to factors of production such as land, capital, credit and technology. Technology that is simple, low-cost and locally produced is one of the pre-requisites to address this aspect.

Other groupings included economic failures that also impacted on support for smallholder farming; the "lethal-mix" of HIV and Aids, drought and failing government that resulted in lost lives, reduced life expectancy and a resultant limitation in food production by communities; and lastly the vulnerability of poor rural communities that usually lack capital and tools, livestock, literacy (to name a few), and that consist mostly of the elderly, women and children.

2.2.3.3 Policies and strategies to address food insecurity

The South African IFSS prioritized improvement of HH food production, nutrition and food safety (NDA, 2002:28-29). Possible policy interventions identified included, *inter alia*:

- increasing access to productive resources such as land, technology, credit and training;
- promotion of RWH technologies;
- promoting productivity-enhancing, environmentally sustainable technologies for the agriculture and agro-processing sector, targeting small-scale producers;

- linking land/water and tenure reform to other farmer support services, including access to financial services and markets;
- improving extension services to ensure that these are appropriate for the needs of HH food security;
- improving rural infrastructure.

Nutrition and food safety could be improved through enhanced public education, improved monitoring methods and strengthening HH food security and nutrition training at both pre- and in-service training (NDA, 2002:31). However, it could not be established by the researcher whether these strategies have been developed and are being implemented.

The same priorities are echoed in other documents: the FAO (2006:3) identified policy priorities for food security as part of a two-track approach:

a) Rural development / productivity enhancement:

Availability: improving rural food production especially by small-scale farmers; investing in rural markets and rural infrastructure;

Access and utilization: re-establishing rural institutions, enhancing access to assets and land, reviving rural financial systems;

Stability: diversifying agriculture and employment, monitoring food security and vulnerability, reviving access to credit systems and savings mechanisms, dealing with structural causes of food insecurity.

b) Direct and immediate access to food:

Availability: Seed/input relief, restocking livestock capital, enabling market revival;

Access and utilization: asset redistribution;

Stability: monitoring immediate vulnerability and intervention impact.

The article on Southern African regional food security also considered strategies for achieving food security (SARPN, 2005:14–21) and the author made the point that a national food policy should address all aspects of the food system – supply, distribution and consumption. Nine strategies that

would form part of such a policy were presented. The first one relates to complementary support systems that should enable smallholder farmers to produce a variety of crops (to increase their own HH food security but also to assist them to sell to other people), and which should address price policies, women's access to production, availability of efficient technologies, credit, markets (accessibility to well-functioning and well-integrated markets and market information), infrastructure and storage facilities. He also indicates that the role of parastatal agencies should be gradually reduced while market regulation should increase.

Policies for increasing domestic production should include strengthening and diversifying food production capacity, enhancing the role of women as agents of change, government inputs into agricultural and rural development and especially food production (providing for instance, low-cost simple technology packages and promoting human resource development) and conversion to more yield-oriented agriculture, while protecting soil and water resources (SARPN, 2005:15-16).

Another strategy should address the need for appropriate macro-economic policies and political will. Macro-economic policy will include the institutional structure and design of the national economy, rate of growth, direction of growth, distribution of income, management and supply of credit, interest rates and others. In addition, various ministries (besides agriculture) should participate in implementing such strategies while simultaneously making a considerable effort to protect the interests of the rural poor and women as their political power is minimal. The production of high-value goods through the creation of agro-industries should be included and would benefit smallholder farmers and also increase employment. They also emphasise that food security should be a Southern African regional rather than a national objective and that there would be a need for bilateral and multi-lateral agreements between SADC states for development and implementation, in order to ensure that the region becomes collectively self-reliant with a food secure population (SARPN, 2005:16-17).

Selective support for increased domestic production should, however, also consider increasing demand elasticity of traditional products through raising awareness on an increasing diversity of staples as well as to diversify consumption patterns. This should be done to prevent overproduction of such products. Attention should also be paid to increasing production of food crops to meet a rapidly rising demand, including rice, sugar, vegetables and fruits. Other support could include provision of subsidies (decreasing over time to promote sustainability) for seeds and fertilizer, and provision of services and technologies to establish best practice and improve yields (SARPN, 2005:17-18).

Other strategies are price support systems which could include a guaranteed minimum price for food crops managed through national and strategic food reserves, and institutional reforms for land tenure (also specifically aimed at promoting women's access) (SARPN, 2005:18-19).

Policies for women food producers should be stimulative, supportive and sustaining. Stimulative policies refer to a motivational element that would build informed and enlightened women food producers. These could be provided through extension services. Supportive policies would aim to assist women to establish and run their farms efficiently, and include establishing of group institutions to assist in providing marketing bargaining power, creating credit to help with seasonal production and longer-term investment, and provision of storage facilities. Sustaining policies would ensure continued efficient functioning of farms and could help in modernization, diversification and expansion (SARPN, 2005:19-20).

The last strategies refer to extension services for women and for addressing the impact of HIV and AIDS on HHs (SARPN, 2005:20).

The paper also discusses regional policy processes and the key regional players and concludes that food security should be a regional objective and that collective self-reliance is critical for the region to harness its resources and ensure a food secure population (SARPN, 2005:21-27).

The aspects mentioned in the preceding section and which are considered relevant for HH food security are summarized at the end of the chapter in sections 2.2.7 and 2.2.8.

2.2.3.4 Monitoring and evaluation

Numerous publications are available in the international food aid literature that address the development of indicators for food insecurity (FANTA, 2003; Coates, Webb and Houser, 2003:i-iii; Coates, Swindale and Bilinsky, 2007:1). The following three components associated with food security are usually addressed (FANTA, 2008:1, Riely, Mock, Cogill, Bailey and Kenefick, 1999:2):

- *Availability:* Sufficient quantities of appropriate, necessary types of food from domestic production, commercial imports, or donors are consistently available to individuals or are in reasonable proximity to them.
- *Access:* Individuals have adequate incomes or other resources to purchase or barter to obtain levels of appropriate foods needed to maintain consumption of an adequate diet and nutritional level.
- *Utilization:* Food is properly used: existence of proper food processing and storage practices, adequate knowledge and application of nutrition and child care, and adequate health and sanitation services.

The Food and Agricultural Organization (FAO) of the United Nations also identified an important fourth component namely *Stability* that refers to a population, HH or individual having access to adequate food at all times. They should not risk losing access to food due to sudden shocks (such as an economic or climatic crisis) or cyclical events (such as seasonal food insecurity). The concept of stability refers to both the availability and access dimensions of food security (FAO, 2006:1)

Saad (1999:9) adapted the following information on Food Security Indicators, based on the above components (Table 1):

Table 1: Food Security Indicators

Food availability		**Food access**		**Food utilization**
Resources Natural Physical Human	**Production** Farm / Non-farm HH / Non-HH	**Income** Farm / Non-farm HH / Non-HH	**Consumption** Food Non-food	**Nutrition** Child M/F/age Adult M/F/age
Indicator Categories				
Resources **Natural** Rainfall levels, stability Soil quality Water availability Forest resource access Fish and seafood **Physical** Livestock ownership Infrastructure access Farm /HH Implement ownership Land ownership or security of tenure/access and control Other physical assets **Human** Gender of HH head Dependency ratio Education, literacy levels H/H size Ages of H/H head and members	**Production** Total area cultivated Irrigated area Area in fallow Access to and use of inputs Number of cropping seasons Crop diversity Crop yield Food production Cash crop production Number of sources of non-farm income Cottage industry production Gender division of labour	**Income** Total income Crop income Livestock income Wage income Self employment Migrant income Producer prices Market, road access	**Consumption** Total expenditure Food prices Non-food consumer Prices Dietary intake Meal frequencies per/day/over 2-3 seasons Composition of daily meals	**Nutrition** Anthropometric data Serum micro-nutrient levels Morbidity rates Mortality rates Fertility rates Access to health services Access to potable water Access to adequate sanitation

Sources: Adapted from Webb, Richardson, and von Braun (1993), 'Conceptual framework for famine analysis: A HH income approach', International Food Policy Research Institute (IFPRI), and Chung, Haddad, Ramakrishna and Reily (1997), *Identifying the Food Insecure: The application of mixed-method approaches in India*. Washington DC, IFPRI.

All three components mentioned above are relevant for the use of RWH for HH agricultural food security.

A document has also been produced on Water for Food Security (Water Development Report, 2006: 191-213), which contains some information on

indicators related to food security such as percentage of agricultural production contributing to GDP, daily supply of calories as percentage of needs and coefficient of food dependency (2006:191). It also contains some indicators of irrigated agriculture such as irrigated area and hectares per 1 000 inhabitants (2006:208).

Various publications are available on the food security status and their associated indicators of individuals in South Africa (Watkinson, 2008:2; Steyn, 2000:2; Rose and Charlton, 2002:3235-3242). These are respectively child malnutrition indicators, nutritional indicators for children aged 6 to 71 months, and quantity indicators from a food expenditure survey. The latter consists of two quantitative HH food insecurity indicators: “an indicator termed food poverty, measures whether the amount of money spent by a HH on food is enough to purchase a nutritionally adequate basic diet” (2002:3235) and a second indicator, “termed low energy availability, which assesses whether the energy available to a HH from its food purchases and home production of food is less than the sum of its members’ recommended energy intake” (2002:3236).

All of the above documentation and any additional relevant information that could be found were drawn on for the research.

2.2.4 Rainwater harvesting (RWH)

The practice of RWH is increasingly becoming important again in both the developed and developing worlds due to the benefits that it has for governments and citizens in general. In the developed world it is mainly seen as a water conservation measure while in other areas it is seen as a critical additional source of water for the poor. The specific link between RWH and poor HH food security is, however, not made in general, except in the literature on the Chinese practices. The concept of RWH and its regulation through legislation, standards and best practices in different countries are discussed as these could assist in instituting them in SA for improving HH

food security. The following points present the main advantages of RWH and its practices, where RWH:

- Provides an inexpensive supply of water – harvested rainwater is free;
- Augments drinking water supplies;
- Reduces storm water runoff and pollution;
- Reduces erosion;
- Provides water that needs little treatment for irrigation or non-potable indoor uses such as toilet flushing (about 80 per cent of domestic demand does not require drinkable water (Kloss, 2008:2));
- Helps reduce peak summer demands;
- Helps introduce demand management for drinking water systems (Kloss, 2008:1);
- Is a local intervention with primarily local benefits on human livelihoods and ecosystems (UNEP, 2009:x).

Various governments at national, provincial or local level have instituted requirements for RWH practices. These can provide water during water scarce periods – "it reduces the dependence on treated water and provides a convenient buffer in times of emergency or a shortfall in the water supply" (Shahwahid, Suhaimi, Rasyikah, Jamaluddin, Huang and Farah, 2007:1).

In the **United States of America** the goals of RWH policies are to protect water as a human right, safeguard public health and promote rainwater use, resource conservation and sustainability. Types of policies identified (as referred to in their literature) are government standards and enforcement, incentive-based policies and outcome-based policies (Stark and Pushard, 2008:20). The authors mention what could be considered ineffective policies and some unintended consequences that could arise from their implementation. These are important should a policy and legislative framework be developed in SA. They can include required compliance with numerous different codes, codes that require approval by high levels and costly people with expertise (such as engineers), decision-makers'

uncertainty in a changing world, unnecessary complexity and lack of intra-government communication.

In some states there are legislative requirements for new developments or expansions to have a “self-sustaining water supply system”, while financial incentives are increasingly being provided. These include subsidization for the cost of RWH cisterns up to a certain level, selling of cisterns below cost, rebates on installing of equipment and processes, and property and sales tax exemptions for commercial installation. The state of Texas is leading and offers incentives at the local and state levels. A summary of the various incentives are provided in Meinzen (2009) and include specifics of the above. In Arizona, for instance, there is a one-time tax credit of 25 per cent of cost of a water conservation system (maximum limit is $1 000). Texas allows for recuperation of initial investments through savings earned on utility bills, so that water and energy conserving measures are thus expected to pay for themselves within a specified period. Importantly, Tucson, Arizona published a municipal ordinance requiring developers of commercial properties to harvest RW for 50 per cent of their landscaping requirements. Various states also provide guidelines on RWH. In general, RWH is increasingly becoming integrated into flood, drainage, storm water, conservation and transportation plans (Pima Association of Governments, 2009).

Key characteristics of good RWH policies are being seen as making sense from economical, social and environmental perspectives; they should focus on end results; should be easy for the public to understand; should be simple for the public to implement, should be achievable and measurable; should have been reviewed by RWH practitioners; should include education of the public, councillors and government officials; and have a standardized and streamlined application process (Stark and Pushard, 2008:21; Kloss, 2009:2). In summary, they emphasised the importance of including RWH requirements in state, county and city codes, providing financial incentives, and providing education and technical support. They further indicated that definitions are crucial and that RWH should not be classified as storm water, run-off, grey water or waste water.

It is important for this research to keep in mind the requirements of establishing a Municipal Rainwater Harvesting Programme (Kloss, 2008:10). The programme should consist of establishing specific codes or regulations for RWH; identifying acceptable end uses and treatment standards; describing the detail required of system components; describing processes of permitting, maintenance and rates of re-use. These considerations could assist substantially if a municipal RWH programme for poor HH food security is considered.

In **Malaysia** guidelines for installing RWH systems have been available since 1998 but implementation of these non-compulsory guidelines has been low (Shahwahid, *et al*., 2007:8). More research with pilot implementation in selected identified representative systems has been done since 2004 while a National Urbanization Policy published in 2006 included RWH as a water management efficiency measure. The Malaysian government made it mandatory in Malaysia since 2006 and large buildings are required to comply. Legislation for enforcement has, however, not been developed. At this point, it is proposed that by-laws should be developed for enforcement. These are discussed in more detail in the document cited.

In Chennai, **India**, legal instruments have resulted in 98 per cent of its citizens utilising rainwater as an alternative to their main water supplies (Shahwahid, *et al*., 2007:5).

RWH measures are also common in other countries such as **Australia**, **Germany**, **Japan**, India (UN-HABITAT, undated:9), **Bermuda**, the **Philippines** and **Thailand**. Especially in Australia, the legislative framework and associated systems are well developed. An example is in Victoria (Australia) where, since 2005, new houses and apartments must be built to meet energy efficiency and water management requirements of the 5 Star Standard. This requires either a RWH tank for toilet flushing or a solar hot water system. In Sydney and New South Wales, restrictions are instituted in

the use of piped water at certain times and for specific volumes: Building regulations, for instance, require a 40 per cent reduction in mains water use.

Germany collects fees for the amount of impervious surface cover on a property that generates runoff directed to the local storm sewer. A revolving fund was started to assist HHs to install their own RWH facilities in a Province in the Philippines (Salas, 2003:2) and Thailand (Global Development Research, GDR, 2010). In Bermuda the public health act regulates RWH, where roofs have to be painted with white latex paint (every 2 – 3 years) and storage tanks must be cleaned at least once every six years (GDR, undated).

Various websites and reports provide lists of additional websites, reports and publications for rainwater catchment legislation, policy guidelines, design and maintenance (RWH websites).

In **South Africa** general measures that could be used in regulating water use, also water use associated with RWH, are indicated in Box 2. The main statutory measure applicable to RWH is the Schedule 1 permissible use of water for reasonable domestic use in that person's HH, and specifically to store and use run-off water from a roof (NWA, 1998: Schedule 1). Use of rainwater for food gardening purposes is not otherwise regulated through the Act, except if it leads to significant pollution of the water resource. The DWA also published a policy and regulation on Financial Assistance to Resource Poor Irrigation Farmers that provided for a grant for rainwater tanks for family food production and other productive uses (DWAF, 2004a and b). Standards (South African National Standards) could also be developed for water use associated with RWH for HH food security. Of relevance are also the persuasive measures such as influencing, advocacy, education and awareness raising and the protocols that can be drafted to improve co-operative governance.

Box 2: Measures used in water use source control	
Statutory measures	**Persuasive measures**
Schedule 1 (NWA, 1998) water uses Standards Regulations General authorizations Licensing Compliance Monitoring Auditing Directives Enforcement	Contracts Voluntary agreements Influencing Self-regulation (eg ISO 14000 certification) Monitoring Advocacy, education and awareness creation
Co-operative governance	**Economic measures**
Dispensing licensing Integrated planning Support Protocols Deregulation (WUAs and CMAs) EMPs, landfill site permits, EIAs	Waste Discharge Charge Penalties

Source: Adapted from DWAF and WRC, 1999

This section identified various legislative and policy instruments being used throughout the world for regulating RWH. Some reference is also made to regulatory measures available in SA for water use and specific mention is made of the DWA subsidy for a RWH/HH food security package.

2.2.5 RWH for HH food security in China

RWH practices in China are described in more detail as these appear fairly commonly applied in arid areas to the benefit of large parts of the population. RWH to alleviate the critical water shortage experienced in some areas.has been researched extensively in China since the 1980s. They now use RWH successfully as a “lubricant to the social and economic development in an extreme water scarce area” (Qiang and Yuanhong, 2007:1). Aspects of the practice include its appropriateness in certain areas, the planning and design of the RWH system, how to construct RWH in catchments, operation and

maintenance of the system, economic analysis, policy aspects, the importance of water quality, RWH in urban areas and community management practices (Li, Zhang, Gong and Xie 2002:482; Qiang, *et al.*, 2007), which are well documented and will be referred to in this section.

The research that preceded the large scale roll-out of the practice in Gansu Province indicated that a serious water deficit existed in the growing stages of wheat production which would have a significant influence on the yield. The problem was associated with the intensity and timing of the rainfall rather than only the intensity as such. Sixty per cent of the rainfall (including intense thunderstorms which caused huge amounts of erosion) occurred between July and September when crops do not need rainfall most (Cook, Fengrui and Huilan, 2000:1). The water that could be held in the loam and sandy loam soils was insufficient to carry the crop through these stages (Qiang, *et al.*, 2007:7 and 8). Existing rainwater storage practices also did not ensure enough water due to the low amount and intensity of rainfall events which could not produce enough run-off to fill the underground water tanks. Through experimentation, two projects were initiated.

The **"1-2-1" Rainwater Catchment Project** ran from 1995 to 1996 and mainly aimed to provide drinking water to 1.2 million people in an area where no surface and groundwater exist (note that transfer of water from other catchments was not considered feasible due to reasons such as high costs and remoteness of dwellings (Qiang, *et al.*, 2007:8)). It consisted of:

- One 80 – 150 m^2 of tiled roof and/or concrete paved courtyard;
- Two water cellars of 15 – 20 m^3 each and a hand pump;
- One piece of land close to the HH to be irrigated by rainwater.

The system was fully subsidised through funds provided by government and raised by them from society internally and internationally.

After the success of the above project, the Chinese government initiated the **Rainwater Harvesting Irrigation Project** which was similar to the "1-2-1"

project except that the irrigation tank's capacity ranged from 30 - 70 m^3 and more use was made of less permeable surfaces of existing structures like paved highways, country roads or where not available, concrete lined or plastic film covered surfaces. Guidance is provided to ensure that the water harvested is used in the most efficient way.

The success of the projects is evident from the next quote: "By the end of 2001, there were 2.2 million newly built storage tanks, allowing supplementary irrigation of 236 000 hectares of land. At the same time the beneficiaries of the domestic water project had further increased to nearly two million people. Now the project is still developing at a speed of enlarging 33 000 hectares of irrigated land each year" (Qiang, *et al.*, 2007:12).

The harvested water is also used to grow vegetables, watermelons, fruit trees and other cash crops. Greenhouses are built to supplement the projects and flowers, herbs, vegetables and rare wild animals are raised there (Qiang, *et al*., 2007:187).

Despite these large developments, it is estimated that less than 0,1 per cent of the total rainfall is used for water harvesting and that this practice thus does not decrease water yields significantly in catchments.

Researchers are presently developing a complete set of technical solutions to suit different regions, terrains and economic conditions. It has, for instance, already also been established that plastic covered ridges combined with gravel mulching can increase corn yields by 1.9. This is attributed to better utilization of light rains, better infiltration into the root zone and decreased evaporation due to mulching (Li, Gong and Wei, 2000:371).

RWH is regarded as sustainable and is seen to improve agricultural production, to control soil and water loss, and to improve the ecological and environment system. The reason for this is seen as the practice being a decentralized solution, suitable for scattered dwellings in a mountainous region, using indigenous resources, adopting traditional and acceptable

techniques and requiring low input from government and with low operation and maintenance (O&M) costs. Communities using the practice are also involved throughout the planning and operation of the system and this makes it easier to ensure their commitment to the project.

More specifically the success of the project is attributed to the following factors:

- The design and development of alternative **policy instruments** and social institutions that facilitate adoption of RHW practices; **Technical codes of practice and regulations** have been developed to regulate the process; Complete technical and design construction **methods** are provided to ensure good engineering quality (Qiang, *et al*., 2007:189);
- There is **political will and active support** for the projects (Qiang, *et al*., 2007:189-190);
- The RWH initiative has **buy-in from leaders** at all levels and it is actively being promoted and supported; leading groups are established at all levels (Qiang, *et al*., 2007:187-188);
- Extensive **research** took place before the practice was rolled-out (Qiang, *et al*., 2007:188);
- **HHs** using the practices are convinced of the real benefits to them; Demonstration plots are set up to enable easy acceptance of the concepts and for leaders to understand the concept; **Training and extension services** are provided to farmers; HHs are made aware from the start as they need to take ownership of projects; Communities are encouraged to rely on themselves to make the projects a success. Minimal state input is used. People are, for instance, encouraged to provide labour and to help each other (Qiang, *et al*., 2007:189);
- **Government subsidies** are provided and in addition **micro-credit facilities** are made available to set up green houses and develop small industries. Subsidies are not provided through cash but by providing materials and equipment and with technical staff working closely with

HHs during construction (Qiang, *et al*., 2007:189). **Strict quality control systems** are in place (Qiang, *et al*., 2007:189);

- **Integration** of different relevant aspects into a comprehensive agricultural-management system takes place: RWH, use of farmland, roads, livestock and agricultural production, small township construction and basin rehabilitation (Fengrui, Cook, Geballe and Burch Jr, 2002:1);
- **Awareness and understanding** of the practices are promoted and RWH symposiums are held annually. Technical papers are presented at conferences (Qiang, *et al*., 2007:188).

These and all the other aspects identified in the review are taken into account and included in the summary in section 2.2.7.

Future work identified by the Chinese includes further technological improvement and standardization of standards, to extend RWH to urban areas and to advance eco-environment sustainability.

The documented Chinese initiatives and experiences provide extensive detail of the science that informed processes, give detail of the RWH practices, and provide a clear indication of what was required to make its implementation sustainable in the long term.

It also shows how rainwater could be used for multiple purposes – for domestic purposes (provided the quality is fit for use), food security, agricultural purposes and small entrepreneurial activities.

A monitoring format has been suggested for RWH projects (Qiang, *et al.*, 2007:337). It is described in Table 2.

Table 2: A monitoring format suggested for Chinese RWH projects

Hydrological data	
Rainfall (standard gauges at important sites) Run-off (at least visual recordings of occurrences)	
Input	
Labour/Machinery hours for -	1. Construction 2. Maintenance 3. Standard agricultural operations
Cost	
Labour/Machinery use for -	1. Construction 2. Maintenance 3. Standard agricultural operations
Output	
Crops: yields of treated plots compared with controls Trees: survival and growth rates Grass/Fodder: dry matter of treated plots compared with controls	
Achievement	
Area (hectares) covered each season Number farmers/Villagers involved/Benefiting	
Incentive/Support	
Quantity and costs	
Training	
Number of training sessions Attendance/Number of trained personnel	
Extension	
Number of farmers visited Number of field days and attendance	

Source: Qiang, *et al.*, 2007:337

The concept to use water in an integrated way at homesteads has been practiced through the centuries and the practice is being revived in the current climate where addressing poverty and food security and promoting growth and development has acquired greater importance. It is especially useful in addressing the challenges facing women and the rural poor if a more holistic and integrated approach could be used to provide them with water. As evident from the Chinese experience, RWH can be an integral part of such a service especially in arid areas and for scattered rural communities.

The next section discusses SA research being done on RWH for HH food security.

2.2.6 South African research on the use of RWH for food security

2.2.6.1 Introduction

Extensive research has been done recently by numerous organizations in SA on harvesting rain to improve the lives of especially the rural poor. From the

information provided below it is clear that compared to the arid North African and other countries, these practices have not over the centuries developed to the same extent in SA. Very encouraging results are however obtained that these practices can contribute to HH food security and improvement of quality of life in general. The research includes identifying and overcoming the numerous challenges associated with successful implementation of such practices in the present South African rural socio-economic climate and culture.

2.2.6.2 Report on indigenous RWH and conservation in SA

This research identified 13 practices in SA and described 10 in detail (WRC, 2008a:v). The broader concept of water harvesting and conservation, that includes RWH practices, is categorized in various ways. Of relevance is a system described in the report (WRC, 2008a:16) which differentiated between water collection methods (such as in-field and external storm water from roads), water storage methods (such as in the soil profile and/or in structures), water use or application (such as directly from the soil profile or through irrigation from the storage structures), and the nature of the infrastructure used for collection (such as trenches, pipes and gutters). In line with international practices a categorization system has been proposed for SA and is based on scale and associated storage descriptors (WRC, 2008a:18).

The indigenous RWH practices that stood the test of time and presumably have been successful are described (WRC, 2008a:19-38). They include an interesting practice called "*saaidamme*" or planting dams in the Northern Cape that are similar to those found in the Nile River and comprise a series of large flat basins (between 1 and 100 hectares in area and up to 1 metre deep). The dams cover an area of approximate 35 000 hectares and are situated in a harsh and flat desert area with an average annual but highly unreliable rainfall of 100 to 200 millimetres. The dams catch fertile, silt-laden floodwater from mountains with higher rainfall about 100 to 150 kilometres away. The water in the dams saturates very deep alluvial soils. About 95 per cent of the country's lucerne seed is produced here. Another interesting

practice is granite dome harvesting at Paulshoek (Northern Cape) where water is caught from an area with a perimeter of 670 metres into a catch pit and is from there conveyed to a polyethylene-lined storage dam covered with corrugated iron. Water is used to supplement domestic water supply and is described as a "communal RWH initiative".

2.2.6.3 In-field rainwater harvesting (IRWH) in the Free State

Extensive research has been done by the WRC and ARC in SA since about 2000 on developing sustainable water use efficiency techniques (especially in-field rainwater harvesting, or IRWH) to improve HH food security. It started with intensive field experiments by the ARC at their Glen station (near Bloemfontein in the Free State) and at Thaba 'Nchu where the natural resources that influence crop yield such as climate, topography and soil conditions, are similar. It was found that over a six season period, maize and sunflower yields were increased by as much as 50 per cent compared to conventional production techniques.

The research indicated that the IRWH technique is sustainable in terms of increased agronomic productivity, entrenchment of risk, conservation of the natural resource base, social acceptability and economic feasibility (Botha, Anderson, Groenewald, Mdibe, Baiphethi, Nhlabatsi and Zere, 2007a:vii).

After the success experienced with the field experiments, the research was extended and the technique was transferred to backyards of rural communities at Thaba 'Nchu and Botshabelo. Extensive assistance and support were provided to both the communities and Department of Agriculture's extension officers by using various innovative methods. Spectacular results in terms of communal uptake of the technique were documented with 6 HHs participating in the 2001/2002 growing season and more than 1033 HHs in 42 communities participating in the 2004/2005 season (Botha, *et al*., 2007a:x).

To attain these results the research team used numerous innovative techniques and methods to transfer scientific and technical knowledge. Emphasis was also placed on the socio-economic aspects and the research also included an outcome and impact assessment.

This WRC research project formed the basis for the case study done as part of this research and is evaluated further there (point 4.3). An attempt was made to determine whether this project is successful in the shorter and longer term and what the indicators for input, output, outcome and impact based on this success could be.

2.2.6.4 Impact assessment of IRWH techniques at Thaba 'Nchu

This research was conducted through qualitative and quantitative surveys in the 42 villages where IRWH was implemented. They found that IRWH has been taken up by communities and that it improved their social wellbeing. It was also established that the successful uptake of the technique was determined by strong leadership and social cohesion in villages.

The key to advance IRWH "is to provide well-focused help and demonstration models for and in those villages where a good cohesion and a rich deposit of social capital exist" (WRC, 2008b:ii).

2.2.6.5 Participatory development of training material

While this project has not been finalized, various draft reports are available. The project started with a situation analysis report for SA (WRC, 2005) that contains wide ranging information on where the homesteads are, the situation there, food production in the villages, policy thinking in the SA context, the demand for water, economic incentives and entrepreneurial opportunities, insight into village gardening and training triangles. The section on **insights into village gardening** contains the present information on gardening with rainwater, rainwater reservoirs for HH productive use, creating fertile

vegetable beds, home food production potential for the average HH, and others.

It appears that in general practices are well developed in various regions and for different circumstances in SA, and that roll-out is possible to address RWH for HH food security on a large scale, while at the same time providing flexibility in that practices can provide for individual needs under different conditions.

The section on training (WRC, 2005, section 9:117-162) includes information on the material available, the process, venues, demonstrations, approaches to implementation and last, but not least, the people.

It is necessary to refer to the **processes** available and in particular those practices followed by the Water for Food Movement, which operates under the auspices of the International Water Management Institute in Pretoria. This process consists of five steps (village scoping, mind mobilization, individual implementation, mobilization in the village, and a follow-up workshop on experiences) conducted over a period of about four months in a village (WRC, 2005:146).

The situation analysis thus comprehensively describes the present situation regarding homestead farming and training available for this purpose. Attention is specifically given to identifying and building on what has been found to work in practice.

2.2.6.6 RWH research combined with construction of RWH tanks

This research is still in progress but some of the results already attained will be presented. The information was obtained from consultants involved in co-ordination of the projects (Rural Integrated Engineering (Pty) Ltd). Research done by the Smallholder Systems Innovation programme at the University of KwaZulu-Natal in the Potshini catchment (Thukela basin) indicated that low and poorly distributed rainfall resulted in low food production in this very poor

and remote community. Trial sites were identified where IRWH (mainly based on till and no-tillage practices) was started. It was found that no-tillage resulted in decreased run-off (and thus more storage of water in the soil profile) and an increase in maize yields. They further determined that the installation of an underground RWH storage tank is feasible and would benefit the community.

The Department also initiated a specific implementation project for the subsidy on RWH and draft reports are becoming available on progress being made. For DWA the challenge is now to finalise operational policies, standards, minimum requirements and associated guidelines, and to implement them in a practical and sustainable manner. Part of this would be to have the necessary structures and support (including financial support) services in place to provide a user friendly and accessible service to poor HHs. This will have to be done in close co-operation with other government departments and in a structured and agreed manner.

2.2.7 Identified crucial aspects of RWH for HH food security

This section provides a summary of the aspects identified in the theoretical framework and literature review that should be researched further, as possible requirements for success in using RWH for HH food security.

1. **Policy and legislative framework**: acknowledgement should be given at political and senior government level on the use of RWH for HH food security, and strong leadership and guidance should be provided; a strategy for implementation should be developed that will clarify roles and responsibilities of different government departments, spheres and other role-players; provision should be made for co-operation between government, research organisations (WRC, ARC, IWMI, universities) and other partners (the organized agricultural sector including farmers' organizations such as the National African Farmers Union (NAFU) and the national agricultural union for SA (AgriSA)); realistic goals should be

set; resources should be made available for achievement; regulations, standards, guidelines and manuals should be developed.

2. **Institutional arrangements:** suitable structures on various levels including farmers' level should be formed. The existence of strong community organizations is regarded as an essential component for the eradication of poverty and to ensure sustainable farming practices (King as cited in Fairclough, 1999:306). Amongst many reasons, communities are then able to influence and participate in processes and provide a single strong voice to represent their interests. Skills are also transferred more efficiently and effectively. Tribal authorities (where relevant) should be supportive, and land tenure security is needed.

3. **Empowerment, training and support services**: people should become self-reliant since "An enabling environment is required that places resource users in the drivers' seat of their own development and allows them to draw on support services as needed" (SADC, 2006). Training should be comprehensive and needs-based. It is important that individual leadership capabilities should be improved for the local organization of food security interests (Selener, as referenced in Nieuwoudt and Groenewald, 2003:165). Special efforts should be made for empowering women and the youth. Support services are essential and include government extension services, government funded research, co-operative services and depots, repair and maintenance services, study groups, and access to appropriate information (Van der Merwe, personal communication).

4. **Technical and technological development**: the use of appropriate technology can assist tremendously in providing food security, where "Substantial improvements in HHs' food security and incomes … in a cost effective manner" has been reported for the use of treadle pumps, low-cost drip kits, clay pot irrigation and various *in-situ* and *ex-situ* water harvesting and storing techniques (IWMI, 2006:vii); the success of technology development and transfer could be improved if research and

development address HHs' real needs and constraints; development of adoptable technologies could be promoted through involving all stakeholders at the outset and throughout the development process (SADC 2006:6); simplicity of a technology will determine the scale of uptake of the technology; communities will easily adopt a technology that gives the highest returns in the shortest possible time; land and water management technologies must be simple and applicable to the farmers' socio-economic situations; technologies that do not require expensive inputs are the most sustainable; therefore, land and water management technologies must have low implementation costs; regular meetings and training sessions for staff and farmers are required to ensure timely delivery of technical messages and feedback (Nieuwoudt and Groenewald, 2003); demonstration plots and the involvement of farmers in demonstrations are advisable.

5. **Natural resources, climate and production potential:** sufficient and reliable rainwater and water (for at least basic human needs and to grow food) are required; soil of the required quality, sufficient land and property rights, and the temperature range for crops to be produced are needed.

6. **Financing and financial services:** loans, credit and savings facilities, as well as appropriate repayment requirements should be available; government grants and subsidies should be made available.

7. **Infrastructure, market potential and economic location:** water infrastructure such as water storage, water supply and distribution, transport, energy, telecommunications, postal services, and security arrangements are required. Markets are required where produce could be sold. Where HHs can access markets, they should be aware of quality requirements, price levels and trends, harvest timing and expected market changes.

2.2.8 Conclusion

The literature review mentioned the water-related priorities, including food security, that were agreed upon globally. Reference was also made of the MDGs and that RWH can play a primary and secondary role in achieving them.

A comprehensive IFSS is available for SA. It referred to the reasons for the inequalities in agricultural production and also HH food insecurity. The document mentioned strategies to address HH food security, including the use of RWH. The different government departments that should lead implementation of various sections of the strategy were also identified. The document is, however, not being implemented.

Literature on the Southern African situation emphasized the importance of HH food security and indicated that a food policy for a country should address all aspects of the food system, i.e. supply, distribution and consumption. It specifically pointed out the role of women as agents of change, appropriate macro-economic policies that would protect the interests of the rural poor and women, and increased training of female agricultural extension officers.

The advantages of using RWH are generally acknowledged in various countries in the world. Some of the practices have been used for centuries and are being revived. Countries such as India, the United States and Australia have guidelines and incentives such as subsidies and rebates on offer for the installation of RWH equipment. Tucson (Arizona) in the United States has an ordinance that requires that 50 per cent of the landscaping requirements on commercial properties should be provided for by RWH. In these countries RWH is not necessarily linked to HH food security, but rather to environmental concerns.

However, the situation is different in China where rainwater is harvested in arid areas. The RWH practices have been researched extensively there since the 1980s and significant implementation is taking place with 2.2 million

storage tanks having been built by 2001. The practice is supplemented with green houses for growing of flowers, herbs and for the raising of rare wild animals. RWH is also used to provide HHs drinking water. The point is made that the large developments regarding RWH are still using less than 0.1 per cent of total rainfall in a catchment. It is thus sustainable from a water resource management perspective.

The reasons for the success of this initiative have been well researched and are extraordinary similar to the aspects identified in SA. In addition to the aspects mentioned, they found that micro-credit facilities must be available to farmers, grants such as providing materials and equipment should be strictly controlled through appropriate systems, political will and active support of all levels of government are essential, and integration of different relevant aspects at community level should take place. This includes (in addition to using RWH for drinking purposes and food gardens) the integration of RWH use for livestock, small town construction and catchment rehabilitation. Their future work as identified includes technological improvement and further standardization, extension to urban areas and to advance eco-environment sustainability. They also developed a monitoring format that would be useful for the provision of appropriate indicators.

The elements required for success and described above were also researched and confirmed in the international (and specifically African) literature. It was reiterated that co-ordination should be done at district, provincial and national level through appropriate structures. Practical expertise and experience should be at hand to assist HHs when needed. It would be important to involve all relevant training officers to enable smooth continued support, transfer and on-farm training.

The formation or participation of HHs in agricultural unions such as the National African Farmers Union (NAFU) and the agricultural farmers union (AgriSA), water users associations, and any other “approved legal entity” (DWAF, 2004b) are seen as crucial.

Food security indicators were identified which addressed aspects of food availability (resources and production), food access (income and consumption) and food utilization (nutrition). These, in combination with the aspects described above, were used to identify indicators for RWH to successfully improve HH food security (Chapter 5). Food availability indicator categories included rainfall levels, water availability, taking of ownership, land ownership, gender of HH head, education and literacy levels, area cultivated, number of cropping seasons, and crop diversity and yield. Food access included total income, crop income, livestock income, markets and road access, total expenditure, food prices, meal frequency and composition of daily meals. Food utilization included age, mortality rates, access to health, potable water and adequate sanitation services.

Extensive research by the WRC and ARC is, and has been, taking place on using water in agricultural activities, and specifically using harvested rainwater in HH food security activities. Their investigations found 12 indigenous South African RWH practices (old and new) that are still active.

From research commissioned by DWA for the RWH grant, the previous points were mainly found to be essential to ensure sustainable use of the subsidy package provided. They in addition found that the practice of deep trenching and filling with compost contributed to improved growth of vegetables. It was in fact found that any soil type could be enriched in this way for HH food gardening.

Based on the above research findings, comprehensive training material is being developed.

In conclusion, the aim of this research project was to identify what is required and which indicators have been described for use of rainwater to successfully improve HH food security. Various preliminary aspects that could contribute have been identified in the literature and summarized. These were further investigated as part of this research.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 INTRODUCTION

Research is defined as “seeking through methodical processes to add to one’s own body of knowledge and, hopefully, to that of others, by the discovery of non-trivial facts and insights” (Howard and Sharp, 1983:6 as cited in Bell, 2007).

Researchers thus aim to describe an aspect of reality and use various methods to position themselves closer to, and obtain data and information about this reality, in order to better understand and evaluate it. During the process, researchers construct their own understanding of the material researched. It is important that appropriate methods should be used for the specific research being conducted. Three dimensions of data gathering could be used: what the researcher read (examples are literature reviews and document analysis), saw (observations) and heard (such as interviews).

The research has to be defensible, credible, with limited bias, non-judgemental, well-organised, reliable, sufficient and conducted with appropriate participation. Triangulation (that is, using multiple investigations, source of data or data collection methods, to confirm findings) should be used to ensure reliability and validity.

3.2 RESEARCH APPROACH

The purpose of this research is to obtain answers to the research problem through the primary and secondary research questions posed. The research conducted is in the field of public policy and its evaluation, and the previous deliberations reflected the complexity of the specific problem. The theoretical framework and literature review indicated the required political direction, and the involvement of an efficient and effective government and private partners

in networks to ensure success in using harvested rainwater for HH food security. The research had to take this complexity (where many parts are linked in intricate arrangement (Weaver, 1948:536)) into account when answering the research questions. The research approach and design had to be developed accordingly.

An interpretative philosophical stance was adopted. It relates to hermeneutics which means "to make the obscure plain" (Neuman, 1997:68). The research conducted under such circumstances will consist of in-depth and detailed analysis of different parts of a complex problem that would attempt to find connections between the parts. The research was, however, also exploratory as it had to provide significant insight into the situation. It thus had to rely extensively on evaluation of existing data.

Research conducted as explained above is, to a large extent,subjective and caution had to be exercised to prevent bias and to ensure the validity and reliability of the research. The approach and design should provide for that, as would be indicated in the design of the research (section 3.3).

The approach used in the research was mostly qualitative (compared to quantitative). Such an approach is typically used to answer questions about the complex nature of phenomena with the purpose of describing and understanding the phenomena (Leedy and Ormrod, 1995-2008:94). It is also based on the view that reality is constructed by individuals interacting with their social worlds: "..[Q]ualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them" (Denzin and Lincoln as cited in Ritchie and Lewis, 2005:3). Qualitative researchers are "more concerned to understand individuals' perceptions of the world – they seek insight rather than statistical perceptions of the world" (Bell, 2007:7), and words and pictures rather than numbers are used to describe and convey understanding. The qualitative method investigates the *why* and *how* of decision-making, not just *what, where*, *when* – it wants to find out what *kinds* of things are relevant

rather than to determine *their frequency.* Attention is also often given to a specific situation in order to understand that situation.

Qualitative methods also provide for the diversity in responses expected when researching complex problems. It is, however, important to note that qualitative methods produce information only on the particular cases studied (Denzin and Lincoln, 2005).

Based on the above, the methods used in this research where it has to be determined what constitutes success in using harvested rainwater for HH food security, consisted of key informant qualitative interviews and a case study (Cresswell, 2003:4). The design of the research is explained in the next section.

3.3 RESEARCH DESIGN

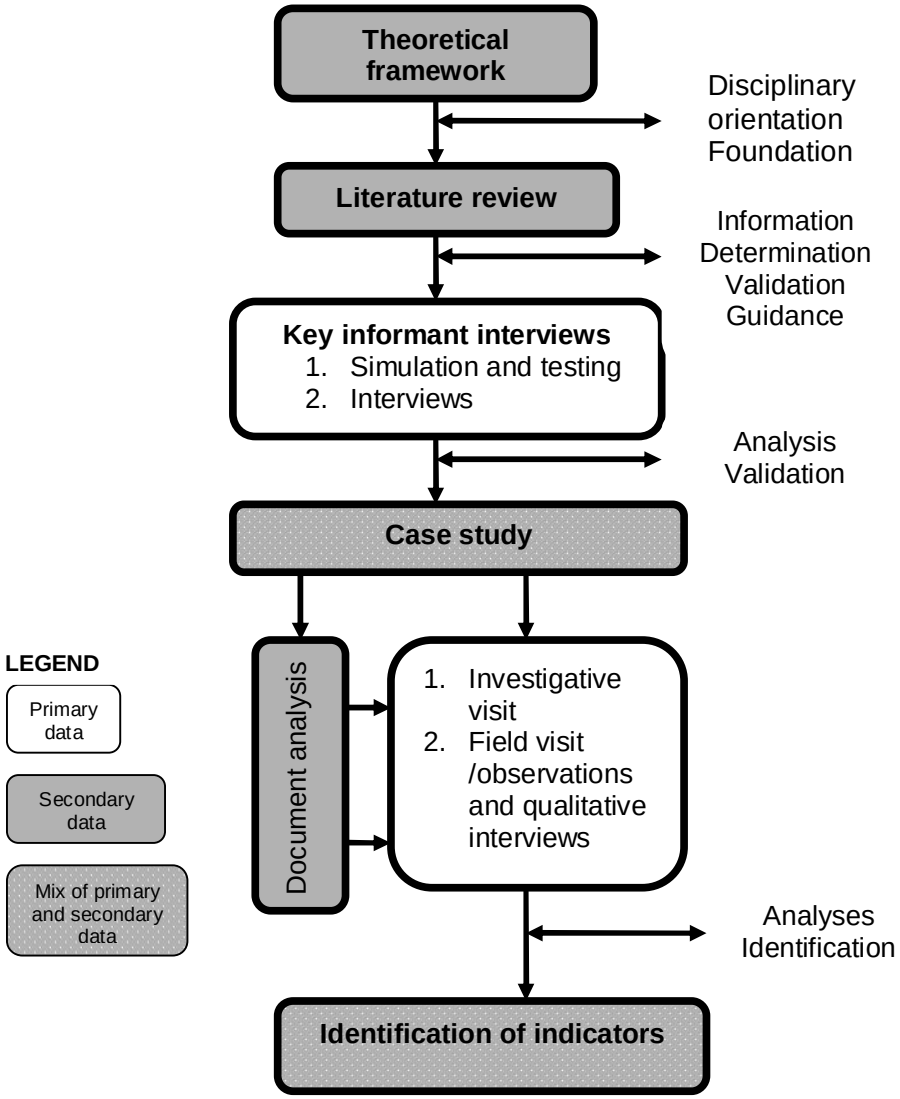
3.3.1 Introduction

The research had to be designed to address the specific complexity of the research problem. A qualitative approach was used.

3.3.2 Research design

The research started with the literature review described in Chapter 2, which provided the macro view and informed the research approach and methods to be used. This was followed by qualitative key informant interviews held with experts and people closely involved with RWH and HH food security. The information gathered there informed aspects to be investigated in depth and intensively in the case study – the single unit or bounded system of this research (Merriam, 1998:19). The case study consisted of HH interviews and a document analysis. The research design is depicted in Figure 2.

Figure 2: Research design



Source: Adapted from Lubbe, 2003

3.3.3 Key informant qualitative interviews

These interviews were held to elicit information on interviewees' perceptions on what has been done, their knowledge, opinions, feelings and impressions (Bell, 1999:135; Valenzuela and Shrivastava, 2010: slide 12) on the complex problem identified. Motives could also be explored. Qualitative interviews

provide flexibility where follow-up questions could be asked, further probing could be done and the direction of the interview adjusted if necessary. Opportunity is provided for focused interest on the interviewees' points of view and for provision of rich and detailed answers (Wengraf, 2001:313). Respondents are encouraged to share their best insights and underlying attitudes, beliefs and values.

Interviewees were identified based on their knowledge and involvement in harvested rainwater for HH food security.

The interviews were planned to be semi-structured with a list of specific topics and questions developed (Appendix A) to ensure that specific information is elicited from all interviewees. The questions were formulated after the comprehensive literature review was done and were finalized after it was tested. It is important that the interviews were, to a large extent, standardized to facilitate analysis and interpretation. Questions asked for opinions and views of the interviewees and interviewees were afforded quite a lot of scope in their discussion of the topics. Questions did not necessarily follow in the order indicated in the questionnaire.

An effort was made to ensure that questions were clear. They were mostly ideal position and interpretive questions (Merriam, 1998:77) although detailed information was also requested through additional questions and probing.

3.3.4 Case study

The qualitative research also included a case study as unit of analysis, where harvested rainwater was successfully used to secure food for HHs. This is an excellent research method to determine how policies have an effect on society at the micro level, and also to see if theories have the predicted outcomes on the individual level (Writing Guide, 2010). It is thus particularly suitable if a process is investigated, such as in the identification of indicators (Merriam, 1998:33).

A case study is defined as " [T]he collection and presentation of detailed information about a particular participant or small group, frequently including the accounts of subjects themselves". As a research method it provides for the intensive research of a specific case where the interplay of all variables is examined in order to provide as complete an understanding of an event or situation as possible (Writing Guide, 2010), where the emphasis is on exploration and description – the *how* and *why* of the research (Zandamela, 2007:39). Detailed information is assembled on particular participants through intensive investigation that could include direct observations, interviews, protocols and examinations of reports. It is anchored in real-life situations. This type of comprehensive understanding is arrived at through a process known as "thick description", which involves an "in-depth description of the entity being evaluated, the circumstances under which it is used, the characteristics of the people involved in it, and the nature of the community in which it is located" (Writing Guide, 2010).

Case studies thus allow the study of a multiplicity of perspectives of a phenomenon within a certain context (Ritchie and Lewis, 2005:52). As a single method it could be used to collect information from people with different perspectives on what is being experienced or observed.

Case study has been characterised by Merriam (1998:29-30) as being particularistic (focusing on a particular situation), descriptive (the end product being a thick description of the situation) and heuristic (allowing the researcher to study or learn something for him/herself). She also referenced Stake (Merriam, 1998:31-32) in stating that case study knowledge is different from other research knowledge in that it is more concrete, more contextual, more developed by reader interpretation, and more based on a reference population determined by readers.

More specifically, strengths of case studies relate to its use to gain holistic, comprehensive and contextualized insight into a specific phenomenon and in this specific case into emergent properties of communities practicing RWH (Noor, 2008:1602). Case study research also allows for flexibility where

interviews are less structured and where a researcher can adapt the research as more information comes to light. Interviewees are also encouraged to provide their insights, opinions and feelings on topics identified. The researcher obtains information through first-hand observations, “deep data” and “thick descriptions”.

Weaknesses of case studies relate to its inherent subjectivity and the high degree to which it relies on personal interpretation of data and inferences. It is even more than other research approaches dependent on the personal integrity, sensitivity, and possible prejudices and/or biases of the researcher (Writing Guide, 2010). Case studies can also oversimplify or exaggerate a situation (Merriam, 1998:42). How these weaknesses can be addressed in case study research is discussed in the section on validation of the results (section 3.6).

From the information collected on the complexity of using water to improve HH food security as provided in the literature review, and on the use of case studies provided above, the use of the case study as a preferred and suitable research method for the research contemplated in this project was evident. It provided for the in-depth investigation of a specific situation where rainwater was used to improve the food security of specific HHs. The different aspects required for success were researched and confirmed. It also served to further interrogate the information compiled from the interviews (Bell, 2007:10).

3.4 DATA COLLECTION

3.4.1 Introduction

Data collection consisted of gathering primary and secondary data. Primary data are “data collected for the purpose of solving the problem at hand” (Nel, Radel and Loubser, 1988:121; Leedy and Ormrod, 1995-2008:89) and involves the collection of data that does not already exist through, for instance, interviews (Kelly, 2005). Secondary data are regarded as “existing data that have been collected and processed for purposes other than the one

at hand and, being available, may be applied to solve the particular problem" (Nel, *et al.*, 1988:121). Secondary research involves the summary, collation and/or synthesis of existing research (Kelly, 2005). In this research it was used to gain better insight into the problem situation and to validate and evaluate data collected in the interviews (Nel, *et al.*, 1988:122). Both types of data were used in this research.

3.4.2 Primary data

As indicated in Figure 2, primary data was gathered through interviews with key informants and as part of the case study, where investigative discussions and qualitative interviews were held with persons involved in using in-field rainwater harvesting (IRWH) for HH food security. Observations were also made and pictures taken of IRWH practices during a field visit to the IRWH activities in Thaba 'Nchu.

3.4.2.1 Key informant interviews

The interviews consisted of the following:

- Simulation and testing with an expert, and
- Interviewing of identified interviewees, including managers and researchers involved in the case to be researched.

The key informant qualitative interviews consisted of in-depth semi-structured interviews of selected participants with in-depth knowledge and/or experience of the subject. The researcher identified some of them, but interviewees were also asked to list possible candidates. The interviewees came from the departments of water affairs, agriculture, research institutions (WRC and ARC) and consultants employed in DWA's RWH project.

A preliminary set of open-ended questions was developed and this was then simulated and tested with the person who spearheaded RWH for HH food security in DWA and who had extensive knowledge and experience in the South African situation. The initial questionnaire was mainly based on topics

identified in the literature review superimposed on variables identified to determine success (Kerzner, 1989:504-517). This was then combined with eight pillars required for sustainable small-scale irrigation development (Van der Merwe, 2008). The questionnaire was adapted and is provided in Appendix A. Main topics were identified, followed by a sequence of sub-questions for further probing.

Twelve people were identified to be interviewed and are indicated under the research findings in Table 3. Care was taken to ensure that points made were correctly recorded (Bell, 1999:144; Holstein and Gubrium, 2004:140).

Most of the interviews were person-to-person through direct contact although one interview had to be conducted over the telephone. In some instances, interviews were held with 2 or 3 people at the same time for reasons of convenience.

In one such case where 3 people were interviewed in a group, it was not sufficiently productive as it was dominated by one of the participants talking extensively on a specific aspect of the questionnaire while other aspects could not be covered. A follow-up interview was therefore held with one of the interviewees while another of the interviewees provided written notes on the questions through electronic mail.

The key informant interviews included a manager and a member of the project team involved in the case study.

3.4.2.2 Case study interviews

During the case study, an initial investigative visit to 4 residents in the study area took place during December 2008. This was followed by an in-depth document analysis as well as qualitative interviews with 4 residents in June 2009. The residents visited and interviewed included 3 females and 1 male in each event. Although there was overlap between the people visited and interviewed, it was not exactly the same people approached in both

instances. The interview questions were drafted based on the document analysis and are included in Appendix B. The 4 residents interviewed have been involved with IRWH for more than 4 years, their RWH activities are regarded as successful, and they are members of the Community Based Water Harvesting Interest Group (CB:WHIG) in their villages and in some cases were members of the Municipal Based Water Harvesting Interest Group (MB:WHIG). The activities were also directly observed and pictures were taken of IRWH practices during the two field visits. Interviews were conducted through a translator.

3.4.2.3 Case study observation

Observations were an important aspect throughout (Merriam, 1998:97-98) and included elements such as observing activities and interactions and taking subtle factors into account such as non-verbal communication and dress. A first-hand account was obtained when pictures were taken of some of the RWH activities. The fields were visited after most of the preparatory work had been done for the planting season but in some instances, where water was more readily available for watering of plants or where small areas were prepared, growth was evident. Fields that were prepared showed the essentials of the IRWH technique. Peoples' pride in the work that they are doing was evident in all instances.

3.4.3 Secondary data

Secondary data was evaluated in the literature review and in the case study. In the latter case it included reports such as those prepared as part of the RWH activity itself, ARC and WRC research documentation that resulted in the activity taking place, and documentation related to policy and legislation applicable to the activity. None of these documents were developed as part of this research and were thus independent sources of information.

The documents can be regarded as authentic and accurate as they were mostly produced by reliable research organizations such as WRC, ARC-

ISCW and the University of the Orange Free State. The work done was practical and systematic and much of the work has been awarded PhD and master degrees. The researchers had in some cases also presented their findings at international conferences and won various prizes. In many cases, the documents reflected on-the-ground or first-hand research in the fields of agricultural scientific and social sciences. Information received during the interviews was also collaborated with what was found in the documents. One of the advantages in using document analysis was its stability – information in documents does not alter (as could happen during an interview) and could be re-read to verify information. It also served to ground the research due its authenticity (Merriam, 1998:112-133).

3.4.4 Sampling

3.4.4.1 Introduction

Due to the qualitative approach to the research, key informants, the case to be studied and HHs to be interviewed in the case were selected purposefully. The research was information oriented – information-rich people and cases were selected for in-depth analysis. Small focused samples were selected for their appropriateness in typifying certain characteristics or contextual locations, as the researcher wanted to discover and gain insight, a sample from which the most could be learned had to be selected. Random sampling could not be done as it would probably not result in people being identified that have the required insight and knowledge (Yin, 2009).

During the sampling process the researcher had as far as possible to limit bias. This was done by involving other interviewees and researchers in the sampling process.

3.4.4.2 Key informant and case study interviewees

Sampling of the interviewees for these interviews was based on the following criteria (Merriam, 1998:62-63):

- Maximum variation: people with in-depth knowledge of the various aspects associated with the subject such as RWH and food security legislative and policy development, research of RWH activities for food production, implementation of the DWA RWH for food production package, and implementation of food security in the NDA. Their organizations and their expertise were as follows:
  - DWA – policy development and project implementation sections;
  - NDA – water use in agricultural activities including extension services and food security;
  - WRC, ARC and IWMI - water use research;
  - ARC - agricultural production research;
  - IWMI - international experience in RWH and HH food security;
  - Consultants - expert involvement in policy development and project implementation.
- People with experience in the aspects mentioned in the previous point;
- Convenience: people were interviewed who were readily available in the Gauteng and Bloemfontein areas over the period when the interviewing was done;
- Networking: additional people were identified by interviewees;
- Adequacy in number and scope to answer the questions posed.

Sampling of the interviewees as part of the case study occurred when the case was considered and after the case was selected, and consisted of the following:

- A manager and researcher involved in the ARC-ISCW project – involved as key informants;
- Persons involved in successfully using RWH for food security in the ARC / WRC research project at Thaba 'Nchu. The persons were identified in collaboration with ARC-ISCW;

- People that were available during the site visits;
- People that were willing to be interviewed.

3.4.4.3 Selection of the case study

The following criteria were used for the selection of the case study (Merriam, 1998:66):

- Whether the RWH technique has been used for more than 3 years;
- Whether more than 60 per cent of the original participants are still involved;
- Whether food security has been attained for more than 60 per cent of the participants, or whether significant increases in food production have been experienced by more than 60 per cent of the participants?

Based on the above, the case study consisted of an in-depth study of communities in Thaba 'Nchu using IRWH to successfully improve HH food security. This activity started as a research project initiated by ARC (with co-funding from WRC).

3.4.4.4 Case study document analysis

Relevant documents were identified as follows:

- Literature review;
- Specific RWH WRC research;
- Specific RWH for food security WRC research;
- ARC RWH and IRWH and food security research documentation;
- ARC case study specific project documentation.

The above presented a wealth of information that could be used in identification of indicators.

3.5 DATA ANALYSIS

The key informant and case study interviews were based on open-ended questionnaires where topics were identified and where additional questions could be asked if more discussion became necessary. This provided some standardization that assisted in analysis of the data.

The analysis was phenomenological in nature as it researched the practice of RWH to produce food security to HH and determined which indicators would describe success in these practices (Merriam, 1998:158).

Data analysis did not only commence after all the data was collected as some analysis took place after each interview and this influenced subsequent interviews. This is one of the characteristics of qualitative research.

The following actions were taken in analyzing the data (Merriam, 1998:151 - 178; Writing Guide, 2010):

1. Coding: elementary coding or notation took place to highlight specific, striking or important comments made by interviewees;
2. Interpretation: Comprehensive notes were taken during the interviews. These were captured electronically afterwards. Some degree of interpretation took place during this phase;
3. Recursive abstraction was then used where the datasets were summarised into a more compact version of the interviews (Writing Guide, 2010). To ensure that important and relevant points made by interviewees were summarised correctly, the originally captured data sheets were again scanned;
4. Initial grouping of data was done to identify recurring regularities or patterns;
5. A narrative description of the phenomenon was done;
6. Category construction. Data was sorted into categories based on commonalities. These categories were named based on the topics

identified. The categories reflected the purpose of research, were exhaustive (all data could be placed in categories); were mutually exclusive (a unit could be placed into only one category); sensitive (as sensitive as possible to what is in the data); conceptually congruent (in this case related to the research questions posed);

7. Consolidation was done;
8. Reasonable conclusions and generalisations were made based on the preponderance of the data (Merriam, 1998:152);
9. Higher level interpretation took place when the results were used to develop indicators.

A case record as explained above was thus prepared in the case study.

3.6 VALIDITY AND RELIABILITY

Validity and reliability are central concerns of qualitative research. This type of research involves observation, interview, and content analysis of a particular case, and most of the interpretations are made based on the opinion of the individual researcher. The subjectivity of the researcher in his/her interpretation, opinion, judgement and decisions is of major importance in the research.

Triangulation is a process of verification [checking for truth] that increases validity (also known as credibility and/or dependability) and ensures reliability by incorporating three different viewpoints and methods (Qualitative interviewing, 2010). Triangulation can use multiple investigations, sources of data or data collection methods for “cross-checking” and to confirm findings. Merriam (1998:153) indicated that the more grounded in supporting detail, the more trustworthy and credible the research is.

Triangulation was used in the following ways to achieve internal validity in the research:

- Different techniques were used such as –

- A literature review that set the scene for the research and identified topics to be covered in the subsequent qualitative research;
- Key informant qualitative interviews, and the
- Case study consisting of –
  - document analysis; and
  - qualitative interviews;

- Certain procedures were used consistently (such as the use of the same open-ended questionnaire);
- A comprehensive record of the qualitative research was provided in the research report;
- A defensible trail was provided between conclusions drawn and the data on which they were based;
- The ultimate test for validity is that the research findings have to be congruent with the reality being researched.

All of the multiple evidence gathered through the above-mentioned processes acted as methods for cross validation.

3.7 CONCLUSIONS

A research proposal to identify indicators for water use to successfully improve HH food security was approved in January 2009. The proposal contained an explanation on what the research would entail and how it would be conducted.

The research design consisted of establishing the theoretical framework and reviewing the literature, holding key informant qualitative interviews and conducting a case study comprising a document analysis, an investigative visit to the study area, and holding of qualitative interviews with residents from different villages participating in IRWH. Criteria were developed to choose (sample) the key informants and HH to be interviewed, as well as to choose the case study. Data analysis and ensuring validity and reliability of the research were also discussed. An attempt to ensure validity included the use

of different techniques in conducting the research (such as a literature review, key informant qualitative interviews and the use of a case study), using the same open-ended questionnaire when conducting interviews, drafting a comprehensive record of the research, to provide a defensible trail between conclusions drawn and data on which they were based, and to have research findings that are congruent with the reality researched. Some relevant theories for the research have been briefly described. The research results are provided in the next section.

CHAPTER FOUR
RESEARCH FINDINGS

4.1 INTRODUCTION

The literature survey identified the existence of policies for food security at national level but information on a consolidated and co-ordinated implementation plan and detail on success achieved in roll-out could not be found. The qualitative interviews thus gauged knowledge and perceptions on these as well as what people in general thought constituted success of RWH for HH food security.

People interviewed included researchers involved in RWH for food security, DWA officials and their consultants involved in developing and rolling out the department's policy on providing RWH tanks for HH food security, and Department of Agriculture officials involved in food security and agricultural water use.

4.2 KEY INFORMANT QUALITATIVE INTERVIEWS

4.2.1 Interviews

The people with whom interviews were held, their affiliations and relevance for the study are indicated in Table 3. Individual (telephonic or person-to-person) interviews as well as interviews with groups of two or more people were held. The information gathered through the interviews is reported according to the questions raised in the questionnaire (Appendix A). Note that a discussion on proposed weights of aspects was not included in the interviews as it was regarded as not relevant at the time when the interviews were held.

Table 3: Key informant qualitative interviewees

Name	Date of interview	Position	Relevance for RWH and Food security
Francois van der Merwe	4 Dec 08	DWA Engineer in Water Abstraction and In-stream use	Involved in developing legislation and policy on RWH
Nasele Mehlomakulu and Mohammed Vawda	9 Jan 09	DWA Director and Deputy Director: Financial Provision	Implementation of DWA RWH grant
Mary-Jean Gabriel	19 Dec 08	Director: Dept of Agriculture (national)	Involved in water use in agricultural activities and extension officers
Steve Mohlabi	7 Jan 09	Director: Dept of Agriculture (national)	Food security
Gerhard Backeberg	19 Dec 08	Researcher, WRC	Involved in research and developing manuals on water use for agriculture, and small scale farming
Cobus Anderson and Cobus Botha	10 Dec 08 and 17 Dec 08	ARC Institute of Soil Climate and Water, Glen	Involved in researching and implementing IRWH at Thaba 'Nchu
Barbara van Koppen	12 Dec 08	Researcher: International Water Management Institute	Involved in research and implementation of RWH in SA, Africa and the world
Chris Stimie, Jonathan Dennison and Charles Crosby	12 Dec 08 and 5 Jan 09 (C. Stimie) E-mail dated 21 Dec 08 (C. Crosby)	Consultants Retired agricultural engineer	Involved in implementation of DWA rain water harvesting package
Marna de Lange	7 and 8 Jan 09	Consultant	Long-term involvement with RWH and drafted DWA guidelines

Source; Ligthelm, 2009

The interviews commenced with a question to gauge the interviewee's opinion on which variables he/she would consider essential to ensure success of RWH for HH food security. The views in general were that there is a range of variables that should all be achieved to ensure success. It was mentioned that a system containing a critical path for success is needed (Stimie, interview, 12 December 2008). The variables mentioned are included in the discussion below where perceptions on specific aspects are reflected.

The next questions in the questionnaire then focused on specific variables identified in the literature survey. The variables mentioned as well the opinions expressed could be grouped together and are explained below.

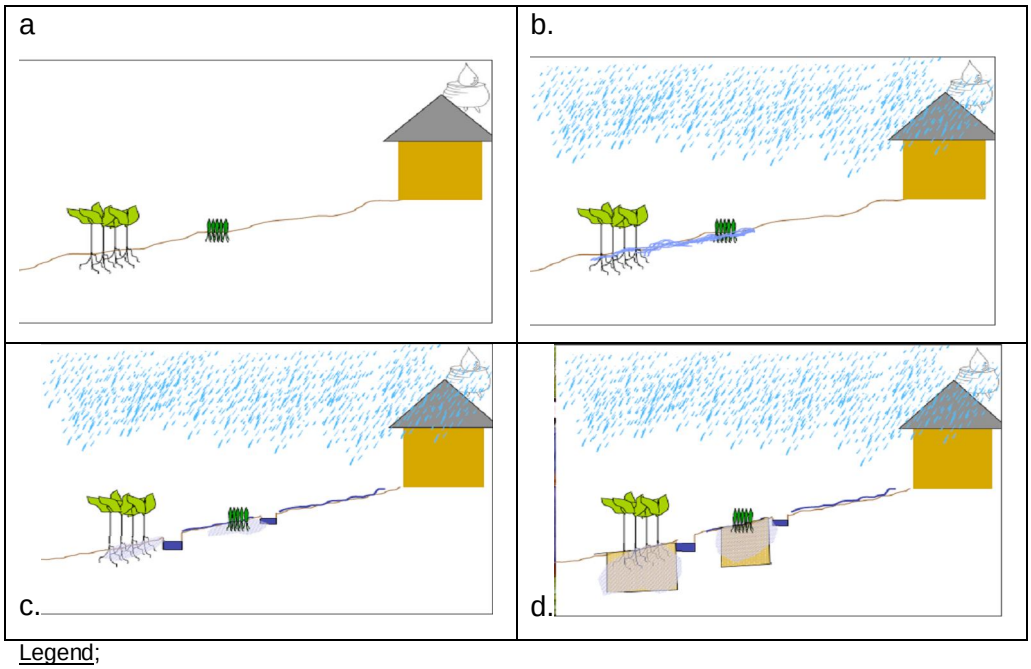
4.2.2 Water and soil

All interviewees regarded water as essential for success in HH RWH activities. It was mentioned that HHs in South Africa have a right to free basic water (Van Koppen, interview, 12 December 2008). This means a free 25 litres per day per person within a distance of 200 metres of their dwellings, or 6 000 litres per month per HH. Where this water has already been provided it is insufficient to ensure food security for a HH (Van Koppen, interview, 12 December 2008). To use domestic supplies provided by municipalities for food gardening would, however, be prohibitively expensive for the poor (Mohlabi, interview, 7 January 2009). Of interest is that the WRC is at present doing research to determine whether larger amounts such as 62 litres per person per day would provide water to HHs for productive uses (Van Koppen, interview, 12 December 2008). The DWA is investigating how not only domestic water, but also water services for broader multiple usage, could be developed (Van Koppen, interview, 12 December 2008).

Interviewees indicated that water should be brought to HHs or the means (physical and/or know-how) to use rainwater should be provided. The problem in many areas is that there is not enough rain and/or that rain does not fall at the right time for crop production (Anderson, interview, 10 December 2008, Backeberg, interview, 19 December 2008). It was indicated that before RWH projects are launched, it should be determined whether the rainfall in the area would be sufficient to use specific techniques developed and/or to install RWH tanks. Material developed by the WRC describes how to determine how much water is available on the yard, and how to consider rainfall patterns and intensity for RWH purposes (De Lange, interview, 7 and 8 January 2009).

It is then crucial that people use the rainfall harvested optimally. Mention was made of out-of-field and in-field harvesting (Stimie, interview, 5 January 2009 and De Lange, interview, 7 and 8 January 2009). Out-of-field RWH refers to practices where rainwater or run-off is harvested from roof tops or other hard areas such as roads or fields and stored in either above-ground or underground rainwater tanks. IRWH refers to various practices used to improve the use of the water for growth purposes. Optimal in-field harvesting is illustrated in Figure 3 and consists of constructing basins upstream of planting areas to catch and store water for better uptake by plant roots and to dig deep composting containing trenches, before planting.

Figure 3: IRWH techniques to optimize water use for plant growth



Legend;

a and b: Plant growth on slope without enhancing rainwater harvesting;

c: Improved RWH: catching basins upstream of planting area;

d: Further improved RWH: catching basins and composted trenches.

Source: De Lange, interview, 7 and 8 January 2009

IRWH techniques have also been specifically developed for HHs in the Thaba 'Nchu area and are described in detail in the case study (section 4.3) (Anderson, interview, 10 December 2008 and Botha, interview, 17 December 2008).

Provision could also be made for out-of-field harvesting to store water (at HH or community level) to ensure water is available as required. One of the interviewees mentioned that small-scale reservoirs and village tanks have been built with great success in African countries such as Zimbabwe, Ghana and Kenya (Van Koppen, interview, 12 December 2008). In South Africa, the DWA provides a package consisting of a 30 000-litre underground or partially underground RWH concrete tank, basic equipment such as a hose, wheelbarrow, treadle pump (if required), fork and spade, seeds and comprehensive training, and support for a period of 18 months (Mehlomakulu and Vawda, interview, 9 January 2009). This is discussed in more detail in section 4.2.9.

The quality of soil available for HH food gardens was not viewed as a problem by consultants involved in implementing the DWA's RWH package, since suitable soils are "manufactured" through deep trenching with compost (Stimie, interview, 5 January 2009). The quality and nature of soils for IRWH can, however, be crucial (Anderson, interview, 10 December 2008 and Botha, interview, 17 December 2008) and are discussed in more detail in the case study (section 4.3).

The consultants employed by DWA made the point that indigenous practices are scarce in SA (Dennison, interview, 12 December 2008). To illustrate the point it was mentioned that rainwater often runs freely down roads and streets but people do not know how to harness and use it (Stimie, interview, 12 December 2008).

The lack of water for domestic use is still a major issue in some of the communities (Mohlabi, interview, 7 January 2009).

4.2.3 Land

HHs would need a large enough piece of cultivable land as well as hardened areas such as a roof, road or other surfaces to catch water (Van der Merwe, interview, 4 December 2008). An area of 20 m^2 is usually sufficient for intensive food gardening (Gabriel, interview, 19 December 2008). Security of land tenure in the short or longer term is thus required (Backeberg, interview, 19 December 2008; Van der Merwe, interview, 4 December 2008). In areas where tribal authorities are still active (such as at Thaba 'Nchu) people can buy a small plot with an associated crop land area for R230. A maximum of 3 plots is allowed (Anderson, interview, 10 December 2008). The boundaries of the crop land are not always determined (areas are not fenced and crop lands are worked collectively as communal areas) and the WRC recently completed a study to assist communities in determining these and to prepare a register to enable people to fence their areas (Anderson, interview, 10 December 2008; Manona and Baiphethi, 2008:vii).

Dr Backeberg of the WRC (interview, 19 December 2008) made the point that HHs perceive that they have land tenure (and thus security in using land) in tribal areas, which is not correct, as land tenure entails an explicit and exclusive right to land, which in these situations is not entirely accurate. This can ultimately result in a lack of incentives to implement RWH.

Another anomaly mentioned by one of the interviewees (Backeberg, interview, 19 December 2008) is that many people are food insecure but that large pieces of land are available but not used for subsistence in rural areas. He hypothesized that the reason for this is that people do not have security of tenure and they also do not have the necessary skills for food gardening.

Another major gender-related issue regarding use of land for RWH, is that women in general still do not have decision-making authority and traditionally do not have the right to own land in rural areas – they thus have little or no incentive to establish and maintain food gardens, other than to try to put food

on the table for their families (Backeberg, interview, 19 December 2008; Anderson, interview, 10 December 2008).

4.2.4 Households taking responsibility for their own food production

The point was emphatically made by more than one interviewee that communities need to be willing to take responsibility for food production and that people need to have the aspirations to improve their livelihoods (Backeberg, interview, 19 December 2008). Because "people who are food insecure are essentially powerless" (De Lange, interview, 7 and 8 January 2009) and as this powerlessness has been ingrained in them through years of disadvantage, an attempt to assist the poor to improve their food security will have to address their perceived or real powerlessness. It will serve little purpose to only hand out food parcels and grants as people need to start believing in themselves; they need to be given hope and this goes beyond providing a "sufficient diet". Projects should thus be designed in such a way that people should ultimately have control over what is provided to them, and should be empowered to use it to improve their food security. Another interviewee said that as an incentive, people should ultimately have the assurance that they have control over resources for food security (Backeberg, interview, 19 December 2008). It would thus be important to ensure that 'new' dependencies are not created when addressing food security through RWH.

It was also identified that HHs should be motivated and convinced that practices can be successful, on condition, however, that identified variables are addressed correctly (Anderson, interview, 10 December 2008). These "conditions" should be explained well and would form part of the extensive training and support to be provided. The festivals organized by ARC were seen as a major motivator for residents. These activities, described in more detail in section 4.3, provided opportunities for residents to exchange knowledge, learn from each other and to showcase their produce.

4.2.5 Transfer of knowledge and skills

From the ARC-ISCW's experience it was determined that people should be trained on how to grow plants (when, which plants, how deep seeds need to be planted, and distances between different plants), control weeds, use fertilizer, harvest, how to add value, how to work in groups, how to deal with conflict, and how to use water for livestock (Anderson, interview, 10 December 2008). However, training should not be limited to these but should include training on peoples' nutritional requirements as well as the nutritional value of products that they themselves could produce. The point was made that people should not be "forced" to grow specific nutritious food but that the culinary customs of the community should also be taken into account (De Lange, interview, 7 and 8 January 2009).

The ARC developed nine steps to convert land into effective IRWH practices (section 4.3, Anderson, interview, 10 December 2008). They concentrated their efforts on HHs that are already involved in food gardening and made extensive use of demonstration plots to illustrate the advantage of using IRWH practices, as compared to conventional practices to improve crop yields.

The ARC furthermore concentrated their training on "the person that has to put the food on the table". These were mainly females from the mainly female-headed HHs in the villages. The training also had to provide for illiteracy as most of the older generation could not read and write (Anderson, interview, 10 December 2008).

The Department of Agriculture's Extension Officers were included in the ARC-ISCW's training where possible. Training consisted of special courses that included testing. Officers achieved very low grades. In some cases these officers were found to be reluctant to attend and the impression was that this was because they were worried that their lack of knowledge would be exposed. For all intents and purposes, their involvement was described as

"non-existent in the Free State" (Anderson, interview, 10 December 2008). In other provinces they were more supportive in RWH projects (Anderson, interview, 10 December 2008). The lack of skills and knowledge as well as the lack of their involvement in general in agricultural activities were also acknowledged by NDA officials who indicated that accredited training is being developed, as well as associated material (Gabriel, interview, 19 December 2008). The NDA is also centralizing their training through accredited courses being designed and presented at agricultural colleges (Gabriel, interview, 19 December 2008).

Transfer of RWH knowledge to HHs should not be a single event but rather a process, and support should be accessible over a longer period. Sustained support and aftercare were considered crucial for success (Anderson, interview, 10 December 2008; De Lange, interview, 7 and 8 January 2009).

Despite being able to grow a large variety of food, HHs would probably not be able to supply all of their nutritional needs through implementing RWH (Anderson, interview, 10 December 2008). They should thus progressively be exposed to the options for disposing of their excess produce and how to market it. The availability of markets, transport in rural areas and their importance for success are described in point 4.3.

Communities involved in RWH were encouraged to form study or garden learning groups to facilitate easier learning (De Lange, interview, 7 and 8 January 2009; Anderson, interview, 10 December 2008).

The point was made that there were not enough trainers available in SA at present and that this could be a limiting factor in RWH being successfully implemented (Anderson, interview, 10 December 2008).

4.2.6 Institutional arrangements

Getting the commitment of community leadership to projects in rural areas is crucial and in areas where chiefs are active, their approval is required

(Anderson, interview, 10 December 2008; Van der Merwe, interview, 4 December 2008). In some areas in SA there is still conflict between the municipalities and tribal authorities and RWH projects should take this into account. In tribal areas, people get tenure of land and interviewees were not aware of any place where this was not granted (Stimie, interview, 5 January 2009). In Thaba 'Nchu chiefs were also very supportive of IRWH activities. The NDA had an experience where their Minister had to abandon the launch of a food security project as correct processes to involve tribal authorities had not been followed (Mohlabi, interview, 7 January 2009).

In the Eastern Cape the Department of Agriculture's Co-ordinating Committee for Agricultural Water (CCAW) meetings, where RWH activities are discussed, are attended by tribal authorities and members of the National African Farmers Union (NAFU) (Gabriel, interview, 19 December 2008). Interviewees perceived that municipalities are becoming involved and in the DWA's projects, municipalities assist in identifying communities where tanks could be installed (Mehlomakulu and Vawda, interview, 9 January 2009). In other cases it remains a challenge to involve them in projects (Anderson, interview, 10 December 2008; Stimie, interview, 5 January 2009; Mohlabi, interview, 7 January 2009).

Anderson and Botha indicated that at a community level, the ARC-ISCW Glen researchers in Thaba 'Nchu established village community RWH committees in areas where RWH was piloted (interviews, 10 and 17 December 2008) A municipal RWH committee was also established for the area. These are discussed in more detail as part of the case study in section 4.3. The committees were initially very active and met regularly. Problems experienced by the farmers were discussed there and addressed. However, people were expected to pay R10 per HH per month and were then no longer keen to attend. Communication is also not very good. In one of the villages the village leader misused his influence and people were afraid to challenge him as he had some influence regarding the allocation of RDP houses.

The NDA is involved in establishing co-operatives for small scale farmers (Mohlabi, interview, 7 January 2009) but the progress is slow (Stimie, interview, 5 January 2009). Although some have been registered, they often only consist of a table and chair (Backeberg, interview, 19 December 2008). Small co-operatives are thus not functional and are unable to provide a service to communities at present.

The ARC is signing agreements with provincial departments of agriculture to act as implementing agent to train communities in IRWH (Anderson, interview, 10 December 2008; Anderson and Botha, interview, 17 December 2008).

4.2.7 Community culture and climate

When communities are participating in IRWH, social variables such as their culture, conflict within their communities, and traditions have to be addressed and should be such that it will support and encourage the development (Anderson, interview, 10 December 2008; Anderson and Botha, interview, 17 December 2008). A culture of willingness will also assist to establish the practice (Stimie, interview, 5 January 2009).

Gender is of the utmost importance in considering the success of RWH and food production (Van Koppen, interview, 12 December 2008). Traditionally women are expected to ensure that there is water for families and house chores, and they usually develop the food gardens. In any process the women's responsibilities for these activities should be secured. A problem is that in tribal areas women are culturally only allowed to work around homesteads but not on crop land (Anderson, interview, 10 December 2008). The rights of use in these areas are also associated with men and on their death, these rights go to brothers, with the wife and women left with nothing (Backeberg, interview, 19 December 2008).

Community culture should be conducive to producing food with rainwater. People are often jealous of the success of some of the HHs and they are

worked out of the system. In instances people who are successful in growing vegetables are marginalized and their crops destroyed or stolen. Political infighting also often paralyse progress in rural areas (Anderson, interview, 10 Dec 08).

More could be achieved if community members support each other (Anderson, interview, 10 December 2008).

4.2.8 Infrastructure and technology

Infrastructure would include water storage, water supply and distribution, road transport and access to markets. The requirement of complicated operations and extensive maintenance of infrastructure should be limited when addressing food security for the poor (De Lange, interview, 7 and 8 January 2009).

The technology for food production and IRWH is not new and has been tested exhaustively (Anderson, interview, 10 December 2008; Mehlomakulu and Vawda, interview, 9 January 2009). Its success if transferred properly is guaranteed. The technique is simple and no complicated tools are required. People are also able to see the advantage of its implementation within the first 2 to 3 months (Anderson, interview, 10 December 2008).

ARC-ISWC (Glen) indicated that people initially thought that they were wasting land by having the 2 meter space to divert runoff to the planting basins (figures 5 and 6), but changed these views after the first farmer's/HH day and after they saw the crops being produced with the technique (Anderson, interview, 10 December 2008; Anderson and Botha, interview, 17 December 2008). Building of RWH tanks is also a well developed technology and with proper design and correct construction, problems should be minimal (Stimie, interview, 5 January 2009).

In the Thaba 'Nchu area, roads are in a bad state and transport is not readily available. People cannot use bicycles to fetch fertilizer and taxi transport is

costly. There are bus services available (Anderson, interview, 10 December 2008).

HHs also need sheds and cooling facilities (Anderson, interview, 10 December 2008; Backeberg, interview, 19 December 2008).

4.2.9 Political will and governance

The MDGs have set targets for the international community, and one of these goals is that the proportion of people who suffer from hunger should be reduced by half by 2015 (Van Koppen, interview, 12 December 2008). According to Steve Mohlabi (interview, 7 January 2009) the baseline for at least the number of poor in SA and where they are situated has not been established by the NDA, and is presently being determined. Only then can the degree of achievement of the MDGs be accurately assessed. According to him their department has seriously underestimated this number. From the rest of the discussion on the information gathered during the interviews, it became apparent how important political will and integrated and co-ordinated governance would be to successfully achieve this goal, and how the lack of it impedes the ability to address food security in SA.

While all the interviewees agreed that there should be political will at the different spheres of governance to ensure food security, they did not agree that it was in place, although the perception was that it had attained a higher political profile after Trevor Manuel (then Minister of Finance) mentioned its importance in 2008 (De Lange, interview, 7 and 8 January 2009). Some thought there was leadership on this (Mehlomakulu and Vawda, interview, 9 January 2009) while others said that the lack of especially this element contributed to the problems experienced in HH food security in SA (Stimie, interview, 5 January 2009).

Interviewees agreed that a consolidated governmental policy and legislative framework and definite implementation action plan indicating responsibilities, time-frames and budgets are required but have not yet been developed.

Various departments such as agriculture, water, public works, social development, education, health and Stats SA should be involved in an integrated and consolidated manner but this is not presently the case (Mohlabi, interview, 7 January 2009). Providing food security is however a very low priority on most of the departments' agendas.

There is thus no high level co-ordination and integration between relevant government departments on policies and their implementation, and collaboration takes place in a haphazard fashion. In some instances there is duplication (such as delivering of seeds and other equipment in a haphazard manner by different departments) while needs of villages are not determined in a co-ordinated manner and support is then not provided according to those prioritized needs (Anderson, interview, 10 December 2008; Anderson and Botha, interview, 17 December 2008).

Municipalities are regarded as the key drivers of development and should be actively involved in food security initiatives (De Lange, interview, 7 and 8 January 2009), but their involvement is very low. Their planning tool (the IDPs) where planning for food security should take place, is also not alive (Gabriel, interview, 19 December 2008).

The various available initiatives are discussed in more detail below.

Steve Mohlabi (interview, 7 January 2009) indicated that the IFSS (developed by the NDA) was approved by Cabinet in 2002 but implementation is proceeding very slowly. One of the reasons for this is that different aspects required for successful implementation are situated within different chief directorates of the NDA and the provincial departments of agriculture, and the required integration and co-ordination are lacking. The NDA, for instance, established a directorate for food security but implementation of programmes that are essential for effective implementation of food security, such as CASP (Comprehensive Agricultural Support Programme that could provide fencing for crop land development), is situated in another directorate. The Directorate of Food Security provides food trees, seeds, broilers, bags of maize meal,

cooking oil and fish to communities. Food production tunnels are also provided in the Gariep area. The NDA officials believed that this situation would improve as the Presidency recently launched the War on Poverty and NDA is drafting a master plan and establishing baseline information to facilitate development and implementation of a strategy. Most of the other interviewees were not aware of this draft plan and it is thus probably not included in their Growth and Development Strategies and IDPs.

Nasele Mehlomakulu and Mohammed Vawda (interview, 9 January 2009) indicated that the DWA developed a policy on providing financial support to resource-poor farmers and a grant for RWH for HHs forms part of this. These activities are further regulated through a public notice published in 2008 while a comprehensive guideline is available to implement its use. The policy is, however, still being tested in a pilot phase, and in 2005 – 2007, 67 tanks were built and skills and knowledge transferred. Testing is mainly aimed at the technology itself, but community uptake in a sustainable manner is also assessed. The slow progress on the testing phase was mainly attributed to changes in the DWA's senior managerial structure, with new managers having had to be convinced of the merits of the project. Extensive and comprehensive advocacy through meetings and workshops was required initially to get commitment at ministerial and senior government official level (De Lange, interview, 7 and 8 January 2009). It was noted that one of the new senior managers had come from the NDA and has extensive knowledge and experience in agriculture, and it was expected that the implementation process will thus receive renewed support (Vawda, interview, 9 January 2009).

The DWA's support consists of a once-off grant for a RWH package containing a constructed RWH tank (usually a 30 000-litre tank), food gardening and nutritional requirements training (for the whole community where the tanks are installed) and equipment such as a hosepipe, fork, spade, wheelbarrow and seeds. A treadle pump can also be included if necessary. The packages are given to the community who then has to identify individuals where the tanks will be built. Individuals cannot at this

point in time approach DWA for the grant. Importantly, through this grant women can get water and can be enskilled to make their own decisions regarding food gardens, thus contributing to their empowerment.

Municipalities (as suppliers of water services) need to be actively involved in the DWA process from an early stage. The Water Services Development Plans that are required to be developed by municipalities in accordance with the Water Services Act do not include provision for water for food security (De Lange, interview, 7 and 8 January 2009).

It was asked whether the Municipal Infrastructure Grant (MIG) could be used to implement the RWH tanks but this has not been investigated further. In a discussion that one of the consultants assisting the DWA had with the then Department of Housing and Local Government, it was decided to place their involvement in the projects under the social branch in that department (De Lange, interview, 7 and 8 January 2009).

The importance of an administration arm to facilitate implementation was mentioned by the DWA and their consultants (Van der Merwe, interview, 4 December 2008; Stimie, interview, 5 January 2009). It was, however, noted that the arm (in this specific case, the IDT) was even slower in implementation at that stage, than the DWA (De Lange, interview, 7 and 8 January 2009).

The importance of co-ordination of initiatives at community level was illustrated by ARC-ISCW officials being interviewed based on their experiences in IRWH in villages in Thaba 'Nchu (Anderson, interview, 10 December 2008; Anderson and Botha, interview, 17 December 2008). They mentioned how a mining company made food tunnels available to members in communities but the tunnels were only provided to people not involved in the IRWH initiatives. Many people then abandoned the IRWH initiatives in order to get tunnels (in Gladstone village the number of people participating in IRWH dropped from 90 to about 55 after the tunnels were provided). The mining company did not, however, provide ongoing support and did not

ensure that water is available for the hydroponic growth of lettuce and tomatoes. Most of these tunnels are now damaged by wind, weeds are growing in them and they are used as animal pens. People in the communities also had to be encouraged again to revive the IRWH activities. The ARC-ISCW officials thought that this unco-ordinated situation could be addressed if all developmental projects could be evaluated at a central committee such as the CCAWs. These CCAWs were specifically established to evaluate projects related to use of agricultural water. They are driven by the provincial department of agriculture, while the NDA as well as the DWA regional and national offices also participate.

No comprehensive food security M&E&R is in place to assist in evaluating and improving the concept (Van der Merwe, interview, 4 December 2008; Mehlomakulu and Vawda, interview, 9 January 2009). An impact evaluation has, however, been done in Thaba 'Nchu and is discussed in section 4.3.

During the interviews, Steve Mohlabi (interview, 7 January 2009) mentioned that a workshop on food security would be hosted in February 2009 by the Development Bank of Southern Africa in an attempt to get a co-ordinated and integrated plan developed and implemented. Attendance was limited to invitees from NGOs, universities, government and the private sector. The DWA, for instance, did not attend. One of the recommendations made there was that a "centre of excellence" for RWH and HH food production should be established. The group participating in the workshop identified the need for a well-informed and trusted group of people that could be available for advice and assistance. The same concept was also mentioned by one of the interviewees (Crosby, e-mail, 21 December 2008).

4.2.10 Financial considerations

The cost associated with the construction of the RWH tank (for water storage) is regarded as very high with costs having doubled recently (Mehlomakulu and Vawda, interview, 9 January 2009). Mohammed Vawda (interview, 9 January 2009) involved with implementing the RWH grant does not regard the

provision of tanks as such as a cost-effective solution to providing HH food security, although it may well be considered worthwhile in light of the value added to peoples' lives. This cost is at present regarded as the single most important weakness prohibiting widespread implementation. It was mentioned that the Engineering Council of South Africa recently launched a competition for the development of engineering designs that are less costly (De Lange, interview, 7 and 8 January 2009).

4.2.11 Markets

The DWA official involved in financing the RWH tank package (Vawda, interview, 9 January 2009) was of the opinion that it would not be important to also consider establishing or providing access to proper markets for the food being produced by HHs. He emphasized that the grant should address hunger and not poverty. However, the ARC-ISCW and other researchers working in Thaba 'Nchu clearly indicated the need to assist with development and access of markets (Anderson, interview, 10 December 2008; Anderson and Botha, interview, 17 December 2008). Residents produce more than what they and even their neighbours need and HHs should be able to sell their surplus produce if they are to fully utilize the benefit gained through implementing the IRWH technique (see more detail on this research in the discussion of the Case Study in section 4.3).

Interviewees agreed that residents in general cannot access bank loans as the amounts required are too small and they thus often need to borrow money from loan sharks who charge up to 55 per cent interest (as experienced in some communities) (Anderson, interview, 10 December 2009).

4.2.12 Summary

The interviews established the importance of the availability of minimum volumes of rainwater at the right time of year and the ability of HHs to use this water optimally for food production. Technology to harvest this rain in the field has been extensively researched by ARC and other researchers and is

readily available. Storage of rainwater for food gardening is also not a new concept and is being done successfully all over Africa and in Asia. The DWA started to roll out a RWH grant to communities consisting of a once-off package containing a 30 000-litre underground or partially underground concrete tank, associated equipment and training for an 18-month period.

Minimum areas (about 20 m^2) of land are required to produce food. In the rural areas that were part of the former SA homelands, longer term land tenure can be a problem as people can only use land if approval is obtained from the traditional authorities. However, none of the interviewees was aware of a single case where such approval had been refused.

The point was made by all interviewees involved in, or knowledgeable on, transfer of skills to communities to improve HH food security, that such processes would not be successful if dependencies are promoted and if people are not sufficiently empowered to take control of the food production process. People need to believe in themselves and regain their confidence. This is a crucial point for success and can easily be overlooked.

Interviewees agreed that extensive transfer of skills on food production and nutrition over a longer period of time and using different communication techniques are required for success. Concern was expressed by interviewees that the institutional arrangement for a large scale roll-out of a HH food security programme in SA is not available and can thus impact on its success. Although traditional authorities in most cases support it, the involvement of municipalities is very limited. Involvement of government officials of the other spheres is also almost non-existing. The limitation of fragmented or limited involvement was evident in the IRWH initiative driven by ARC-ISCW in Thaba 'Nchu. They championed the process, largely using their own resources and that of WRC to accomplish this. They had almost no assistance from other government spheres and departments.

The ARC-ISCW researchers mentioned the successful establishment of the community- and municipal-based water harvesting interest groups

(CB:WHIGs and MC:WHIG), but indicated that the community had experienced challenges in maintaining these.

The effect of community culture and especially practices regarding treatment of women were identified as important. This is examined in more detail in the discussion of the case study (section 4.3).

The technology used as well as the elements associated with its successful transfer has been well researched and could be successfully implemented if done according to processes described. The associated infrastructure in the case of the RWH tanks is not new and all the required tools are simple and easy to obtain.

A gap has been identified in government being able to roll-out the process in SA. Although there appears to be political will to address food insecurity, no consolidated plan with clear targets, resources required and responsibilities spanning different spheres of government is available and will apparently not be put in place soon. Departments are in general not geared for implementation. An example mentioned was that extension officers of the DoA are not allocated, assigned and specifically trained to provide services on RWH for HH food security. They are also not motivated, enthusiastic and committed to provide a service to HHs. The best progress being made seems to be the RWH package containing a tank, equipment and training over an 18-month period, which is being piloted by DWA. Understandably no M&E system has been developed.

From a financial point of view, poor HHs are not able to access loans and are dependent on grants being provided by government and on loan sharks in the rural communities.

DWA is at present of the opinion that it is not necessary to consider the development of markets for HHs to sell their excess produce (the grant will address hunger and not poverty). However, the success achieved in Thaba 'Nchu over a ten-year period indicated that as more HHs take up the

technology and produce food, neighbourhood markets become saturated; thus, in order to ensure success in food security for HHs, they will have to be able to access wider markets.

Some of the issues not explicitly mentioned above, and that are being further investigated are:

- The supply of fencing to allow for the use of crop lands for IRWH;
- Provision of food tunnels to allow extending the planting period through April to July;
- Training on use of grey water – soapy water can be used to combat pests;
- Funding to buy building materials;
- Supply of seeds to HHs.

4.3 CASE STUDY

4.3.1 Introduction

RWH has been practiced in homestead use for centuries in many areas of the world. This was especially necessary in arid areas where rainfall is erratic. Some of these practices are still in place today and a renewed effort is being made in countries such as China, India, Northern and South Africa to alleviate the plight of the poor in rural areas through transferring RWH techniques for food security and other small industrial uses. The practice is also used for supplying domestic water, provided that the quality is acceptable.

About 54 per cent of the population in the Free State is food insecure, 56 per cent suffer from poverty and 31 per cent are unemployed (Botha, *et al*., 2007a:1). Many of the poor and unemployed live in 42 communities scattered around Thaba 'Nchu and Botshabelo which were part of the former Bophutatswana homeland. More specifically, the average consumption expenditure for a HH in the Thaba 'Nchu area was R278 per month (in 2004) while the equivalent poverty line for a HH in the Free State was R711 per month. People in Thaba 'Nchu thus live well below the poverty line and are

regarded as ultra poor (Mdibe, 2007:4). Most of their cash income is in the form of old age pensions and child support grants.

Each HH does, however, have access to about 2 to 4 hectares of arable land but these are not used for agricultural purposes as continued crop failures were experienced due to the climate and resource characteristics in the area. The area is semi-arid with low and erratic rainfall and predominantly duplex and clay soils.

The ARC-ISCW at Glen near Bloemfontein has been conducting research under these natural resource conditions in an attempt to increase crop yields. They developed IRWH techniques that increased maize and sunflower yields by as much as 50 per cent compared to conventional production techniques. These techniques are also appropriate to produce high value crops such as vegetables and could thus be implemented to improve food security and poverty in the area. The research in recent years focused on this aspect and included intensive training of communities on HH food production.

The research started with a three year project to develop RWH techniques that would increase crop yields as compared to conventional production techniques. Due to the well-known challenges experienced in transferring exogenous technology to poor HHs, a second project on the social acceptability and economic feasibility followed.

4.3.2 Case study methodology

The case study consisted of a document analysis, an investigative visit to the area and a field visit during which 4 residents were interviewed. During the interviews, focus was on the actions taken that resulted in the success of the activity and these actions were also correlated (or otherwise) with the primary and secondary research questions posed. The secondary research questions were mainly linked to the social situation and acceptability, availability of natural resources, existence of appropriate institutional arrangements, availability and transfer of technology, economic feasibility and governance.

The next sections describe the detail found during the document analysis, and information found during the qualitative interviews held with HHs.

4.3.3 Document analyses

4.3.3.1 Introduction

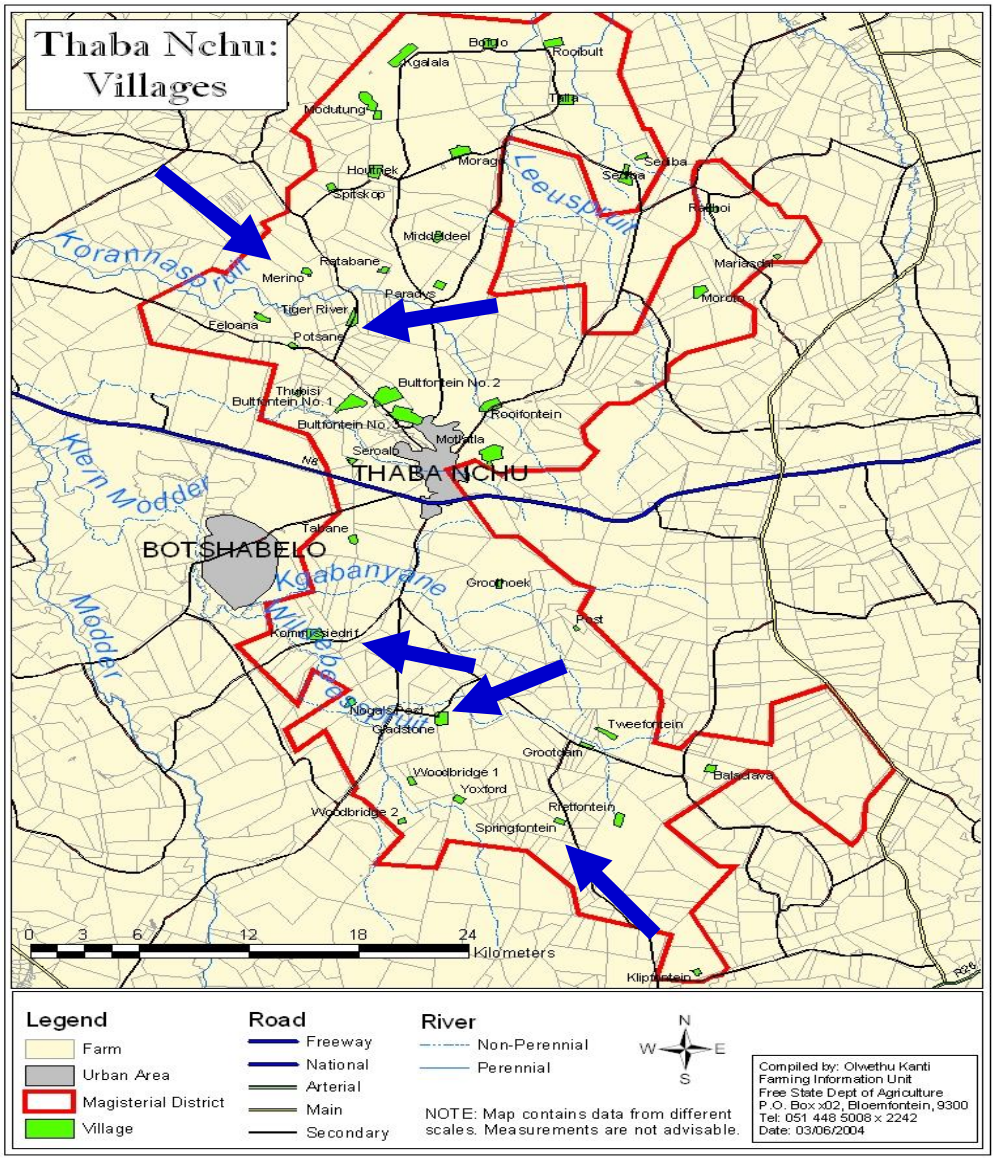
Various reports have been produced as part of the research organizations' documentation, including WRC and ARC documents and theses produced by post-graduate students at the University of the Free State. The ARC-ISCW team involved was multi-disciplinary and consisted of an agronomist, an agrometeorologist, a soil scientist, sociologists, agricultural economists and a graphic designer.

4.3.3.2 Overview of the project - WRC reports

A research report describing the application of the IRWH techniques at homesteads in villages at Thaba 'Nchu was published in 2007 (Botha, *et al.*, 2007a) and provides an overview of the project. This document is one of the key documents analysed as part of the research.

The location of the 42 different villages is indicated in Figure 4 (Botha, *et al*. 2007a:8). The villages visited during this research are indicated with arrows.

Figure 4: The villages visited in Thaba 'Nchu



Source: Botha, *et al*., 2007a:8

Land is communally owned and people are allocated residential and cropping land after permission is obtained from the tribal authority. Residents also have access to communal pastures. Residential, arable and grazing areas (land areas in hectares) are thus available for the 42 communities

(Kundhlande, Groenewald, Baiphethi, Viljoen, Botha, Van Rensburg and Anderson, 2004:6).

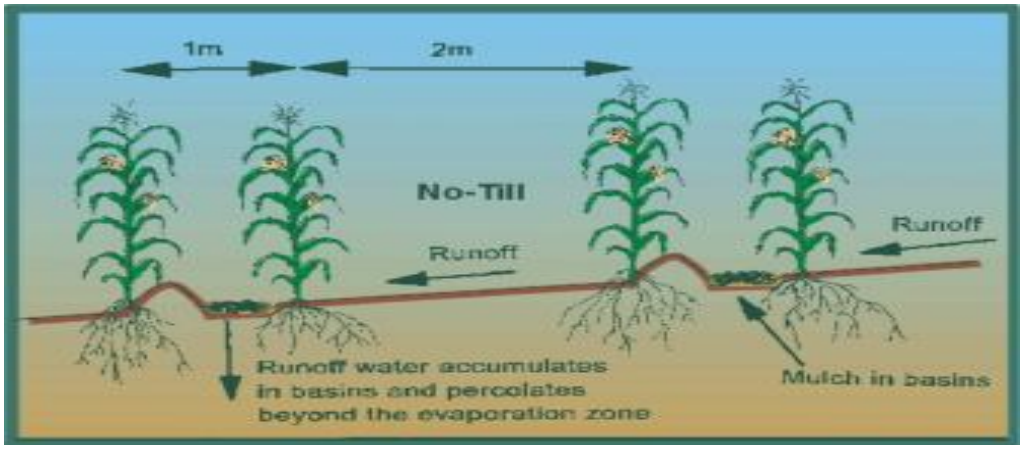
Where natural resources are concerned and importantly for IRWH, rainfall occurs in the form of high intensity rainfalls during December and January. More reliable rainfall takes place in March. The evaporative demand is lower during the March periods which make the area suitable for planting crops with a short growing season early in January. Rainfall available during the crop growth cycle is however inadequate to support good crop growth with conventional farming methods and the area was thus mainly used for grazing. Another feature of the area is that the sloping land is suitable for crop production. In addition the soil has a high clay content and is shallow.

4.3.3.3 Development of appropriate technology

The specific IRWH technique ("2-metre wide run-off strip and 1-metre wide basin" technique (Kundhlande, *et al.*, 2004:163) used by the ARC–ISCW is described through a 10-step process. The outcome of using the process after preparation of the field and growth at the end of crop growth results are indicated in Figures 5 and 6. The combination of techniques consists of the following:

- Two meter sloped strips are created where no tilling takes place and from where rainfall runs off to basins constructed at the bottom of each strip. Non-tilling of these strips results in surfaces becoming hard, thus reducing rainfall infiltration;
- The basins at the bottom catch the water, rainfall can infiltrate and evaporation is limited;
- Organic material (mulching) or stones can be used to cover the basins in order to further reduce evaporation;
- Mulches can also be put on the 2 metre strips to reduce soil movement and reduce evaporation;
- Crops are planted both sides of the basins (as indicated in the figures) for their roots to utilize the moisture maximally.

Figure 5: A diagrammatic representation of the IRWH technique



Source: Botha, *et al.*, 2007b:2

Figure 6: IRWH technique after the fields have been prepared and after crop growth



Source: WRC, 2008b:37

The research included comparisons with generally used conventional agricultural crop production practices and showed consistent improvement in yields if the IRWH techniques were used. It is important to note that the above techniques are agro-ecosystem specific and need to be adapted if used in other regions in South Africa. The specific natural resource

requirements to make the technique successful were described in the research report (Botha, *et al*., 2007a:14).

The ARC-ISCW established that the technology was suitable to increase agronomic productivity, entrench risk and to manage the natural resource. These were regarded as three of the five pillars required for sustainability of processes as identified by them. The other two pillars related to social acceptability and economic feasibility and these aspects were then researched during transfer of IRWH to rural communities around Thaba 'Nchu (Kundhlande, *et al.,* 2004:xvii).

For the initial roll-out or scale-up to communities and to ensure quality research on social acceptability and economic feasibility, the WRC team also included (in addition to the ARC-ISCW team) the Department of Sociology of the University of the Free State in Bloemfontein.

An important element of the success of the process is reflected in the remarkable adoption of the IRWH in the HHs in the Thaba 'Nchu villages since 2001. This is indicated in Table 4. Community adoption varied between communities and within specific communities.

Table 4: Adoption of IRWH technique by communities and HHs

Year	Rural households participating	Communities participating
2001/2002	6	4
2002/2003	108	6
2003/2004	400	37
2004/2005	1033	42

Source: Compiled from Botha, *et al*., 2007a:5

The next sections explain why communities so successfully adopted the scientifically based agricultural techniques.

4.3.3.4 Social situation and acceptability

a) Introduction

This aspect was researched by Kundhlande, Groenewald, Baiphethi, Viljoen, Botha, Van Rensburg and Anderson (2004) and Mdibe (2007). During the first stages of transferring the technology to communities, a huge effort was made to ensure sustainability especially in view of the difficulty generally experienced throughout the world in adoption of new technology by HHs and farmers. The approach used during the initial process as well as the expansion process will be discussed in the next sections. Expansion to the wider community only took place after the technology was adopted and accepted by the pilot communities. Interviews were held afterwards to determine how well transfer had occurred and what had contributed to its perceived success.

b) Technology diffusion

The term "diffusion" is in general used to describe the adoption of innovation in any community. Various factors influence the diffusion process. Two of those are time and the social system into which the technology is transferred. In general, five adopter categories of members of a social system have been identified and are described in the document (Rogers and Scott, 1997 as referenced in Botha, *et al.*, 2007a:55). The adoption categories are based on the time taken to adopt the innovation.

The other factor that is important in the adoption of innovations or technology is the social system within which it is done. This system refers to the way that a specific community engages in solving problems to accomplish a common goal (Rogers and Scott, 1997 as referenced in Botha, *et al.*, 2007a:57). Other factors that affect diffusion in communities are culture and opinion leadership. Culture includes knowledge, beliefs, customs, norms, and values shared by a community, and how cultural expectations influence the way people behave and make decisions.

The factors needed to improve successful diffusion have been studied and implemented to assist with the sustainable scale-up of IRWH.

c) Participatory Action Research (PAR)

The WRC team (ARC-ISCW and Department of Sociology) implemented participatory action research (PAR) in transferring the agricultural techniques to the community (Kundhlande, *et al.*, 2004:xvii). This type of research emerged during the 1970s after conventional research methods failed to address issues in developing countries. By 2000 this method was well established in social sciences research at grassroots levels. Importantly, PAR empowers communities (versus increasing dependency) and helps the "disadvantaged to regain their confidence in themselves", to take ownership of projects and to improve self-esteem, self-reliance and self-determination (Kundhlande, *et al.*, 2004:17-18). Other characteristics of PAR are summarized by Kundhlande (2004:15-18) and explain the various aspects of the model that were relevant to this research. In the process, communities thus ultimately take the lead in research that will help them achieve their aims (Babbie as referenced in Botha, *et al.*, 2007a:16). Another element of this type of research is that the professional helpers assist communities to create informal and social support networks.

Specific aspects of PAR and their description in the project are indicated in Table 5.

Table 5: Participatory action research (PAR) as used in the IRWH project

Aspects addressed through PAR	Brief description
Community	The community is helped to create informal and social support networks in co-operation with professional helpers for mutual support and to address problems.
Mobilization	Participants are mobilized as active agents in the process of creating knowledge, reaching a collective objective and solving problems.
Capacity building	This refers "to the potential and capacity of the people in the particular community and to the process of assisting them in developing skills at various levels in order to become the masters of their own development and thus acquire the capability to manage their own future" (De Vos as referenced in Botha, *et al*., 2007a:17).
Empowerment	Empower people with research capabilities that they can identify and transform their situations for themselves.
Human well-being	Includes well-being of people on all levels such as social, economical, technological, cultural and spiritual potential.
Self-reliance	A creative activity that "requires an awareness of one's creative assets, confidence in one's ability to solve life's problems, the courage to take on challenging tasks and the stamina to make sustained efforts".
Community participation	People participate actively and assume responsibility for their own development.

Source: Compiled from Botha, *et al.*, 2007a:16-18

The different aspects of PAR mentioned in Table 5 were implemented and achieved by using various communication channels in the WRC Thaba 'Nchu project.

d) Communication channels

The project differentiated between communication channels for mass media, groups and individuals:

Mass media: the project team developed various pamphlets, leaflets, brochures and newsletters. These were translated into Sotho and distributed at information days and other technology transfer activities.

Posters and papers were written for scientific conferences, radio talks on the subject were held, articles were written for popular magazines, and a video/CD was made on the IRWH technique. An IRWH song and dance was also created.

Group approach: This approach is highly suited to transferring technical agricultural techniques to communities. It provides for feedback, reducing misunderstandings and obtaining new ideas. The approach included information and farmers' days, exhibitions, demonstration through 3D models and development of demonstration plots within communities and at the Glen Station, and holding festivals to share knowledge and experiences ("fests-of-knowledge"). Pre- and post-harvest festivals were held and were spread over a few days to allow for smaller separate festivals, as well as a final day where all the farmers came together. Communities not familiar with IRWH were also invited, to raise their awareness and to motivate other communities to participate. As part of the festivals specific farmers were invited to share their experiences and challenges.

Training was conducted in the form of workshops or one-day courses. Target audiences included extension officers and youth workers, leader farmers and community representatives.

e) Empowerment through rural community-based organizations

Community committees were established as part of the early piloting in communities. These were transformed into a Tswelelopele Small Farmers Co-operative (TSFC) (an umbrella body for all the communities) which was developed as a municipal-based water harvesting interest group (MB:WHIG) where 11 representatives of 42 community-based water harvesting interest groups (CB:WHIG) as well as other co-opted stakeholders, form an Executive Board. Co-opted members are from the municipality, traditional authority and local agriculture office. Also included in the institutional arrangement is a General Assembly consisting of 42 community representatives and the 11 Executive Board members. The members of the Executive Board are elected by the General Assembly. The 42 CB:WHIGs consists of at least 9 members each. The CB:WHIGs are registered as primary co-operatives and the

MB:WHIG as a secondary co-operative in terms of the Co-operatives Act, 1005 (Act 14 of 2005). A constitution has been developed for the co-operatives (Botha, *et al.*, 2007a:161).

Final decisions are made at the General Assembly and implementation is ensured by the Executive Board. The TSFC has the high level aims of reducing food insecurity, alleviating poverty, improving living standards, contributing to the creation of employment opportunities and for empowering themselves through the application of the IRWH technique (Botha, *et. al,* 2007a:107).

At a practical level, HHs share successes and failures and assist each other with day-to-day challenges at the WHIGs. The WHIGs have given members greater bargaining power, protected them from exploitation from unscrupulous people, provided for recognition by other stakeholders such as government and municipalities, and provided a platform for agreement on selling prices for products. Training of communities can be better co-ordinated through the TSFC. The MB:WHIG organized a successful 'post-harvest' festival on 28 November 2006.

Training of the TSFC was done by the ARC-ISCW on conflict resolution, communication skills, role and functions of committees, markets and marketing, value adding and the importance of record-keeping. Also included were technical aspects of the IRWH technique such as construction of basins, planning of a variety of crops, weeding, pest and disease control, applying fertilizers, maintenance and keeping rainfall data.

The importance of these organizations in enhancing uptake of new techniques was emphasized by Baiphethi, Viljoen, Kundhlande, Botha and Anderson (2009:1358).

Research done by the Sociology Department of the University of the Free State specifically evaluated the outcome and social impact of the project.

f) Outcome and social impact evaluation

This research is described by Mdibe (2007). Information was gathered through focus-group discussions, in-depth interviews, personal interviews, drama and storytelling, and personal observations. The qualitative interviews were held with 20 per cent (240 participants) of the farmers practicing IRWH in the whole area.

The researcher found that IRWH benefited the HHs positively and that HHs accepted and adopted the technique. As indicated in Table 4, more than 1000 HHs in 42 villages adopted the technique within a very short time period. The technique is described as "a simple duplicable technique that everybody can handle" (Mdibe, 2007:71).

The adoption process was analysed in more depth by exploring perceptions on motivators (what encouraged people to take up the techniques) and demotivators (what discouraged uptake). **Motivators** included excitement created, support by community leadership, presence of established structures, usage of collective action/communal approach, good communication/co-ordination, good crop yield, regular meetings, holding festivals, making a video, the increased income generated from IRWH and simplicity of technique. **Demotivators** included project overload (many projects being done by different agencies without good co-ordination), cultural issues (some people are very reluctant to consider adopting something coming from outsiders), village politics, lack of respect for each other, drought, limited job opportunities, community leadership being against the project, and the levying of a subscription fee. Interestingly, women are not allowed to adopt the techniques if their husbands are against it as this is considered a sign of disrespect.

For effective adoption of the IRWH technique people had to believe that they could implement the technique successfully. Success of the use of a specific communication channel was measured by considering the number of people attending the technology exchange action and people's opinion of the different technology exchange actions or tools used.

It was found that the best way to gain entrance to a community is to meet with the headman, explain the aim and purpose of the project and get his co-operation. A meeting is then held with the community. It is important at the first meeting to indicate clearly what the benefits could be and what the technique entails. People have to be convinced that they are able to adopt the technique. Materials used at the first meeting included posters, a 3D model, and the IRWH video. During further meetings a demonstration plot could be developed at a place chosen by the community.

From the results of the interviews it was concluded that festivals were the most successful communication channel, probably because they consisted of a number of different channels such as farmer-to-farmer training, demonstration plots, focus group discussions, a workshop and training. Other channels included the use of demonstration plots, support from ARS-ISCW technicians, showing the IRWH video, and a focus group discussion (in that order of preference). It was concluded that "(T)he very successful technology exchange phase was the result of different communication channels used during various stages of the technology exchange process" (Botha, *et al.*, 2007a:53).

Regarding the impact, the researcher found that farmers indicated that they produced much more food than before the technique was introduced, and that IRWH reduced food insecurity (as indicated by 80 per cent of respondents), they had an improved income and economic status (79 per cent and 96 per cent respectively), developed farm management skills and improved understanding and use of available natural resources. Unintended positive outcomes included improving the status in the villages and self-confidence of participants, and more importantly, farmers had hope for a better future. Women played an influential role in the project and not only helped themselves but talked about and taught the technique to others. Songs were created about the adoption of the technique.

Respondents also indicated that their health improved, their education and capacity increased, there was a reduction in stealing of produce and their participation improved their social lives (Mdibe, 2007:72). The researcher also found that by implementing the IRWH technique, HHs are able to produce more than they need. However, if a market is not available – beyond selling to neighbours and other villagers – produce became spoiled due to lack of storage facilities.

Constraints related to marketing include proper marketing structures, transport and marketing facilities. The researcher concluded by referring to the practice instituted by ARC-ISCW where farmers light candles to indicate the principle that a single lit candle can spread the light thus symbolizing the ongoing fight against food security and poverty.

In summary, the application of the IRWH technique contributes towards higher crop yields, greater crop diversity, HH food security, job opportunity, higher incomes, better health, educated farmers, reduction in crime in the community, and better social lives.

Importantly for this case study, the WRC report repeatedly mentions that extension officers of the provincial Department of Agriculture provided very limited support, commitment and participation in the project and that ARC technicians mainly had to exercise these functions. Training material for the HHs and agricultural extension officers were produced as part of the research project (Botha, *et al*., 2007b).

The next section refers to research done in the same area to determine the requirements for access to markets after the IRWH technology is successfully adopted by larger numbers of village residents in the longer term.

g) Commodity and financial markets and the sustainable adoption of the IRWH technique

This research was conducted by Mabannda (2007) in the villages of Potsane and Rietfontein in the Thaba 'Nchu area. It established that HHs were able to successfully meet the challenges associated with the adoption of new

technology of the IRWH technique (despite being described in general as being notoriously difficult worldwide). HHs were able to produce various types of crops and to sell some of the surplus through farm gate marketing and street vending in Thaba 'Nchu. Due to the successful uptake of the technique by increasing numbers of farmers, an oversupply saturated these markets. To address food security and ultimately poverty in the villages successfully in the long term, HHs and small-scale farmers would thus have to be able to access new markets, and in this regard, the following gaps were identified:

- no adequate market information;
- no storage facilities;
- no proper grading measures;
- lack of transportation;
- non-existence of marketing organization; and
- a lack of adequate training about record-keeping, strategies on price setting and understanding of market structure in operation (Mabannda, 2007:i).

A Principal Component Analysis (PCA) and Ordinary Least Squares (OLS) regression confirmed that financial markets, socio-economic status of farmers and infrastructure were significant factors influencing sustainable adoption of the IRWH technique (Mabannda, 2007:ii). These have to be addressed to ensure sustainable and successful adoption of the IRWH technique.

Farmers and HHs need to determine consumer wants, commodities suitable for production and choose the marketing channel suitable to them. Marketing channels available to small-scale farmers are discussed in the report and range from farm gate marketing, village marketing, fresh produce markets and contract marketing to communal marketing. The advantages and disadvantages of each for the farmers are discussed and for fresh produce markets, for instance, higher prices are set but transportation costs have to be paid and there is a risk of timely information not being provided (Mabannda, 2007:15-17).

The researcher indicates that "[T]here is consensus that access to markets is one of the critical factors that plays a role in the smooth operation of the process of adoption of a technology" (Mabannda referencing Feder, Rust and Zilberman, 1985, and Zeller, Diange and Mataya, 1997, 2007:17).

Mabannda further noted that "[A]ccess to local markets has become increasingly important under globalization, as only those who have it can exploit the new opportunities. Without such access, the potential benefits of higher product prices and lower input prices are not transmitted to poor HHs" (Mabannda, 2007:18). The International Fund for Agricultural Development (IFAD, as referenced in Mabannda, 2007:18) identified objectives that had to be met to improve the rural poor's access to markets. These included improvement of the terms of their participation and thus their market share, and revising the rules of trade in their favour. Subsistence food crop production would not substantially increase rural incomes and market-oriented production systems were needed. Mabannda (2007:18) poses that this, amongst other things, requires the intensification of agricultural production systems, increased commercialization and specialization in higher value crops. "These must be built upon to establish efficient and well-functioning markets and trade functions; ones that keep transaction costs low, minimize risk and extend information to all players, and that do not exclude or work contrary to the interest of the poor particularly those living in areas of marginal productivity and weak infrastructure" (IFAD as referenced in Mabannda, 2007:18,19).

The information presented in the documents analysed will be further interrogated in Chapter 5 when indicators will be identified for use of rainwater for successful HH food production.

A summary of the information found in the document analysis is provided in section 4.4 at the end of the chapter.

4.3.4 Qualitative interviews

Five of the villages in the Thaba 'Nchu area were visited on two occasions with the aim of visiting HHs that successfully implemented IRWH. Some of the HHs have been involved with IRWH or "matangwana" for about 6 years. The first visit took place on 17 December 2008 while the second took place on 19 June 2009.

The first visit was exploratory and intended to familiarize the researcher with the area and the IRWH practices in communities. It was combined with conducting qualitative interviews with ARC-ISCW researchers driving the IRWH process in Thaba 'Nchu.

The residents visited and their villages are indicated in Table 6. Approval was not requested and thus not obtained to identify the residents visited and their names would thus not be revealed. Villagers will only be identified by using the notation Resident 1, etc. The villages are indicated in Figure 4.

Table 6: Residents visited and their villages

Resident	Village
Resident 1	Merino
Resident 2	Potsane
Resident 3	Kommissiedrif
Resident 4	Springfontein
Resident 5	Gladstone

Source: Ligthelm, 2010

The first visit took place during a very dry and hot period. One HH visited had already harvested his crops (Resident 3, visit, 17 December 2008) while another small scale farmer/HH lost about 5 000 cabbages because of the lack of rain during winter and spring. He was also reluctant to start planting maize because of the dry spells that they had (Resident 1, interview, 19 June 2009). His problem was that the planting season was ending and there had been insufficient rain. Significantly, and as an indication of the plight of the villagers, the farmer had a borehole but lacked money to keep the pump

running. He also needed pipes and sprayers. Another HH (Resident 2, interview, 19 June 2009) was discouraged by the frequent dry spells but was still able to produce some maize (Appendix D, Picture 6), despite cuts in drinking water to the village. During the visit in June people were more optimistic and had already prepared their lands for the planting season and even had small growth areas that they were able to maintain during the winter (Appendix D, pictures 1, 2 and 3).

During the second visit, semi-structured qualitative interviews were held with 4 residents at their homesteads (Residents 2 – 4, Table 6). All 4 residents are members of the Community Based Water Harvesting Interest Groups (CB:WHIG) while one interviewee (Resident 4. interview, 19 June 2009) was also a member of the Municipal Based Water Harvesting Interest Group (MB:WHIG). An ARC-ISCW employee assisted with translating questions and answers. The questionnaire is attached as Appendix B.

The first question elicited answers on who assisted the residents to do IRWH. All the village residents were full of praise for the ARC-ISCW members and indicated emphatically that mainly ARC assisted them. The support was provided in many ways but residents mentioned the personal involvement of researchers and technicians who demonstrated techniques when educating residents on how IRWH should be done. This included giving the correct planting measurements for various vegetables and crops, calendars for when to plant which crops, and as Resident 3 (interview, 19 June 2009) indicated, “everything”. In later questions the residents were questioned on more detail of the support provided.

In Potsane, the Kgosi (tribal chiefdom) and municipal councillors sometimes attended meetings (Resident 2, interviews, 19 June 2009). In one of the villages the municipality also provided hosepipes and seeds while the provincial DoA supplied wheelbarrows, spades and forks and also showed residents how to use them (Resident 5, interview, 19 June 2009).

All residents indicated that demonstration plots at Glen were a necessary part of the support. It assisted them to identify what they were doing incorrectly and how to correct these mistakes. They were also able to duplicate what was demonstrated in their own gardens. Residents felt in general that the only way this could be improved would be to have them visiting these plots more often.

People mostly work on their own in their own gardens in the villages. Some of the reasons mentioned included that some people are lazy, leaving most of the work to others (Resident 3, interview, 19 June 2009). Yard sizes also differ which would make work division unequal (Resident 4, interview, 19 June 2009).

The CB:WHIGs were functioning well. Issues are discussed there and then taken to the community for decisions. Residents were of the opinion that it worked "beautifully" and that it could not really be improved (Resident 5, interview, 19 June 2009). The groups also demonstrate the IRWH technique to new members and one resident indicated that 3 new people had become involved (Resident 2, interview, 19 June 2009).

One of the residents thought that the MB:WHIG was not functioning well (Resident 2, interview, 19 June 2009). One of the challenges experienced at the MB:WHIG at present is that they want to register as a co-operative (Resident 4, interview, 19 June 2009). They need to pay a registration fee of R270 and do not have that amount at present. The co-operative will enable them to access more funding which is needed to continue with IRWH in croplands.

Another problem that residents in Potsane and other villages are trying to address – also through the CB:WHIG – is the supply of tap water on a continuous basis (Resident 2, interview, 19 June 2009). This is being provided by Bloem Water and despite many promises from Bloem Water domestic water supply is still intermittent. Taps are also often far away (1 kilometre from houses) (Resident 3, interview, 19 June 2009). Some

residents have access to borehole water but yields are not high (Resident 1, discussion, 17 Dec 2008; Resident 3, interview, 19 June 2009).

Communication in the villages is mainly done through word-of-mouth. Villages are small and people can be reached easily. People also use the telephone but there are sometimes problems due to poor network connections (Resident 2, interviews, 19 June 2009). Communication with ARC is usually through personal visits by their technicians. Residents appreciated the visits by them. The festivals that were previously held also helped in communication between different villages (Resident 4, interview, 19 June 2009).

Residents thought that the demonstrations (where people could see the benefits first-hand) and the personal assistance by technicians helped them best to implement IRWH. They were trained (educated) intensively on aspects such as how to prepare the basins, when to plant, what to plant, how to plant, how to tend to the plants, how to eradicate weeds, treat plant diseases and harvest the crop. The training was not once-off but continued throughout the year. One of the farmers was also visited by, the then Minister of Water Affairs and Forestry, the Honourable Ms Sonjica (Resident 5, interviews, 19 June 2009).

Residents practicing IRWH in general do not experience problems with other residents in the communities. People do, however, experience instances of jealousy especially during harvesting time – “some people don’t want to assist with the work but want to reap the benefits” (Resident 4, interviews, 19 June 2009). One lady also had problems with people opening her gates at night, with animals coming in and destroying her crops (Resident 2, interviews, 19 June 2009). Residents are, however, encouraging other villagers to do IRWH. People would also like to have proper fences in some instances, and sheep (Resident 5, interviews, 19 June 2009).

The following question gauged residents’ views on what they gained doing IRWH. People indicated that they can now grow vegetables and other crops

such as maize and ensure their families' food security. They also do not have to buy certain foods and can redirect available monies to buying other necessities. The food from the garden is also fresh, and some food can be used for livestock such as chickens (Resident 4, interview, 19 June 2009).

There was an improvement in health through better nutrition and through getting more exercise by working in the garden. One of the residents mentioned specifically that her blood pressure is lower (Resident 2, interview, 19 June 2009). Another resident indicated that she felt "old but fresh" (Resident 4, interview, 19 June 2009).

People are selling their extra vegetables and other crops within the communities where they live and can earn a little extra. One resident was even building a new house for herself with income generated (Appendix D, Picture 4). On being prompted, people indicated that the process helped them to better make decisions. The process changed their lives. They felt empowered and now have a lot of work to do. One of the residents indicated that this made her happy (Resident 2, interview, 19 June 2009). The planning that has to go into IRWH helped them to do planning in general.

Residents indicated, however, that they are more productive when there is rain. On a question on whether storing water in a large tank will help them though dry spells, they indicated that it would help a lot. One resident who has a steady supply of tap water indicated that she would use the tap water to fill up the tank (Resident 4, interview, 19 June 2009).

These answers mostly indicated the best things that IRWH brought. One resident in addition indicated she was no longer walking around the village gossiping and was enjoying what she is doing (Resident 4, interview, 19 June 2009). She has been doing IRWH now for seven years. Others are now "financially fit" (Resident 2, interview, 19 June 2009). Another resident indicated that she "got educated and in the process they are eating" (Resident 5, interview, 19 June 2009).

None of the residents could think of anything bad that came with the IRWH process and would not want to go back to their lives before they learnt about IRWH. Residents are growing beetroot, spinach, carrots, pumpkins, beans, onions, sweet potatoes, turnips and maize. They are able to plant whatever they want to produce. Some of the farmers also maintain their fruit trees by constructing RWH basins around them (Appendix D, Picture 7). They produce more than they can use and sell produce within their communities. One of the residents is drying vegetables such as spinach and pumpkins and is preserving carrots and fruit, while also making jams (Resident 2, interview, 19 June 2009).

Residents indicated that they still struggle to get seeds and would appreciate some assistance with accessing markets. Some would also appreciate continuous clean tap water (Resident 2, interview, 19 June 2009; Resident 5, interview, 19 June 2009). The MB:WHIG's attendance number is also fluctuating and an effort to encourage residents to attend would be appreciated (Resident 5, interview, 19 June 2009).

The last question in the interview related to the candle-lighting event where resident farmers participated. People indicated that they thought it was important. They thanked God for the progress made and also asked for rain to enable them to continue with the good work, and were keen to have it again.

A site where RWH is being implemented is the residence of Ms Matshepo Khumbalo at Cullinan near Pretoria, which was also visited in December 2009. This excellent and comprehensive site shows the various ways in which RWH can take place:

1. Storing falling rainwater in the soil (similar to the IRWH practices at Thaba 'Nchu);
2. Catching and storing relatively clean roof rainwater in tanks;
3. Storing falling rainwater in underground storage tanks.

Ms Khumalo had developed a plan for RWH on her plot (Appendix D, Picture 5). The outcome of her activities is indicated in Picture 8 (Appendix D).

4.4 SUMMARY

The case study researched as part of the investigation to identify indicators for RWH to successfully improve HH food security, examined the implementation of IRWH in Thaba 'Nchu villages. The primary and secondary questions that comprised the research were investigated and mainly determined which variables are required for success in HH food security through the use of RWH, or IRWH in this specific case. The research area was visited on two occasions, a first exploratory visit in December 2008 and visiting and conducting qualitative interviews with 4 residents in June 2009.

The **document analysis** included various substantive research documents developed as part of the process: the IRWH technique has been developed over the last ten years by ARC-ISCW at Glen for subsistence farmers in that region to improve their crop yields (Hensley, Le Roux, Gutter and Zerizghy, 2007:10). After it was established that this could be achieved through relatively simple agricultural techniques, the practice was transferred to HHs in Thaba 'Nchu to assist them with producing vegetables and staple foods to improve their food security. The scientists at ARC enlisted the assistance of sociologists of the University of the Free State to ensure that communities were empowered to sustainably take up these practices. The research has thus been conducted by a proficient training and support team. Implementation of the technique improved crop yields by up to 50 per cent as compared to conventional planting techniques.

Despite numerous challenges, the technology has been adopted successfully over a four year period by about 1 000 HHs in 42 villages. The process was initially tested through implementation by 6 HHs in 4 villages, whereafter it was rolled-out to the other villagers. The technique has been termed "*matangwane*" by the local population.

Residents and researchers agreed that the IRWH technology is “a simple duplicable technique that everybody can handle” (Mdibe, 2007:71). This statement belies the major difficulties usually encountered in transferring technical agricultural procedures to communities and is a testimony to the input made by the ARC-ISCW and Social Sciences team for the successful uptake of the technology.

PAR was used by the team to transfer the technology and consisted of empowering HHs, making them self-reliant, improving their social, economic and technological well-being, and assisted them to create informal and social support networks. A social impact evaluation consisting of mainly conducting focus group discussions and in-depth interviews established the perceptions of a large number of the residents on the impact that the process had on their lives. Surveys also assisted in identifying which communications methods worked best with communities. Perception on motivators (encouraging uptake) and demotivators (discouraging uptake) were explored. These are important and will be included when determining indicators for success. Festivals were perceived to be the most successful communication channel. Farmer-to-farmer training, demonstration plots, focus group discussions, workshops and other training were included the festivals. Other channels included the use of demonstration plots and support from technicians. People that participated in the survey also indicated that their health improved, their education and capacity increased, there was a reduction in stealing of produce and people’s social lives improved. Residents interviewed as part of this research also confirmed these findings where probed during interviewing.

Community and municipal-based interest groups (CB:WHIGs and an MB:WHIG) have been established and are maintained by the communities themselves to discuss issues and to serve as a platform for consolidated action. Participation by the municipality, tribal authority and other government departments can take place here, although their involvement is limited.

As part of this case study the **qualitative interviews** identified that only the ARC-ISCW team assisted the HHs to implement IRWH and support their

journey from poverty and food insecurity to empowerment and food security. Residents identified the use of demonstration plots and personal visits by officials as essential elements of the successful transfers. This enabled the residents to master the art of HH food production and as one resident said: "We got educated and in the process we are eating". The residents are now growing a wide variety of vegetables including beetroot, spinach, carrots, pumpkins, beans, sweet potatoes, turnips, and staples such as maize.

It appears as if residents are mostly working alone in their own gardens but participate in the community based interest group discussions. In Merino, HHs worked together more and HHs planted the same crops per street. People bemoaned the dry weather spells and indicated that storage of rainwater would help them during the growing season.

When asked what would improve their lives even more, village residents mentioned that they needed seeds and access to markets to sell some of their excess produce. One of the social researchers (Mdibe, 2007:74) provided some thoughts on assisting HHs to gain access to markets and mentioned that Thaba 'Nchu is close to Lesotho and that many people from Lesotho travel to Bloemfontein regularly. A large farmers market could be developed at Thaba 'Nchu to accommodate these travellers. She also mentioned that the possibility of adding value through processing should be explored. This is already happening but could be extended.

The practice is regarded as successful for the following reasons:

- It resulted in increased agronomic productivity as crop yields were improved by 50 per cent compared to conventional practices;
- Risk was increasingly entrenched by providing customized and intensive training and ongoing personal support on when, what and how to plant, and how to use rainfall optimally;
- The project was socially acceptable, with greater acceptance where the leadership within the community accepted and promoted it. Acceptable methods and communication channels resulted in communities taking

ownership of activities. The activities were also adopted better if there was good cohesion in a village. HHs within a very short time span (3 months), became convinced that they could master the technology and that they could become more food-secure and also gain financially from it. Communities were assisted to form RWH interest groups at a community and municipal level to assist in addressing problems experienced and to provide for a consolidated base to promote their activities. These are run by the communities themselves.

- The IRWH activity is economically feasible at HH level and could provide for steady growth of this sector provided that aspects such as provision of crop storage facilities and access to markets could be addressed.
- The natural resource base is conserved with soil and water being used optimally.

CHAPTER FIVE
DATA ANALYSIS AND IDENTIFICATION OF INDICATORS

5.1 DATA ANALYSIS

5.1.1 Introduction

In this section the information and data gathered in chapters 2 and 4 are analysed to assist in the identification of indicators which are provided in section 5.2. For each of the secondary questions posed (section 1.5.2), goals and targets are formulated based on the research findings from the theoretical framework (section 2.1), literature review (section 2.2.7), key informant interviews (section 4.2) and case study (section 4.3). Associated indicators for input, output, outcome and impact are subsequently identified.

5.1.2 Data analysis

5.1.2.1 Achieving the MDG of eradicating extreme poverty and hunger

At an international level, one of the MDGs requires the halving of the proportion of people that suffer from hunger between 1990 and 2015 (United Nations Millennium Declaration, 2000) (see section 2.2.2). An international goal has thus been set to address hunger (Box 3).

Box 3:
Goal 1: Eradicate extreme poverty and hunger (MDG1) by 2015
Halve between 1990 and 2015, the proportion of people who suffer from hunger (Target 2)

Although it was stated in the literature that South Africa was on track to reach all the targets stated (RSA, 2007:5), one of the key informants interviewed indicated that a consolidated governmental policy and legislative framework

and definite implementation action plans to eradicate extreme hunger have not been developed (Mohlabi, interview, 7 January 2009). The points following in the data analysis will elaborate on what would be required to achieve this overarching goal. It is, however, important to note that the use of RWH to improve HH agricultural food security cannot by itself achieve this goal but would have to be included in a national policy and legislative framework to be realised.

5.1.2.2 Political leadership, national policies and legislation

In South Africa the rights of access to food and water are entrenched in the Constitution (1996). To ensure access to basic water, a framework consisting of legislation, policies, guidelines, implementation plans and an M&E system to monitor progress that ensure progressive realization is available and is being achieved, but a similar framework is not available and is not being achieved to eradicate hunger, as will be evident from the discussion that follows. The development and implementation of such a framework depend on political leadership in all spheres of government.

Key informants indicated during the qualitative interviews that political leadership and will in the different spheres of government are required for success in using RWH for HH food security (all interviewees, interviews, 4 December 2008 to 8 January 2009). This was also identified as a requirement to address food security in the SADC region (SARPN, 2005:16) and for the successful large-scale roll-out of RWH in China (Qiang, *et al*., 2007:187). Kerzner (1989:504-517) similarly confirmed that top management leadership and support in organizations are required for success in project management. Such political leadership will set national goals which would result in public policies being developed for achieving them, as indicated by researchers such as Dye (1995:18).

The key informants differed on whether there is such leadership at the moment in South Africa, where Mehlomakulu and Vawda (interview, 9 January 2009) thought that it exists while another interviewee (Stimie,

interview, 5 January 2009) said that he thought that precisely its lack contributed to the limited achievements in using RWH for HH food security to date. Globally, such leadership exists as is evident from the development of the Millennium Development Goals which aims, amongst other things, to eradicate extreme poverty and hunger by 2015.

Although a policy on using RWH for HH food security does not exist in South Africa, a policy and a regulation were developed in terms of the National Water Act (1998) that provided for a grant for RWH tanks for family food production (DWAF, 2004a and b). The National Department of Agriculture also developed an Integrated Food Security Strategy (IFSS, NDA, 2002) which was approved by Cabinet. This strategy includes a reference to the use of RWH for HH food security. There is no implementation of this strategy and no associated M&E to monitor progress. It also appears as if there is no commitment from other government departments to its implementation.

In the case of the DWA grant its implementation is progressing very slowly (Vawda and Mehlomakulu, interview, 9 January 2009; De Lange, interview, 7 and 8 January 2009), while in the case of the IFSS no high level co-ordination and integration between government departments has taken place to ensure its successful implementation (Mohlabi, interview, 7 January 2009). The lack of such policies that would support poor HHs to attain food security in a multi-disciplinary manner was also identified by Nieuwoudt and Groenewald (2003:182) (section 2.2.3.1).

It is the view of the researcher that political leadership is in place at a national level (as evident from the Cabinet decision of the IFSS), a DWA policy on a grant for RWH for HH food security is available, the IFSS has been developed, but in all cases implementation and roll-out are slow or non-existent. An appropriate policy framework for food security is not available.

Caution will have to be exercised in developing such a policy as the literature review showed that wrong sectoral and agricultural policies contributed to

food insecurity and self-sufficiency in the Southern African region (SARPN, 2005:9-14).

Based on the research findings, the researcher proposed that an overarching national policy framework should be developed to eradicate hunger (Box 4). This policy should include an integrated, consolidated and co-ordinated approach to ensure successful use of RWH for food security by HHs and should be based on essential elements identified and confirmed through the research, as being necessary to success. Monitoring and evaluation are included in the policy process (Patton and Sawicki, 1986:63)

Box 4:

Goal 2: Develop (by 2012) and implement a national policy framework including a policy on use of RWH to eradicate hunger and attain HH food security.

Targets:

2.1 Develop a national policy by 2012. The policy will address the main goals and targets indicated below.
2.2 Implement policy to progressively achieve policy goals and prioritized targets;
2.3 Determine resource, technical, economic and social feasibility at national, provincial, district, local and community level;
2.4 Establish institutional arrangements for implementation at national, provincial, local and community level;
2.5 Develop standards, guidelines and technical codes of practice;
2.6 Provide integrated and co-ordinated support that includes grants to construct infrastructure, provision of required equipment; transfer of knowledge and skills to HHs; seeds and other consumables; access to storage and micro-lending facilities, and access to markets;
2.7 Protect especially the interests of the rural poor and women;
2.8 Include monitoring, evaluation and reporting systems that would ensure implementation;
2.9 Progressively use RWH to eradication hunger and ensure food security of HHs according to prioritized targets.

The targets set to achieve Goal 2 (Box 4) are elaborated on in the next points.

5.1.2.3 Institutional arrangements

Brynard and De Coning (in Cloete, *et al*., 2007:194-203) developed the 5-C protocol (content, context, commitment, capacity, clients and coalitions) containing critical variables for policy implementation (section 2.1.3.3). All of these are crucial for the success of RWH in food security and most can be linked to institutional arrangements associated with implementation. Kerzner (1989:504-517) does not view institutional arrangements as such as being necessary to the success of projects, but variables identified for success are all associated with appropriate institutional arrangements.

Key informants interviewed indicated that there is little to no co-ordination between related activities taking place between different sections within and between government departments (Mohlabi, interview, 7 January 2009). Although the Integrated Relations Framework Act (2005) provides for the drafting and implementing of protocols to govern such relations and to ensure implementation of policies to achieve common goals, no evidence could be found during the research that such protocols have been drafted and signed.

Key informants also said that the limited co-ordination between related activities taking place at community level was frustrating and hampering progress (Anderson, interview, 10 December 2008; Anderson and Botha, interview, 17 December 2008).

Despite this shortcoming identified at national level, these inefficiencies were identified but had been overcome in the case that was studied and found to be successful. This had occurred through a consolidated effort of the researchers who had to fulfil all the roles not being played effectively and efficiently by government. They also initiated and assisted with the crucial establishment of the community and municipal-based interest groups and its sustained operations – also seen as necessary by the community involved (Resident 5, interview, 19 June 2009).

Key informants also mentioned the importance of well-functioning Co-ordinating Committees for Agricultural Water (CCWAs) (Anderson, interview, 10 December 2008; Anderson and Botha, interview, 17 December 2008; Gabriel, interview, 19 December 2008), establishing co-operatives for small scale farmers (Mohlabi, interview, 7 January 2009; Stimie, interview, 5 January 2009; Backeberg, interview, 19 December 2008), involvement of municipalities (Mehlomakulu and Vawda, interview, 9 January 2009) and planning through municipal Integrated Development Plans (De Lange, interview, 7 and 8 January 2009).

The next goal described (Goal 3) addresses the required institutional arrangements to successfully achieve HH food security through the use of RWH (Box 5).

Box 5:
Goal 3: Ensure institutional arrangements conducive to using RWH to attain HH food security.
Targets:
3.1 Establish leadership and managerial proficiency by 2013 at national, provincial and local government sphere to implement RWH for HH food security;
3.2 Establish institutions for co-ordination and integration of activities at regional, national, provincial, district and local level;
3.3 Reinforce relationships through developing and implementing protocols and organizational constitutions;
3.4 Ensure that institutions are sustainable;

5.1.2.4 Appropriate technology and its diffusion to communities

International (SARPN, 2005:9-21; SADC, 2006; IWMI, 2006; Qiang, *et al.*, 2007:187-190) and national literature (Nieuwoudt and Groenewald, 2003; HSRC, 2004:43; WRC, 2005, 2008a and b; Botha, *et al.*, 2007a) indicated the importance of research to develop appropriate technology and to promote its successful implementation through the transfer of skills. The WRC team has been able to assist HHs to successfully produce food but this could only be achieved through taking full responsibility for all technical and social aspects.

The technology should be simple to implement (De Lange, interview, 7 and 8 January 2009) without requiring expensive or complicated tools (Anderson, interview, 10 December 2008). The technology used for IRWH for HH food security as described in the case study (Figures 3, 5 and 6; section 4.3) is not new and has now been tested exhaustively and success if transferred is guaranteed (Anderson, interview, 10 December 2008; Mehlomakulu and Vawda, interview, 9 January 2009). The HHs participating in the case study project also described the IRWH technology as a "simple duplicable technique that everybody can handle" (Mdibe, 2007:71) and HHs indicated that they were able to duplicate the technique in their gardens (residents' interviews, 19 June 2009).

Transfer of knowledge to HHs should not be a single event (De Lange, interview, 7 and 8 January 2009; Anderson, interview, 10 December 2008). The ARC-ISCW's training of HHs in IRWH (case study) included training on all aspects of growing plants as well as peoples' nutritional requirements (Anderson, interview, 10 December 2008). Diffusion of technology was crucial and the researchers implemented Participatory Action Research (section 4.3.3.4c; Table 5). Various communication channels were used (section 4.3.3.4d) and included mass media (pamphlets, posters, a video and IRWH song and dance) communicated in Sotho, the language used by the HHs in Thaba 'Nchu. A group approach adopted included information distribution and farmers' days, exhibitions, demonstration through 3D models and demonstration plots, and hosting of pre-and post-harvest festivals. Formal training was also conducted through workshops and one-day courses. Residents interviewed during the case study referred to the extensive support that they received from the ARC-ISCW and one resident was of the opinion that they were trained on "everything" related to planting (Resident 3, interview, 19 June 2009). All residents indicated that the demonstration plots at Glen were a necessary part of the support.

Committees established were also supported and trained on relevant topics (section 4.3.3.4e). A social impact evaluation indicated that HHs accepted

and adopted the techniques transferred to them (Mdibe, 2007:71). The goal (Goal 4) and targets associated with this aspect are indicated in Box 6.

Box 6:
Goal 4: Develop, refine and test appropriate techniques and their transfer to users, for use of RWH to attain HH food security.
Targets: 4.1 Identify techniques being used worldwide to improve RWH and food gardening and that are conducive to implementation in the SA situation. Techniques (including associated infrastructure) should be simple, be cost-effective (provide value for money), provide visible and convincing benefits to users in the short term, be durable and require low Operation and Maintenance (O&M) efforts and costs; 4.2 Simplify (where necessary) these techniques and test implementation in SA communities; 4.3 Develop specifications for implementation of techniques; 4.4 Investigate multiple water use services (MUS) such as RWH for drinking, food gardens, livestock, small-scale farming; basin rehabilitation

5.1.2.5 Self-reliant communities using RWH for HH food security

Various international reports emphasized the importance of self-sufficiency in HH food security (SARPN, 2005:9; SADC, 2006:6; Qiang, *et al.*, 2007:187-190) while the WRS research documentation (WRC, 2005:117-162; Botha, *et al*., 2007a:vii) equally did research to ensure that this crucial aspect is addressed sufficiently in their projects.

Key informant interviewees also emphasized this aspect (Backeberg, interview, 19 December 2008; De Lange, interview, 7 and 8 January 2009; Anderson, interview, 10 December 2008) and the case study found that HHs indeed became self-reliant. For example, Resident 5 indicated that she "got educated and in the process is eating" (interview, 19 June 2009). A social impact assessment done by Mdike (2007:72) found that for effective adoption of the IRWH technique people had to believe that they could implement the techniques successfully and people also had to be convinced of the benefit

that adoption thereof would bring. The goal (Goal 5) associated with this aspect is indicated in Box 7.

Box 7:
Goal 5: Support communities to become self-reliant and take responsibility for using RWH for HH food security.
Targets:
5.1 Transfer skills and knowledge to enable HHs to become self- reliant in using RWH for food gardens by using appropriate communication channels and training methods;
5.2 Identify the HH head as well as the person who would be responsible for producing food;
5.3 Convince HHs of the benefits of techniques by using methods such as demonstration plots that are an excellent way of illustrating a technique and showing benefits;
5.4 Provide personal and intensive training and support to HHs when they start establishing their own gardens;
5.5 Instil self-confidence and pride by assisting communities to become reliant on their own ability to solve problems and succeed;
5.6 Provide training on nutrition and the importance of balanced meals for the young and adults;
5.7 Provide for ongoing access to personal support and advisory services

5.1.2.6 Increasing HH access to RWH techniques for food security

This last goal refers to the actual roll-out of a project or projects to increase HHs' access to RWH for food security. This is mainly related to the roll-out of the DWA grant on a larger scale.

It is important that the ARC-ISCW is extending training on their IRWH technique to other provinces (Anderson, interview, 10 December 2008; Anderson and Botha, Interview, 17 December 2008) but indicated that there is a need for provision of storage for harvested rainwater as that would carry HHs through the dry spells when there is no or insufficient rain (Anderson,

interview, 10 December 2008). Their process should thus be combined with the DWA process where appropriate.

Box 8:

Goal 6: Ensure access to and optimum use of harvested rainwater to eradicate hunger and attain HH food security.

Targets:

6.1 Identify and successfully transfer 200 RWH packages (tanks, equipment, consumables, skills and knowledge transfer) annually per province:

6.2 Secure funds and people with skills on project management, construction and transferring of food gardening;

6.3 Confirm areas where RWH can be successfully implemented from a resource (rainwater and land availability) and social perspective (communities with a high social cohesion);

6.4 Identify poor HHs that are practicing food gardening in selected areas;

6.5 Implement RWH grant;

6.6 Perform M&E to determine successful implementation

In this section six goals were identified for addressing the use of RWH successfully for HH food security, which ranged from the existence of an internationally overarching agreed goal of eradication of hunger, the development and implementation of a national policy framework to ensure that activities executed by different government departments and spheres are determined, co-ordinated and integrated, to transferring skills and knowledge to HHs in such a way that they can become self-reliant. Importantly all the goals identified aim to contribute to achieving the overarching goal to halve hunger by 2015.

The next section provides for the identification of indicators that would allow for the crucial monitoring and evaluation of progress to achieve the goals and targets discussed in this section.

5.2 IDENTIFICATION OF INDICATORS

This section describes the identified indicators associated with the goals and targets proposed in section 5.1. Note that the references stated when the goals and targets were developed will not be repeated here. The indicators related to input, output, outcome and impact (UNDP, 2002:6-10; UNDP, 2001:101; Prennushi, *et al.*, 2002:117) and are described in more detail in the table in Appendix D.

5.2.1 Input indicators

Indicators related to **input** to reach all of these goals and associated targets, referred to an increase in measurable unambiguous political will, the presence of skilled and experienced champions appointed to drive processes, increases in resources being made available and being used to effectively and efficiently achieve goals, and processes being put in place with targets that could progressively be achieved. Input indicators furthermore included development of specific and customized training programmes, actual skills transfer training being presented, commitments made, and participation by relevant government departments where required. It also referred to the number of research projects being conducted and the number of demonstration plots developed for skills transfer of new or adapted techniques.

5.2.2 Output indicators

Output indicators were linked to goals, targets and inputs and included the percentage progress, according to objectives set, for the development and implementation of an integrated and co-ordinated national policy. The output indicators reflect whether the different government departments and spheres make commitments and prioritise RWH for food security by setting aside resources to reach common goals. These would include the number of people being appropriately skilled through training on aspects such as

programme management, usage of RWH for food production and empowering of communities on these aspects. Research-related output indicators include the number of new or refined appropriate techniques identified and tested. Outputs related to the goal of HHs actually taking up RWH for food security included number of training sessions taking place and their attendees, number of people and communities taking up and maintaining use of RWH in food gardens, and also the increase in the sizes of their gardens (Saad, 1999:9).

Output indicators also refer to actual increases in funds allocated for RWH, number of people appointed as project managers, number of RWH tanks constructed and the associated training taking place.

5.2.3 Outcome indicators

Outcome indicators were similarly linked to goals and targets. The outcome indicators stated in the MDG goal refer to decreases in the prevalence of underweight children and the proportion of the population below the minimum level of dietary consumption (United Nations Millennium Declaration, 2000) (section 2.2.2). Other indicators refer to changes in perceptions and actual working together of different government departments and spheres, improvement in relations between officials to assist communities to attain food security, increased commitment from them and increased implementation of programmes. Others related more to leadership, management and institutional arrangements and to measurable changes in active support, guidance and enthusiasm in increasing food security and in this specific goal, through the establishment of suitable committees that can fast-track use of RWH to attain food security. Other indicators refer to drafting of and compliance with protocols that will formalize the relationship between government spheres. Others relate to the various products and services provided by the different government departments and spheres being provided in a co-ordinated and integrated manner.

Continued research and testing of techniques to improve use of RWH for food security are the subjects of goal 4. Outcome indicators related to these refer to the number of new techniques being taken up by HHs and increased crop yields being attained (Saad, 1999:9). This will also lead to an increase in number and nutritional value of meals consumed (Saad, 199:9), especially during the dry season.

Outcome indicators for communities being empowered to become self-reliant are similar to the previous, except that a specific outcome refers to an increase in capacity and skills of HHs.

Outcome indicators associated with actual implementation of RWH for food security programmes include an increase in the number of HH vegetable gardens, increase in crop yield (Saad, 1999:9) and an increase in number of HHs taking full responsibility for their RWH tank and food garden.

5.2.4 Impact indicators

Impact indicators relate to measurable improved nutritional status, health and quality of life of HHs (Mdibe, 2007:71). Other indicators relate to measurable changes in perceptions and actual working together of government departments and spheres in their integration of food security initiatives, increased levels of knowledge and acquired skills on use of RWH for food security, increased status, ability and self-reliance of HHs, and an increased HH income and ownership of fruit trees and livestock.

To contribute to achieving the MDG of halving hunger by 2015, the goals associated with the contribution of using RWH for HH food security (goals 2 to 6) should progressive be realised. Indicators associated with the input, output, outcome and impact required to attain these goals were identified and would assist in ensuring that the pathways set are followed, milestones are reached in a quantitative and qualitative manner as planned, and the ultimate goals reached.

CHAPTER SIX
CONCLUSIONS

6.1 INTRODUCTION

This research was initiated due to the large proportion of the South African population still being food insecure and poor, while RWH is an available technique that could be used to assist people in achieving their HH food needs. The country already has a well-developed agricultural sector but the skills, land and water are mostly associated with large commercial farms still mainly owned by white males. These inequalities are part of the legacy of apartheid. With the political changes instituted since the early 1990s, access to water and food has been included in the Bill of Rights of the SA Constitution, 1996. Major strides have been made in providing basic water services to the population, a programme with definite timelines has been developed and targets are being met. The right to access to food is, however, not being addressed in a similar manner.

Isolated projects of harvesting rainwater for HH food security are emerging and were until recently mainly associated with research done by the WRC and ARC. Large-scale roll-out as found in China is not yet evident in SA, despite the specific RWH circumstances being very similar in the two countries.

6.2 PURPOSE AND RESEARCH METHODOLOGY

The purpose of the research was to identify indicators (related to input, output, outcome and impact) that would be required in using RWH to increase success in agricultural HH food security. Objectives included determining the contributing aspects or variables that are required for success; determining their required contribution for success; and relating these to input, outputs,

outcomes and impacts. Variables were identified and served as secondary questions that guided the research.

The research started with establishing the theoretical framework and reviewing relevant literature. The theoretical framework determined what public policies are and their links to government departments, which policy models are relevant for this research, how public policies can be developed, and how the uptake of research done could be enhanced during the research project itself. It also looked at the theory associated with M&E and indicator development.

The approach used in the research was qualitative and thus subjective and interpretative in nature. The design consequently had to provide for triangulation to increase its validity. The research consisted of in-depth semi-structured interviews with twelve key informants (experts), and a case study. A case study was chosen as a research technique to investigate a particular real-life situation and to draft "thick descriptions" about it in order to gain contextualized insight on a specific phenomenon. The case considered an ARC / WRC initiative where HHs use the IRWH technique for food production (mainly vegetable production) in Thaba 'Nchu villages. The case study consisted of a document analysis, and qualitative interviews were held with four HHs during a visit to the area. As part of the document analysis of the case study, reports prepared as part of the WRC / ARC research were studied in more detail. The ARC researchers' opinions were obtained through the key informant qualitative interviews of experts. In all instances criteria were developed to inform the sampling that had to be done in the research.

Data analysis was done throughout the research process and consisted of elementary coding or notation, interpretation, grouping of data, categorization, drawing conclusions and eventually identifying indicators required for success in using RWH for HH food security. Validity and reliability were improved by using different research techniques, by using procedures consistently, preparing a comprehensive record and as far as possible compiling a

defensible trail between conclusions drawn and data on which they were based.

6.3 RESEARCH RESULTS AND DATA ANALYSIS

Through the research, six goals and their associated targets and indicators were developed. At the highest international level it refers to the MDG of eradicating poverty and hunger worldwide by 2015. The other goals mainly aim to contribute to successfully achieve this overarching objective through the use of RWH and refer to the different aspects identified through the research. These were the development of a national policy framework on the use of RWH to attain HH food security; establishing leadership, management and institutional arrangements conducive to using RWH to attain HH food security; development, refinement and testing of appropriate techniques and their transfer to users; specifically supporting communities to become self-reliant and take responsibility in using RWH for HH food security; and ensuring access to, and optimum use of, harvested rainwater to eradicate hunger and attain HH food security. Due to the close link between some of these goals they are combined in the conclusions described in the next sections.

6.4 CONCLUSIONS

The research reached the following conclusion on key aspects identified.

6.4.1 National policy framework; leadership, management and institutional arrangements

In SA the foundation legislation is in place and provides for rights of access to water and food. In some instances this has been further rolled out through, for instance, the Water Services and National Water Acts, and the development of extensive policy and guideline documents.

The literature and qualitative interviews confirmed that there is an IFSS but it is not being implemented through consolidated and integrated participation by the various government departments involved. Some of the interviewees indicated that this is one of the main obstacles why large-scale establishment of food gardens for HH food security is not happening.

The policy framework for ensuring HH food security is thus not well developed and a comprehensive and robust policy (statement of intent) that incorporates, consolidates and integrates input from different government departments and spheres as well as private initiatives is not available. Of importance, Kirsten and van Zyl (as referenced in Mdibe, 2007:74) indicated that overwhelming evidence is found of how various policies and government actions have reduced small-scale farming in SA to a state where it contributed very little to the economy as a whole and to the welfare and livelihoods of rural dwellers. The policy should thus be very clear on what the problem is and which goals should be reached to address the problem.

In some instances, government departments initiated activities to address HH food security. The DWA, for instance, established regulations to provide grants for installing RWH tanks and for providing extensive training and support to HHs to establish the associated food gardens. These are, however, still being tested and researched and large-scale implementation is not yet taking place. The grant comprises a 30 000-litre concrete underground tank, equipment and comprehensive 18-month training programme to establish food gardens.

The importance of developing an M&E system for the implementation of policies was evident from the literature and the composition of such systems is well-documented. The systems aim to determine relevance, efficiency, effectiveness, impact and sustainability of processes (UNDP, 2002:100). It thus has various benefits and basically determines whether goals set are met and whether these should be adjusted based on information gathered both on progress within the project, as well as on developments taking place in the social, political, economic and scientific environment. Such a system is thus

ideal to determine whether a process such as using RWH for HH food security is successful; and if not successful, such a system would be able to indicate exactly where processes went wrong and by which margins. Adjustment and adaptations could then be made in a timely manner.

6.4.2 Develop, refine and test appropriate techniques and their transfer to users

The WRC initiated various projects on RWH such as identifying indigenous practices in SA and developing training material for practices that could be successfully transferred. They also combined research with the ARC and tested the establishment of IRWH for HH food security in villages in Thaba 'Nchu. The researchers were aware of the difficulties associated with transfer of techniques to the disadvantaged and therefore included social science experts in their team. They researched this aspect carefully and ensured that HHs were empowered to take responsibility for their activities. These aspects were more extensively researched in the case study.

The document analysis performed as part of the case study found comprehensive studies on the establishment of IRWH for food gardens in Thaba 'Nchu villages. The ARC-ISCW researchers at Glen conducted research over a ten year period to perfect the technique. They initially established that the IRWH technique, as developed by them, improved crop yields by up to 50 per cent. The technique was also relatively simple and easily reproducible. The technique was initially transfer to 6 HHs in 4 communities (2001/2002) but this quickly expanded to about 1 000 HHs in 42 communities by 2004/2005, a number that is being maintained. The technique associated with the establishment of the gardens is well described.

Of relevance here, and linked to techniques available for using RWH for food security, experts also confirmed the importance of the availability of water and land during the qualitative interviews. Sufficient volumes of water to grow vegetables on a minimum area of about $20m^2$ are required for food security. Formulas are available to determine how much rainwater would be available

based on the rainfall and the area over which the water is harvested. Land tenure can be problematic in the old homelands areas, as this land can only be rented, albeit for long periods. In these areas, traditional leaders need to provide approval for land use but there are no known cases where this has been refused.

For transfer of skills associated with specific techniques, the ARC found in their IRWH projects that techniques should be demonstrated and hands-on assistance should be provided. Techniques should be communicated and demonstrated in a language and in visible media that people understand. For instance, a ten-step process was developed to illustrate the conversion of land into an effective IRWH system, with communication tools including appealing posters (one of which was drawn by a child of one of the villages) and illustrations, videos and models.

To ensure that the skills are transferred successfully, the research team implemented participatory action research – a well-established method to transfer skills in developing countries. Aspects of the research included, amongst other things, capacitating HHs to become self-reliant and able to transform their own situations. These aspects, as well as the others associated with this research approach, were consciously and specifically included in the research. Communication channels provided for mass and group communication. The ARC also included extension officers of the Department of Agriculture, but their involvement was not a success. The ARC mainly had to rely on their own technicians to assist the communities.

An important aspect of the skills transfer was to assist communities to establish community-based and municipal-based water harvesting interest groups. The ARC conducted training for the groups' members on communications skills, conflict resolution, role and functions of the committees, markets and marketing, value adding and the importance of record-keeping. These committees assisted communities to share their day-to-day challenges and find common solutions, and to also provide a platform for consolidated bargaining power. These groups are still functional but

different people interviewed had different views of its success. In general, people expressed the view that it was still functioning well.

Research conducted by the ARC / University of the Free State team on the outcome and social impact of the skills transfer found that certain motivators enhanced skills uptake. These included excitement created, support by the community leadership, good communication, good crop yields, and festivals. They also determined demotivators such as project overload and drought.

In the above research, HHs indicated that the festivals that served as a communication channel and motivator for them was the most successful communication channel. This was probably because different activities formed part of the festivals. These included demonstration plots, farmer-to-farmer training, focus group discussions, a workshop and other training. Different HHs were visited during these festivals and farmers could showcase their produce.

The impact associated with implementing the IRWH technique was determined by the ARC team through a survey. HHs were of the opinion that they produced much more food by implementing the technique, and they also improved their income and economic status, their understanding and use of natural resources, and their health. It also improved HHs' self-confidence and they had better hope for the future.

The ARC officials indicated that access to markets becomes a limiting factor to successfully establishing food gardens, as the markets to sell produce become saturated as more HHs master the techniques. HHs will need to be assisted to access additional markets. It would also progressively become important to provide storage facilities and to add value by preserving food through various techniques.

The implementation of the DWA's food security grant similarly includes the provision of training and mentoring over an 18-month period to ensure sustainability and successful transfer of skills.

Importantly, the successful roll-out of the use of RWH for HH food security and economic growth in China (as found in the literature review) required that extensive scientific and social research preceded these practices and continued to be a major aspect of the process. The elements identified for its success are very similar to those identified in the SA situation.

6.4.3 Empowerment of HHs in use of RWH for food security

This aspect has been described in the previous section but general aspects determined during the qualitative interviews (both key informant expert interviews and interviews with residents in Thaba 'Nchu held during the case study) are communicated here.

It was clear from the beginning — as confirmed in the literature review — that the process of transferring skills to the poor in order to support them to become empowered in securing their food supply would be very difficult. What would make these processes even more difficult is the fact that the poor in South Africa have been seriously disadvantaged over decades. There is thus no quick and easy way to achieve HH food security. Success stories are, however, available and the purpose of the research was to study these to determine what is required for success. If these are known it could assist in successfully establishing the practice in South Africa.

A crucial point made by interviewees during the qualitative interviews was that dependencies should not be encouraged or created when transferring skills for using RWH for food security. HHs should be empowered to gain the necessary confidence in order to take full responsibility for the DWA grant provided. An important point made in the allocation of the grant is thus also that HHs that received the grants should already be involved in establishing their own food gardens.

The empowerment of HHs has been found to require a variety of communication and training tools. The ARC team indicated that they entered

communities only after obtaining approval and buy-in of the leadership in the village. They also used demonstration plots, personal services and festivals, to name but a few. The festivals served the purpose of sharing information, farmer-to-farmer training, learning from demonstration plots and showcasing products.

It is, however, important to also indicate the views of residents on their empowerment during the ARC/WRC IRWH project as elicited during the case study. The area was visited in December 2008 after a dry spell and the plight of the HHs was evident. One person did not have drinking water (the provision of the service by the provider was intermittent), while another had not planted due to lack of rainfall. On the other hand, one HH had already harvested his produce. During the next visit in June 2009 the mood of HHs was much more positive. Planting basins had been prepared and DWA was in the preparatory phase for installing RWH tanks that could provide rainwater to assist communities through drier times. People indicated that mainly ARC officials assisted them and they appreciated the personal visits. They thought the use of demonstration plots was crucial for transferring the skills to them. They had no doubt that the *matangwana* (their term used for the IRWH) improved their lives, gave them hope and educated them. One resident said that “we got educated while eating”. The HHs also produced a large variety of vegetables and indicated that they could plant whatever was possible under the circumstances. Their income situation improved and they were able to acquire more livestock. One of the persons also added value to her produce by preserving it in various ways.

The successful empowerment of HHs and the elements required have been well researched and are evident from the detailed information provided in this research report. Despite difficulties still being experienced by HHs, they were able to use the skills acquired to contribute to their own food security.

6.4.4 Development of indicators

As indicated, based on the information collected during this research project, six goals were identified that should be achieved for using RWH to successfully improve HH food security. Targets and associated indicators were subsequently developed. The goals ranged from an internationally agreed goal to halve the number of people suffering from hunger by 2015, and at a national level, for the development and implementation of a South African national policy that will ensure, amongst other targets, that integration, co-ordination and co-operation between government departments and between spheres of government would take place. This is crucial, as different departments and different spheres have distinct mandates regarding HH food security and need to work together to achieve this common goal. This essential component required for success can be addressed formally and legally through signing of agreements between the various partners in accordance with the Intergovernmental Relations Framework Act.

The other goals cannot be divorced from the above and relate to leadership, management and the necessary institutional arrangements; continued development, refinement and testing of RWH techniques for HH food security; the specific roll-out of the DWA grant package for HH food security; and lastly and probably most importantly, supporting of communities to become self-reliant and taking responsibility in using RWH for their food security.

Indicators for input, output, outcome and impact were linked to these goals. Inputs required to achieve the goals and targets are mostly associated with political will; leadership; participation by people with managerial, technical and social skills and experience; appropriate training programmes being developed and presented; resources being committed and processes being recognized and included in strategic and annual plans. This should happen at all government departments and spheres and in accordance with a national co-ordinated and integrated programme. Input indicators would refer to increases in political will as measured through number and content of

statements made and programmes started; increases in numbers of skilled and experienced people being appointed; number of government departments and municipalities participating; number of appropriate training programmes being developed and number of training occasions taking place; and increases in budgets being made available.

Outputs are described and would refer to, and would include, policies and programmes developed by different departments and municipalities; functional committees established; guidelines developed; protocols developed to formalize relations between spheres, departments and municipalities; and RWH techniques refined or new ones developed. It would also include RWH activities taken up by communities. The indicators associated with the above and the other outputs specified are indicated in the table in Appendix D. Indicators mostly refer to increases in numbers and percentages of the above.

Outcomes referred to co-ordinated and integrated RWH for HH food security activities taking place and being experienced by participants, co-ordinated support provided by different departments and spheres, adaptations made to processes based on implementation of an M&E&R system, grants being rolled out, women being involved, compliance with protocols drafted, crop storage facilities established, crop processing facilities developed, RWH for food security activities taking place, a diversity of crops being produced, people having food to eat, HHs having the skills required, and HHs taking ownership and responsibility for activities. Indicators related to percentage increase, increase in number, increase in perceptions or increase in quality of the above factors.

Impacts and the impact indicators describe the combined longer term changes on people's lives as a consequence of different outcomes of projects or programmes. In this specific case it would refer to improved nutritional status, health and quality of life of HHs involved in RWH food security activities. It should also refer to increases in income and ownership of livestock of HHs, an increased ability of HHs to execute activities, an

increased perception and actual level of self-reliance of HHs, and importantly, an increase in number of HHs leading fulfilled lives and having hope for the future. Impact indicators would also include measurable improvements in intergovernmental relations, and integration and co-ordination taking place on a day-to-day basis over large areas in SA.

6.4.5 Conclusion

The research identified indicators required to use RWH for successful HH food security. The indicators are specified for input, output, outcome and impact and relate to achieving goals such as the development and implementation of a national policy framework that provides for consolidated and integrated achievement of targets set by different spheres and departments of government and importantly, to empower HHs to sustainably implement RWH for food security. The participatory achievement of the goals and their progressive realization through monitoring and evaluating of the indicators identified would result in widespread use of RWH to successfully improve HH food security in South Africa.

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APPENDICES

APPENDIX A: QUALITATIVE INTERVIEW QUESTIONNAIRE

1. **In your opinion, which variables are essential to ensure success of rain water harvesting for household food security?**

2. **Please provide your view on the variables indicated in the table below for using water for household food security.**
3. **Please provide proposed weights on the variables indicated below as well as the ones added during the discussion.**

VARIABLE FOR SUCCESS	PROPOSED WEIGHT
1. Policy and legislative framework: development	
1.1 Is the problem of household food insecurity acknowledged at senior government level and are there political and government leadership and support?	
1.2 Is a policy and legislative framework in place?	
1.3 Has an implementation action plan been developed?	
1.4 Is the plan being implemented?	
1.5 Has guiding and supporting detail such as guidelines and manuals been developed?	
2. Policy and legislative framework: implementation	
2.1 Have the roles and responsibilities of different government departments and other role players clearly been identified in the implementation plan?	
2.2 Has provision been made to ensure co-operation between different government departments?	
2.3 Are resource (human and financial) requirements specified in the implementation plan and available?	
2.4 Have realistic goals been set?	
2.5 Have provision been made for streamlining processes and limiting bureaucratic and excessive administrative processes?	
2.6 Are all of the above aware of what is necessary to achieve success?	
2.7 Are “spin-offs” that may result from projects identified and emphasised?	
2.8 Does the plan include the development of a monitoring and evaluation (M&E) system?	

VARIABLE FOR SUCCESS	PROPOSED WEIGHT
3. Institutional arrangements	
3.1 Are farmers encouraged to form suitable social structures such as co-ops or water user associations?	
3.2 Are there supportive local and or tribal authorities?	
3.3 Is there land tenure security?	
3.4 Is there an active water user association or other legal entity?	
4. Natural resources, climate and production potential	
4.1 Is there sufficient and reliable rainwater?	
4.2 Is the soil quality suitable for agricultural activity?	
4.3 Is there sufficient land available to ensure household food security?	
4.4 Is provision made for crop diversity?	
4.5 Is the temperature range suitable for the types of crop to be produced?	
5. Infrastructure and technology	
5.1 Is sufficient water storage facilities available for rainwater harvesting?	
5.2 Is the distribution system developed?	
5.3 Is the required equipment available?	
5.4 Are household water services being supplied?	
Specify:	

VARIABLE FOR SUCCESS	PROPOSED WEIGHT

6. Financing and financial services

6.1 Are loans available?

6.2 Are credit and savings facilities available and accessible?

6.3 Are repayment requirements explained?

6.4 Are government grants & subsidies available?

Specify:

7. Capacity building, training and support services

7.1 Are government extension services and training available, easily accessible and well developed?

7.2 Are the support and training based on needs expressed by the community?

7.3 On which subjects are training and support provided?

- Food production?
- Appropriate technology?
- Literacy?
- Basics on marketing?
- Other?

7.4 How should training take place?

- Theory sessions?
- Practical sessions?
- Help line?
- Demonstration plots?

7.5 Is government funded research on rainwater harvesting for household food security taking place?

VARIABLE FOR SUCCESS		PROPOSED WEIGHT
7.6	Are cooperative services and depots available?	
7.7	Are repair and maintenance services available?	
7.8	Are study groups formed?	
7.9	Are farmers encouraged to assist each other?	
7.10	Do participating households have access to appropriate information?	
7.11	Has success been made visible?	
7.12	Is assistance provided in conflict resolution?	
7.13	Is protection provided from political infighting?	
7.14	Are facts carefully weighed and pros and cons explained?	
7.15	Are available publicity media used?	
7.16	Do communities have access to clinics and schools?	

8.	**Market potential and economic location**
8.1	Are markets available for sale of surplus produce?
8.2	Are quality requirements of markets specified and known by the communities?
8.3	Are communities aware of price levels and trends?
8.4	Are communities aware of the importance of harvest timing?
8.5	Are communities aware of expected market changes?

Additional notes on the above questions:

APPENDIX B: CASE STUDY QUALITATIVE INTERVIEW

QUESTIONNAIRE

NAME: **Affiliation:**

1. **Support received during process**:
Who assisted and supported you to establish the matangwana (In-field rainwater harvesting) in your village?
How were you supported?

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a. Tribal chief?

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b. ARC Institute for Soil, Climate and Water at Glen?
Who in ARC? Managers? Technicians?

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c. Provincial Department of Agriculture?
Who in DoA? Food security officials? Extension officer?

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d. Municipality?
Who in municipality?

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e. Community leaders?

---

f. Others? Who?

---

2. Were you supported through demonstration of activity at plots? Was this successful? Can it be improved?

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3. Are households in general encouraged to help each other? Is this happening? How? Does it help?

---

4. Were you encouraged to work in groups? Did this happen? Did it work well?

---

5. How well are the Community based water harvesting interest groups (CB: WHIG) and Municipal based WHIG working? Who is part of groups? What are the groups doing? (minimize mistakes in construction and planting; discussing common challenges; assist each other, exchange knowledge of technologies, provide mouth piece to community, discussion of complementary food security/livelihoods improvement projects).
   Is it necessary? Is it working? What is not working? How can it be improved?

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6. What means of communication are used in the process?
   (Festivals, radio, newsletters, models, video).

Which ones worked best for you? Any ideas what other means could be used to improve communication between households and with the people supporting you?

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7. What helped you best to do matangwana?

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8. Community: Are other people in the community jealous of what you are doing? Is there a lot of conflict between the members of the community? How do you resolve it? If a wife is involved in matanyana, does the husband support her?

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9. What are you gaining in doing matangwana?

Did your food security improve?
Is your health better?
Do you have extra money?
Were you taught to make your own decisions?
Is the process good for you as a person? Do you feel better about yourself and your future? Do you feel that you can achieve something?

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10. What are the best things that came with the matangwama?

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11. Did bad things come too? What are those? What can be done about them?

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12. Would you want to go back to the time before you learnt about matanyana?

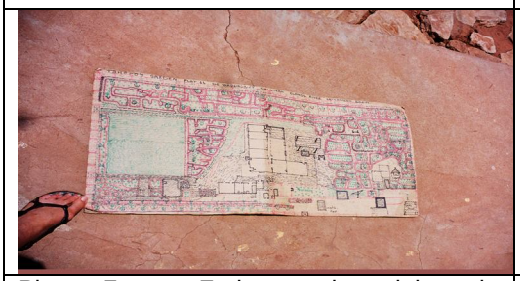
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13. Produce and markets
What do you produce?
Can you produce what you want to produce?
Do you produce more than what you can use? What do you do with the excess? Can you freeze some of the products? Store it in some way or another? Make jam, dry products, or other? Are there markets around that you can use?
What transport do you use?

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14. Does the candle lighting mean something to you?

APPENDIX C: PICTURES TAKEN DURING THE CASE STUDY

Picture 1: Prepared IRWH basins in a Thaba 'Nchu village (winter)	Picture 2: More prepared IRWH basins in a Thaba 'Nchu village (winter)
	
Picture 3: Some growth of crops during the winter months in a Thaba 'Nchu village	Picture 4: House being built by a household with money earned through selling excess crops produces through IRWH
	
Picture 5: Plan developed by Ms MaThepo Khumalo as part of her IRWH activities (Cullinan)	Picture 6: Crops grown through IRWH in a village in Thaba 'Nchu despite dry spells during the planting period. In the background is a food tunnel provided by a mining company
	
Picture 7: Fruit trees planted through IRWH	Picture 8: Crops and trees maintained through RWH (Cullinan)
	

APPENDIX D: GOALS, TARGETS AND INDICATORS

Table:

GOAL 1.	**Eradicate extreme poverty and hunger (MDG 1)**		
TARGETS:			
1.1 Halve between 1990 and 2015, the proportion of people who suffer from hunger (Target 2)			
INDICATORS			
INPUT	**OUTPUT**	**OUTCOME**	**IMPACT**
• Percentage increased political will on all levels; • Number of skilled and experienced champions and officials appointed at all government levels; • Percentage increase in other resources and funds; • Measurable increase in commitment from different departments and spheres; • Measurable increase in consultation and participation	• Percentage progress according to time frames in drafting and implementing national plan through consultation containing prioritised actions, resources required, time frames (see more information in Goal 2)	• Prevalence of underweight children (under five years); • Proportion of population below minimum level of dietary consumption	• Measurable improved nutritional status, health and quality of life

Source: Ligthelm, 2010

GOAL 2.	**Develop and implement national policy on use of RWH to eradicate hunger and attain HH food security**
TARGET:	
2.1	Develop national policy by 2012. Policy includes the following aspects and provides for achievement of national targets (developed in line with international and regional targets). The policy addresses all aspects of the food system, i.e. supply, distribution and consumption:
2.1.1	Implementation to progressively implement policy with prioritized targets;

2.1.2 Determination of resource, technical, economic and social feasibility at national, provincial, district, local and community level;

2.1.3 Establishment of institutional arrangements for implementation at national, provincial, local and community level

2.1.4 Development of standards, guidelines and technical codes of practice;

2.1.5 Provision of integrated and coordinated support that include grants to construct infrastructure, provision of required equipment; transfer of knowledge and skills to HHs; seeds and other consumables; access to storage and micro-lending facilities, and access to markets;

2.1.6 Protection of especially the interest of the rural poor and women;

2.1.7 Include monitoring, evaluation and reporting system that would ensure implementation;

2.1.8 Progressive use of RWH to eradication hunger and ensure food security of HHs according to prioritized targets;

INDICATORS			
INPUT	**OUTPUT**	**OUTCOME**	**IMPACT**
• See detail in Goal 1 inputs; • Increased participation, commitment and contribution made by relevant government spheres	• Percentage progress in development of quality policy (for detail on criteria to determine quality of science in policy see Hovland, 2007:21), including implementation strategy • Percentage involvement of required government sphere representatives and other stakeholders • Number of provincial and local areas identified where RWH can be implemented	• Percentage increase in coordinated and integrated RWH for food security initiatives • Measurable improvement in contributions made by various spheres • Increase in integration of support included and experienced on all levels • Number of initiatives agreed on and implemented by committees established • Increase in support to communities provided by different spheres	• Percentage increase in number of food secure HHs in SA • Percentage increase in poverty alleviation due to use of RWH for food security • Measurable change in perceptions and actual working together and integration of food security policy development

	efficiently and effectively • Number of functional committees at national, provincial and local sphere • Number of guidelines, standards and codes of practice developed • Number of support activities that are integrated • Practical M&E&R system developed • Number of integrated and coordinated RWH practices taking place	of government in an integrated and coordinated manner • Number of changes and adaptations made based on implementation of M&E&R system • Increase in DWA grants being progressively rolled out to communities and HHs • Percentage involvement of women	and implementation • Measurable improvement in perceptions on and actual relations between officials

Source: Ligthelm, 2010

GOAL 3.	**Ensure leadership, management and institutional arrangements conducive to using RWH to attain HH food security**		
TARGETS: 3.1 Establish leadership and managerial proficiency by 2013 at national, provincial and local government sphere to implement RWH for HH food security; 3.2 Establish institutions for coordination and integration of activities at regional, national, provincial, district and local level; 3.3 Reinforce relationships through developing and implementing protocols and organizational constitutions; 3.4 Ensure institutions are sustainable			
INDICATORS			
INPUT	**OUTPUT**	**OUTCOME**	**IMPACT**
• See inputs of goals 1 and	• Number of people	• Measurable change in active support, guidance,	• Percentage decrease in

2; • Number of training curricula developed and presented on policy development, programme management; empowering communities and transfer of skills; RWH techniques; growing vegetables	appointed in government spheres with necessary skills and experience; • Implementation plans developed in all provinces • Number of functional coordinating committees at all spheres • Number of protocols (in terms of the Intergovernmental Relations Framework Act) developed and being implemented	enthusiasm and facilitation by leadership and management, for using RWH for food security through provision of resources and continued involvement; • Measurable improvement in leading and organizing to establish committees at all levels for RWH • Percentage compliance to protocols drafted in terms of the Intergovernmental Relations Framework Act • Percentage increase in coordinated and integrated RWH activities in all provinces • Percentage increase in respective officials fulfilling their roles • Percentage increase in RWH food security associated activities such as establishment of storage facilities and assistance in access to market	duplication of efforts and resources to implement RWH • Percentage increase in HHs adopting RWH • Percentage increase in HH food security • Percentage increase in HH income due to RWH and associated activities

Source: Ligthelm, 2010

GOAL 4.	**Develop, refine and test appropriate techniques and their transfer to users, for use of RWH to attain HH food security**
TARGETS:	
4.1	Identify techniques being used worldwide to improve RWH and food gardening and that are conducive to implementation in the SA situation. Techniques (including associative infrastructure) should be simple, be cost effective (provide value for money), provide visibly and convincing benefits to users in the short term, be durable and require low O&M efforts and costs;

4.2 Simplify (where necessary) these techniques and test implementation in SA communities;

4.3 Develop specifications for implementation of techniques;

4.4 Investigate multiple water use services (MUS) such as RWH for drinking, food gardens, livestock, small-scale farming; basin rehabilitation

INDICATORS			
INPUT	**OUTPUT**	**OUTCOME**	**IMPACT**
• See inputs under goals 1, 2 and 3; • Number of research projects identified and continuing; • Number of techniques being tested; • Number of specifications being developed; • Curricula developed and number of training occasions taking place on efficient water use and soil conservation.	• Simple, cost-effective, effective and efficient techniques identified and tested • Specifications for new techniques and practices developed • Cost effective and efficient options to provide multiple water use services	• Number of new techniques taken up by HHs • Number of techniques adapted to increase efficient water use for food production, and taken up by community • Increasing number of people implementing technique • Increased crop yields by using new or refined techniques • Number of meals consumed per day during dry season	• Percentage improvement in crop yields and diversity of HH food production • Percentage improvement in food security • Percentage improvement in food and nutritional status of present poor HH • Percentage increase in HH income status • Increased perceptions of HHs on higher levels of education and empowerment

Source: Ligthelm, 2010

GOAL 5.	**Support communities to become self-reliant and take responsibility in using RWH for HH food security**
TARGET:	
5.1	Transfer skills and knowledge to enable HHs to become self- reliant in using

RWH for food gardens by using appropriate communication channels and training methods:

5.1.1 Identify the HH head as well as person who would be responsible for producing food;

5.1.2 Convince HHs of the benefits of techniques by using methods such as demonstration plots that are an excellent way of illustrating a technique and showing benefits;

5.1.3 Provide personal and intensive training and support to HHs when they start establishing their own gardens;

5.1.4 Instill self-confidence and pride by assisting communities to become reliant on their own ability to solve problems and succeed

5.1.5 Provide training on nutrition and the importance of balanced meals for the young and adults;

5.1.6 Provide for ongoing access to personal support and advisory services.

INDICATORS

INPUT	OUTPUT	OUTCOME	IMPACT
• See inputs developed on Goal 1, 2, 3 and 4 • Number of appropriate training sessions available – formal and on-the-job training • Number of demonstration plots developed and used on continued basis • Number of certified training sessions as well as appropriate material provided • Increase in number of festivals held	• Number of training sessions • Number of attendees • Number of demonstration plots and number of gardening aspects demonstrated • Number of people taking up RWH for HH food security • Number of communities taking up food gardening • Number of HH food gardens constructed • Number of HH food gardens	• Increase in food production by HHs and communities • Increase in diversity in crop production • Increase in number of cropping seasons • Increase in capacity and skills	• Increased ability by HHs to use natural resources • Percentage increase in dietary diversity and nutritional status of people • Increased ability of HHs to adapt technique to different situations experienced • Percentage increase in HH income from crop sales • Percentage increase in knowledge of HHs on food production and nutrition • Increase in fulfilled lives • Increase in status of

• Increase in willingness and commitment by communities to participate • Number of seed multiplication schemes established	maintained • Size increase of HH food gardens		participating HHs within community • Increase in perceptions of HH on ability and self worth • Increased hope for the future by HHs

Source: Ligthelm, 2010

GOAL 6.Ensure access to and optimum use of harvested rainwater to eradicate hunger and attain HH food security			
TARGET: 6.1 Identify and successfully transfer 200 RWH packages (tanks, equipment, consumables, skills and knowledge transfer) annually per province: 6.1.1 Secure funds and people with project management, construction and transferring of food gardening skills; 6.1.2 Confirm areas where RWH can be successfully implemented from a resource (rainwater and land availability) and social perspective (communities with a high social cohesion); 6.1.3 Identify poor HHs that are practicing food gardening in selected areas; 6.1.4 Implement RWH grant; 6.1.5 Perform M&E to determine successful implementation			
INDICATORS			
INPUT	**OUTPUT**	**OUTCOME**	**IMPACT**
• See input under goals 1 - 5	• Percentage increase in funds allocated for RWH • Number of people appointed and performing as project managers • Number of HHs identified per	• Number of HH vegetable gardens established • Percentage increase in crop diversity • Number of HHs taking full ownership and responsibility for RWH tank and	• Increase in volume and value of selected crops • Percentage increase in nutritious meals of HHs • Percentage increase in number of children and adults with normal weight • Percentage increase in income of HHs due to selling of excess produce

	province • Number of RWH tanks constructed	food gardens	• Increase in HH ownership of fruit trees, livestock • Increase in garden size

Source: Ligthelm, 2010