

**WRC PROJECT No K5/1563: WRM IN RAINWATER
HARVESTING: AN INTEGRATED SYSTEMS APPROACH**

PROGRESS REPORT No 02

PREPARED BY



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1. INTRODUCTION

This second progress report is on work done since October 2005 months of a Water Research Commission (WRC) funded 3 year research project with title 'Water Resources Management in Rainwater Harvesting: An Integrated Systems Approach'. The project falls under the Key Strategic Area (KSA) 'Water Resources Management' and the Thrust 'Policy Development and Institutional Arrangements'. The project started in April 2005 and is scheduled to end in March 2008. The report is prepared for the second meeting of the Reference Group planned for 09 June 2006. The first meeting of the Reference Group took place on 4 November 2005.

The project aims to ensure that Rainwater Harvesting (RWH) is an integral part of the alternative solutions to reconciling water demand and supply while understanding the associated potential impacts and providing a policy framework for its broad scale adoption from a water resources management perspective. It also aims to guide the wide scale adoption of RWH in South Africa through the development of a Decision Support System.

The objective of the project is to be achieved through academic research supported by limited field work and inputs from professionals with hands on experience in various aspects of the project.

It is undertaken by a Consortium of professionals under the umbrella of Source Strategic Focus (Pty) Ltd with the collaboration of the School of Civil and Environmental Engineering of Wits University; AWARD, a NGO involved in water supply for rural communities and the Institute for Soil and Conservation of Water of the Agriculture Research Council (ARC- ISCW).

From the schedule of outputs (Appendix A), the last deliverables for Year 1, as relevant to this progress report, are:

- The draft report on Preliminary Fieldwork and data collection
- The International Paper ' A synthesis of RWH Practices in South Africa'
- Preliminary Conceptual Model for Water Resources Management related to RWH
- Preliminary Conceptual Model for Water System Analysis related to RWH
- Recommendations on a policy on RWH

This progress report discusses the background to the project (Section 2), its Objectives and Methodology (Section 3), progress against deliverables (Section 4), collaboration with other institutions (Section 5) and a work plan (Section 6).

Appendix A lists all the project deliverables while Appendix 2 presents in greater detail (in support of Section 5), the collaboration with other institutions.

2. BACKGROUND

South Africa is a water scarce country. The challenges associated with the development needs of the country call for an integrated approach in the management of our water

resources. The National Water Act (Act 36 of 1998) endeavours to achieve this, but does not mention rainwater harvesting (RWH). This has resulted in a limited understanding of how to guide and regulate this practice. At the same time, the potential of rainwater harvesting has not been fully explored in South Africa and yet it holds the opportunity to contribute to the equitable, efficient and sustainable use of water resources. Those who stand to benefit are the rural poor mainly for increased food security but also for domestic water supply to households. The potential that RWH offers for the productive use of water (beyond the Basic Human Needs provided for in the National Water Act) need to be explored. While still considered as an unconventional source of water, it could be an alternative to dam construction or other sources of water supply. The benefits that RWH offer need therefore to be explored and weighed against the disadvantages from the perspectives of social equity, economic efficiency and ecosystem sustainability.

As RWH is being more and more promoted beyond household scale and gaining in acceptance, several associated impacts require a better understanding. These include the effects of up-scaling, the sustainability of the practice and its socio economic benefits, the implications on flow regimes, the ecological and environmental impacts and the legislative tools. The increased application of RWH is likely to have significant effects on the catchment hydrology, ecology, geomorphology, spatial and temporal dynamics of flows, groundwater recharge and the catchment yields. These need to be well understood.

Thus, a system approach is required to improve the understanding of these effects in an integrated manner. Given practices of RWH in other parts of the world such as in Brazil and the emerging attention that RWH is receiving in South Africa a scanning of the state of the art in RWH needs to be undertaken through appropriate literature review in order to assess what best practices are suitable to the South African context. This has been somehow undertaken during the first year of the project. While the project is unfolding, RWH seems set to receive more and more attention as emerging developments gradually raises its profile. As an illustration, the Minister of Water Affairs and Forestry, Ms Buyelwa Sonjica has expressed strong interest in the potential of RWH attending RWH festival with communities; a subsidy has been established to provide RWH tanks to qualifying households and recently RWH has been considered as an alternative source of water in the guideline under development for the provision of water for small scale Multiple Use Systems (MUS) (DWAF, 2006)

Building on current practices in South Africa and considering this increasing interest, there is a need to develop a methodology to quantify scientifically the impacts of RWH in order to better take them into consideration when planning for water resources as either stand alone methods or by integrating them into current water resources management tools. And while the opportunities for RWH might not be the same countrywide, an indication of where such opportunities offer maximum benefits is required. This would be done through a DSS which would at the same time serve as a guide to support the relevant policy recommendations that need to be formulated. In most countries, there is no framework for inclusion of RWH in National Water Legislation. Sub-Saharan Africa and South Africa in particular are not an exception to this. There is a need to fill this policy gap as the practice of RWH is set to be disseminated at a larger scale.

In undertaking research on RWH, it is important that capacity is built as an investment in the future of the country. The project seeks to achieve this in a mix of an academic

environment, NGO and professional practitioners. It is also supported with limited field work, but building on on-going RWH initiatives in the country and elsewhere. The project therefore has a full time PhD student registered at the School of Civil and Environmental Engineering at Wits University since its inception. Two Master's students have also just registered one at the same university and the other at the University of KwaZulu Natal. The PhD research will cover all aspects of RWH in an endeavour to provide ways of incorporation into a broader IWRM framework while giving specific attention to the issue of up-scaling of RWH and the development of the DSS. One Master's research will focus on the hydrological modelling aspects whereas the second Master's research will deal with socio economic and policy related issues. Both Master's are related to RWH.

The project is pursuing the opportunity to establish synergies with other on-going initiatives such as the Smallholder System innovations (SSI) project in Tanzania and South Africa (Unesco- IHE, 2002) Initial contacts took place during the second half of 2005 with discussions on using field data being collected by the SSI project. Recently, discussions on the collaboration on the socio economic aspects have also taken place, with the Master's student in socio-economic registering at the University of KwaZulu Natal where the SSI project is based and working under the supervision of a SSI team member.

3. OBJECTIVES AND METHODOLOGY

3.1. Objectives

The objectives of the project as in the Terms of Reference (TORs) are

Objective 1: Investigate and report on findings from research and results of previous and current rainwater harvesting practices for the purposes of devising integrated systems in RWH

Objective 2: Develop an understanding of RWH implications in the light of increasing acceptance/adoption of harvesting practices

Objective 3: Implement minimal field-based research to address knowledge gaps concerning catchment-scale interactions and effects associated with RWH practices.

Objective 4: Develop methodologies to quantify socio-economic, hydrological, ecological and environmental impacts and refine these methods for packaging as standalone applications or for incorporation into existing water resources management and water systems analysis models

Objective 5: Build a Decision Support System which incorporates insight from RWH practices and data, information, understanding and methodologies developed in (2) and (3), as well as abilities to scenario building based on a GIS of South Africa. The DSS is expected to guide and facilitate sustainable implementation of RWH.

Objective 6: Develop a draft policy document to guide small to large scale RWH practices within the provisions of Integrated Water Resources Management as

expressed in the NWA, and to ensure that practices comply with other related policies and Acts (e.g. Environmental Conservation Act).

3.2. Methodology

The methodology being followed is described below.

1. Since the inception of the project, research work is being carried out by a full time PhD student, Mr JM Mwenge Kahinda. He holds a Masters in rainwater harvesting completed in 2003/04 through the SADC WaterNet Programme at the University of Zimbabwe. He is registered at the School of Civil and Environmental Engineering of Wits University. He builds on the work that he has done during his Master's research; the project is thus benefiting from the momentum that he has gained during his Master's work. The focus is now on assessing what is relevant to the South African context. The PhD researcher is the lead author of most of the outputs produced by the project. He is supervised by Prof Taigbenu and the Project Leader in view of integration in an IWRM context.
2. The work focuses on the South Africa context in a comparative approach with practices elsewhere to establish where South Africa is in relation to the opportunities especially for productive use of water through RWH and in identifying barriers such as a potential loss of income to local authorities who might prefer conventional approaches to domestic water supply which are income generating and any other barrier and ways to overcome these through experience from elsewhere.
3. The project enjoys the support of a team of professionals in institutional, socio-economic, hydrological, ecological and environmental aspects. The combined expertise of the team includes hydrological modelling, ecological reserve determination, water system analysis and yield modelling and GIS development. AWARD will specifically provide input into socio economic impacts on rural communities and has provided the M Sc researcher who will investigate the socio economic aspects of RWH.
4. Specific expertise on rainwater harvesting techniques in South Africa as undertaken by the ARC and in field experience with AWARD with communities have been assessed to provide a first level of data that can be tested in the DSS to be developed and to guide the socio economic and policy component of the project.
5. The development of the DSS will be based on the WR2005 as well as information available from the Community Water Supply and Sanitation GIS database that was developed by DWAF. A team member has an intimate knowledge of both and the support provided by Dr W Pitman, the author of the Pitman model is aimed at ensuring that a robust and technically sound and consistent DSS is developed. It will be tested using the information from field work above mentioned in 4 to assess whether the sites and approaches used were suitable. Ultimately, the DSS will be used to indicate areas where it is most suitable to apply RWS techniques in South Africa and what supporting information is

available or needs to be collected in the future to ensure the effective implementation of RWH at a large scale.

6. The issue of up scaling will receive specific attention in the research work and will be part of the topic of both the PhD dissertation and MSc dissertation in Hydrology with an investigation on the impact of RWH on overall hydrological processes. The research will also analyse the existing gaps in the understanding of RWH, filling these with information to be obtained from literature review and specific research work supported by the available data to be obtained from point 4 above.
7. Two Master's research will further support the research, the first with focus on hydrological processes (during years 1 and 2) and the second in socio economic benefits with a focus on policy and legislative requirements (during years 2 and 3). Ms Boitumelo Sejamoholo who holds an Honours degree in Water Resources Management from the University of Pretoria and a BSc in Hydrology from Natal University has started her Master's degree in Hydrology at the School of Civil and Environmental Engineering of Wits University under the supervision of Prof Taigbenu. Ms Theo Maluleke from AWARD has now registered for the Master's in socio economics at the University of KwaZulu Natal. She will combine of her professional work on the project at AWARD with the academic requirements of the project and will integrate the work by the ARC and the SSI project (see collaboration with other institutions (section 6).
8. A detailed analysis of the policy and legislative requirements with necessary linkages with other legislation related to the environmental and agriculture as well as water services is underway in order to formulate appropriate recommendations. The issue of classification of rainwater harvesting (in terms of water use) will be dealt with in this part. This component of the work is being undertaken by Ms Tessa Cousins of AWARD and Mr Gugu Mazibuko. The bulk of the ground work will be done by Ms Theo Maluleke as part of her research work.
9. RWH in the context of IWRM within South Africa will be constitute the summary of this research outlining the lessons learnt, the opportunities identified, the gaps as well as providing guidelines for further work to be done. It will qualify and attempt to quantify the potential of RWH for contributing to a balance between social equity, economic efficiency and ecosystem sustainability. The DSS will provide a practical guide to the broader adoption of RWH throughout South Africa.
10. Throughout the project, papers will be published and presented by the research team as the outputs become ready. This will take place at local conferences such as the bi-annual SANCIAHS symposium, Water SA and other international journal and conferences as appropriate. Three academic dissertations (One PhD and two Masters) will also ensure that the findings of the project are of an academic standard while supported by field information and experience from water practitioners. At present, two papers have been published, one at SANCIAHS 2005 and another at water research show case forum. Two other papers by team members presented at SANCIAHS 2005 are indirectly related to

the project but add synergy to the objectives of the project. The deliverable on an International Paper has been submitted for the Conference of the International Association for Science and Technology Development (IASTED) on Environmentally Sound Technologies for Water Resources Management, ESTW 2006 to be held in Gaborone, Botswana from 11 to 13 September 2006.

4. PROGRESS AGAINST SCHEDULED DELIVERABLES

Appendix A provides a list of the project deliverables. For this reporting period, the following deliverables are presented:

- The draft report on Preliminary Fieldwork and data collection
- The International Paper 'A preliminary Conceptual Model of the GIS based Rainwater harvesting Decision Support System'.
- Preliminary Conceptual Model for Water Resources Management related to RWH
- Preliminary Conceptual Model for Water System Analysis related to RWH
- Recommendations on a policy on RWH

Each of these deliverables is below discussed followed by progress on work under way on the other deliverables.

4.1. Deliverables completed

The following deliverables have been completed and the reports submitted to the WRC.

4.1.1. The draft report on Preliminary Field work and data collection

Several field trips have taken place since the beginning of the project. The aim is to identify suitable on-going RWH projects on which the project can build in order to achieve its own objectives. One of the limitations of the project is that no provision has been made for field experiments. The TORs rather requested that the project gathers data from other RWH field work being undertaken by other institutions. The risk of this limitation is that the experiments designed by others do not necessarily correspond to the objectives of the project. Indeed, so far limited opportunities have been identified.

The project team has so far visited two field experiments, one by the ARC - ISCW in the Orange Free State and the second by the school of Bioresources Engineering and Environmental Hydrology (BEEH) of the University of KwaZulu-Natal in the Thukela catchment. Another field trip took place in the area around Bushbuckridge where AWARD is involved in RWH initiatives. Though the trip took place, it was realised it was not appropriate to visit the site (Sand River area) as further discussed below.

- The first site being run by the ARC consists of small scale RWH harvesting initiatives at household level in the Taba N'chu area in the Free State. The benefit to the project will mainly be from the socio economic side, highlighting the improved food production and opportunities for wide scale adoption. This experiment is unlikely to provide any information on the hydrological impacts that

the project seeks to address as it was not designed for this purpose and there is no hydrological data collection. Two field trips were organised related to this area were organised by the ARC (Mr JJ Botha), the last one coincided with the RWH festival in which the Minister of Water Affairs and Forestry participated.

- The second site is in Poschini, near Bergville in KwaZulu Natal and was visited as part of the collaboration with the SSI project. The site focuses on a catchment of 10 km² which is gauged with a nested catchment within it of 1 km² which is also gauged. The data being collected could benefit the objectives of the project at local level, providing insight into the processes of RWH and the impact on river runoff and other components of the hydrological cycle. This could further be up scaled either based on field experiment or modelling. Discussions are also underway with the SSI team to collaborate on the socio economic component of the RWH under the M Sc for which Ms Theo Maluleke has just registered at the UKZN. Details of how this will take place will be provided as the project unfolds.
- A trip took place in the area around Bushbuckridge and the Sand River Catchment where AWARD who are part of the project team is involved in RWH initiatives for both the domestic and agriculture sectors. The domestic component is taking place around Bushbuckridge and will mainly serve the purposes of improving the understanding of the socio economic dynamics associated with RWH in view of informing the policy recommendations document. Several critical social issues emerged from the discussion with AWARD such as the need to assess the water requirements of a community and to provide a comprehensive response rather than a targeted one (steered by a specific objective of an externally designed project). The agriculture component is taking place in the Sand River catchment, the study area is also being gauged. The initial expectation that this site could provide an opportunity for serving the needs of this project for the hydrological investigations is unlikely to be fulfilled. Discussions with the AWARD team and with a researcher from another research project in the same area by a UKZN student indicated that the focus was rather on improving the ecological status of the river system through water retention interventions similar to RWH but not strictly related to the purpose of this project. In addition, recent rains around the site had caused damages which made it difficult to visit the site.
- Following the last Reference Group meeting, discussions are still underway with the CSIR to arrange a field trip to their RWH project in KZN.

The project team members involved in this task include Mr JM Mwenge Kahinda, the PhD candidate; Ms Boitumelo Sejamoholo, the M Sc candidate in Hydrology, Ms Theo Maluleke of AWARD, the M Sc candidate in socio economics, Mr J Boroto, the Project Leader, Mr JJ Botha from the ARC- ISCW, Ms T Cousins and M E Lillie. The responsibility of initiating the field visits and identifying opportunities for the project has now shifted from the Project Leader to the PhD researcher with the support of the rest of the team.

4.1.2. The International Paper

An International Paper ' Preliminary Conceptual Model of the GIS Based Rainwater Harvesting Decision Support System' has been submitted for the Conference of the International Association for Science and Technology Development (IASTED) on Environmentally Sound Technologies for Water Resources Management, ESTW 2006 to be held in Gaborone, Botswana from 11 to 13 September 2006.

The topic of the paper is different from the initial topic presented in the project proposal as 'A synthesis of RWH Practices in South Africa' because this initial topic has already been discussed at the SANCIAS conference in September 2005. Though presented to a local audience, it was felt that this was sufficient for the needs of the project whereas the international paper should present the understanding gained and progress made in addressing the key objective of the project. Thus, the topic on the Preliminary Conceptual model and the DSS I reflects this and provides the opportunity for more valuable inputs and comments to the project than the initial topic.

The paper has to conform to the editorial requirements of the IASTED and is considered as a summary of an expanded version to be published to a refereed journal which will cover part of the initial topic and expand on the Conceptual model and the DSS.

4.1.3 The preliminary conceptual models

A report on the deliverables 'Preliminary Conceptual Model for Water Resources Management related to RWH' and Preliminary Conceptual Model for Water System Analysis related to RWH' has been submitted to the WRC. This critical deliverable was discussed extensively with the WRC Project Manager in at least two meetings. This was needed to align the direction that the project team was proposing with the expectations of the WRC. Of particular significance was the meeting of 2 February 2006 at the WRC during which, after a discussion guided by Mr G Nyland, an IT expert with extensive experience with the softwares used in water resources management and who is seconded to DWAF as a consultant, an agreement was reached on the tools to be used during the project . The minutes of the meetings are attached as Appendice B.1.

4.1.4 The recommendations on a policy on RWH

This deliverable reflects the gradual understanding of the socio economic and policy issues related to RWH that is being gained by the project. It summarises a review of the current policy and legislative provision related to RWH in the form of a preliminary assessment on the position of several policy documents on RWH. These include the National Water Act, the National Water Resources Strategy, the National Environmental Act, the recently launched policy which provides for a R5000 subsidy to qualifying households for rainwater harvesting tanks (mainly for domestic purposes) and the guideline to Municipalities for the provision of water Small Scale Multiple Use Systems (MUS).

It is clear that the increased interest in RWH in the context of a drive for the socio economic upliftment of rural and peri urban livelihoods needs to be properly legislated if it is to receive a wide scale adoption for both domestic and agriculture needs. Issues of its classification (Schedule I or Streamflow Reduction Activity (SFRA), its impact on

other users and its potential for improving livelihoods such as in the MUS initiative or the ARC lead initiative in the Free State also highlight the need an objective assessment of the opportunities, possible conflicts of mandates (and interest) and misuses that might arise from RWH. It calls for a comprehensive needs assessment and provides some pointers towards key socio economic and policy considerations that the DSS also have to include if it has to be relevant and effective.

The understanding summarised in this deliverable is the result of a literature review, field visits, team discussion and consultations with experts who are leading some of the RWH initiatives in the country such as Ms Marna de Lange who has now been invited to join the Reference Group.

As cautioned by the last Reference Group meeting, the project has no mandate to develop any policy but could provide a useful guideline of issues to be considered by those government departments in charge of develop a RWH policy.

4.2. Progress on other deliverables

The deliverables for the current year (2006/2007) are summarised in Table 1 below. Progress on each of them will consist of a build up and consolidation of the work reported in this progress report for mostly the first year of the project. This first year has unpacked key issues and laid the conceptual and field ground for the next phase. With the involvement of two Master's students during this year, both the hydrological and socio-economic/ policy components will be consolidated, leading gradually towards the final outputs of the project. These outputs for Year 2 are discussed below.

Field-based Research (Interim Report)	30 May 2006
Report on Field-based Research	31 Dec 2006
Conceptual Model for Water Resource Management related to RWH	30 Aug 2006
Conceptual Model for Water Systems Analysis Tools related to RWH	30 Sep 2006
A prototype of a GIS based Decision Support System for Rain Water Harvesting	28 Feb 2007
Second Stakeholder Workshop	28 Feb 2007
Development of Draft Policy Document on RWH	28 Feb 2007

Table 1: deliverables for the next delivery period (Nov 2005 to May September 2006)

4.2.1 Progress on Field Based Research

This is an on-going activity which depends on data collected from identified sites. At present, the ARC and AWARD sites hold mostly potential for socio economic insights, though with mixed signals (some positive and others cautionary). The SSI sites are likely to provide some hydrological data while contributing to further socio economic insight. It is expected that the CSIR site which have not yet been visited but for which discussions are under way will also assist in both fronts (hydrological and socio economic).

One key expectation from the field based research is that it would provide sufficient information to test the DSS. Ideally, the project should have been able to design its own experiments to suits its needs. This, however, was not part of the TORs and was not budgeted for. Even if this was budgeted for, the design of such experiences and the collection of meaningful data that would support the meaningful interpretation of any results would require a time frame longer than the lifetime of this project.

It can be stated however that basic information such as rainfall, soil types and topography is likely to be directly incorporated in the DSS so as to broadly delineate areas that can be included or excluded from RWH – say for improved agriculture purposes -. Site specific information such as at the Potchini site will provide illustration of how the DSS would work in practice for a localised RWH investment as well as for the impacts of upscaling.

4.2.2. Progress on the Conceptual Models

Further refinement of the conceptual models is on going to prepare for the actual development of the DSS. As the DSS is developed and tested, the Conceptual Models are likely to be revisited in an iterative fashion until a robust and consistent DSS is built. The focus of work in this period will therefore be to confirm the robustness of the Conceptual Models. The softwares to be used in the DSS will also be decisive at this stage as they should be able to support the applications conceived in the Conceptual Model.

The experience and guidance of Dr Pitman who is on the project team will be critical in ensuring that a sound and practical approach is taken. The last meeting of the project team in charge of the Conceptual Model and the DSS with Dr Pitman in on 12 May 2006 provided useful guidance.

4.2.3. Progress on the GIS based DSS for RWH

The actual building of the GIS based DSS is set to start. Agreement on the softwares to be used has been reached with the WRC and some of these have been purchased. This will be a primary focus of the PhD researcher for this period supported by the field data to be collected to first set broadly the bulk parameters at national level and then gradually focus on specific sites where data would be available. The actual interaction between the DSS and the supporting tools (such as the hydrological models, the socio economic analysis component) will be agreed upon. It is likely that these tools will be external to the DSS with provisions for feeding into it. The work of the two Master's researchers will be part of these supporting tools to the DSS.

In addition to the members of the project team that were earmarked for this component, the ARC has made available to the project the expertise of Dr Teclemariam Zere who has just completed his PhD in Soils Science and who has expertise in modelling. His contribution to this component will be to strengthen the soil component (as part of the hydrological interactions related to RWH) and to provide relevant modelling inputs.

4.2.4. Planning a second stakeholder workshop

A second stakeholder workshop will take place in the last part of this project year (most likely in January 2007). The purpose of the workshop will be to present the preliminary findings of the project, especially a draft Decision Support System, to obtain feedback from stakeholders for its refinement, not only in its design and functionality but also in its actual content (in terms of how it is populated). This workshop will also seek to reach consensus from stakeholders for future steps for making the DSS fully operational and usable for South Africa.

The workshop will present also the key recommendations for a policy on RWH based on the findings of the project and likewise, seek from the stakeholders guidance as to the best way of ensuring that policy makers take into account these recommendations.

These objectives of this workshop already dictate the profile of the stakeholders to be invited, from RWH practitioners on the ground, researchers and officials at local, provincial and national level and from different departments (water, agriculture, local government and environment)

4.2.5. Progress on the Policy Document on RWH

The preliminary report on the socio economics and policy aspects will be expanded and consolidated with the work of the Master's researcher in view of providing a comprehensive overview of all the issues pertaining to RWH and key recommendations for a policy on RWH. This will be discussed at the second stakeholder workshop as above discussed.

5. CAPACITY BUILDING

The project provides for the training of a PhD Candidate as the main researcher and two Master's students.

- Mr Mwenge Kahinda who is registered as a PhD Candidate at the School of Civil and Environmental Engineering of Wits University since 2005 has been working full time on the project since its inception. He is involved in all the components of the study but his research work will pay a special attention of the DSS and the issue of up-scaling RWH to the entire South Africa. He is the lead author of all the papers produced so far and has assumed an increasingly leading role in the project as far as initiating key activities and project meetings is concerned.
- Ms Boitumelo Sejamoholo has registered for a Master's degree programme at the same School of Civil and Environmental Engineering of Wits University. She has just started her research work. Ms Sejamoholo is already employed and her Master work will not require any course work. In her current work, she has extensive experience in modelling packages that are likely to be used in the project. Her research work will be on 'Modelling Hydrological Impacts of Rainwater Harvesting on Catchment Water Resources' and will insight into the hydrological tools that will serve the needs of the project in modelling RWH impacts at different scales. This will support the hydrology component of the PhD research.

- Ms Theo Maluleke has also just registered at the University of KwaZulu Natal and will work under the supervision of Monique Saloman who is also involved in the SSI project. Theo's work experience at AWARD and the other sites that have been identified so far (SSI, ARC) will provide sufficient material to support her Master's research work. This work will further support the recommendations for a policy on RWH.

6. COLLABORATION WITH OTHER INSTITUTIONS AND WITHIN THE PROJECT

Collaboration with other institutions is on going. The project specifically required collaboration with the Challenge Programme and the Smallholder System Innovation (SSI) Programme. Details of both programmes were presented in the previous progress report.

- With regard to the Challenge Programme, Prof Taigbenu (supervisor of the PhD and Master's Research in hydrology) who is part of the project team is also involved in the Challenge Programme and will facilitate the establishment of the necessary linkage between the two projects. At this stage, no opportunity to meet the needs of this project has emerged from the Challenge Programme.
- Collaboration with the SSI programme is taking place already (as illustrated by the field trip reported on in Section 4 above). It has been agreed that formal collaboration will be established so that the two projects throughout and that the opportunities for further integration of the outcomes of this project and the SSI programme be pursued. The methodology to be developed through this project can for example be applied to the SSI site in the Thukela Catchment beyond after this project. As also mentioned above, a new development is related to the socio economic component with Ms Theo Maluleke being supervised by a member of the SSI project. This is a welcome development which was not anticipated at the beginning of the project but which will further strengthen the synergies between the two projects. Prof Graham Jewitt who leads the SSI project at UKZN has been invited to join the Reference Group of this project.
- Collaboration with the Stockholm Environment Institute (SEI) takes place through the Executive Director, Dr Johan Rockstrom who is the co supervisor of the PhD research. He is also involved in the SSI programme and has extensive experience in RWH. The PhD Researcher, Mr JM Mwenge Kahinda and Prof Taigbenu met with Dr Johan Rockstrom on 26 April 2006 at Wits University to discuss progress on the project. Minutes of the meeting are attached as Appendice B2.

Within the project team, regular meetings take place between the team partners as and when the needs arise. The following recent meetings took place:

- A meeting with the ARC (Dr Beukes, Dr Zere and Mr JJ Botha) on 3 May 2006 in Pretoria during which the role of Dr Zere was discussed and agreement in

principle was reached on the contribution of the ARC considering the value that Dr Zere could add to the project.

- A meeting with AWARD on 8 and 9 May 2006 at their offices with extensive discussions on the socio economic aspects of the project, their integration in the DSS, AWARD's experience in RWH, Ms Theo Maluleke's proposal for an M Sc and the overall project coordination and interaction with external stakeholders.

7. WORK PLAN

The following activities will take place until February 2007 to ensure that the next deliverables are produced on target:

1. Further refinement of the Conceptual Models in consistency with the DSS
2. Further field data collection and analysis to prepare for the DSS and to support the socio economics component
3. Development of the DSS and testing the DSS
4. Research work as part of the M Sc work in Hydrology
5. Research work and field visits as part of the M Sc work in socio economics
6. Selection and setting up of models
7. Presentation of two papers at the AISTED conference (Gaborone, September 2006) and at WaterNet/ Warfsa (Malawi, November 2006).
8. A stakeholders workshop in January 2007

A detailed work plan is attached as an Excel file.

APPENDICE A: SCHEDULE OF DELIVERABLES

Deliverables	Target date
Initial Stakeholder Workshop	31 Aug 2005
Inception Report	31 July 2005
Literature Review	31 Aug 2005
Draft Report on Preliminary Fieldwork and data collection	31 Jan 2006
International Paper " A Synthesis of Rainwater Harvesting Practices in South Africa"	28 Feb 2006
Preliminary Conceptual Model for Water Resource Management related to RWH	30 Nov 2005
Preliminary Conceptual Model for Water Systems Analysis Tools related to RWH	30 Nov 2005
Initial Development of Draft Policy Document on RWH	28 Feb 2006
END OF FINANCIAL YEAR 1 (2005-2006)	
Field-based Research (Interim Report)	30 May 2006
Report on Field-based Research	31 Dec 2006
Conceptual Model for Water Resource Management related to RWH	30 Aug 2006
Conceptual Model for Water Systems Analysis Tools related to RWH	30 Sep 2006
A prototype of a GIS based Decision Support System for Rain Water Harvesting	28 Feb 2007
Second Stakeholder Workshop	28 Feb 2007
Development of Draft Policy Document on RWH	28 Feb 2007
END OF FINANCIAL YEAR 2 (2006-2007)	
Development of a GIS based Decision Support System for RWH	31 Jul 2007
Testing of the DSS on field data	31 Jul 2007
Demonstration of the DSS	30 Sep 2007
International Paper " A GIS based DSS for Sustainable Rainwater Harvesting in South Africa"	30 Sep 2007
Draft Policy Document on RWH	30 Nov 2007
Draft WRC Report, combining the field based research, the implications of RWH w.r.t. Integrated Water Resource Management, the DSS and the Policy Document	31 Dec 2007
Final Stakeholder Workshop	30 Nov 2008
International Paper "Rain Water Harvest Potential in the South African Context"	28 Feb 2008
Final WRC Report	28 Feb 2008
END OF FINANCIAL YEAR 3 (2007-2008)	

APPENDICE B 1: MINUTES OF 2 FEBRUARY 2006 MEETING AT THE WRC

MINUTES OF A MEETING ON THE PRELIMINARY CONCEPTUAL RWH DSS BETWEEN THE PROJECT TEAM AND THE PROJECT MANAGER ON WATER RESOURCES MANAGEMENT IN RAINWATER HARVESTING: AN INTEGRATED SYSTEMS APPROACH, HELD AT THE WATER RESEARCH COMMISSION, THIRD FLOOR, MARUMATI BUILDING, 491 18TH AVENUE, RIETFONTEIN, PRETORIA ON 2 FEBRUARY 2006 AT 9:00.

PRESENT:

Mr R Dube	:	Water Research Commission - Chairman
Mr RJ Boroto	:	Source Strategic Focus
Mr. Grant	:	
Mr ESB Lillie	:	Source Strategic Focus
Mr J Mwenge Kahinda	:	University of the Witwatersrand

1. CONSTITUTION OF THE MEETING

- 1.1. The Project Manager (Mr Renias Dube) welcomed the attendees to the meeting. He noted that the meeting was set to discuss about the Preliminary conceptual model for Rainwater Harvesting.
- 1.2. Mr Grant being the only new attendee, introduced himself and noted that he is not a member of the Project Team but an adviser on the IT aspect of the Rainwater harvesting Decision support system (RWH DSS)

2. THE PRELIMINARY RWH DSS

- 2.1. The Project Leader (Mr Jean Boroto) noted that the document had been distributed beforehand. He suggested that Mr. Lillie gives an overview of the Preliminary Conceptual RWH DSS.
- 2.2. Mr Lillie presented an overview of the Preliminary Conceptual RWH DSS in three parts
 - 1st Part Assessment of the potential of RWH in SA
 - 2nd Part Building of scenarios
 - 3rd Part Evaluation of the impacts of RWH
- 2.3. The attendees raised the following comments with reference to the Preliminary Conceptual RWH DSS

With reference to the DSS diagrammatic overview (Figure 1.2)

- a. The Project Manager suggested the users should start by selecting an area like in the already existing GIS based platforms and then decide on the type of RWH.
- b. The Project Manager suggested that considering the resolution of the data, areas such as, field, farm and community might not be available. Mr Lillie noted that the general resolution of the data was 1/50,000.
- c. Mr. Grant noted that since the DSS was GIS based, the data resolution should not be a problem. GIS help to aggregate or disaggregate making the system very flexible on the issue of resolution.
- d. The Project Manager recommended that the DSS should present together results of hydrological, social, economic, environmental and legal analysis. The Project Leader noted that using MCA would help analyse both quantitative and qualitative data.
- e. Mr Lillie asked the Project Manager if there is a data sharing agreement between ARC and WRC. The Project Manager indicated that there was no such agreement.
- f. The Project Manager felt that the Evaluation of catchment and tank size should also come after the coverage intersection. The PhD student (Mr. Mwenge Kahinda) indicated that it would be done.

3. SOFTWARE SELECTION AND METHODOLOGY TO FOLLOW

- 3.1. Mr. Grant gave a presentation on the steps to follow when selecting the necessary software to build the DSS and the methodology of the specification requirement.

Mr Grant indicated that:

- i. The choice of the programming language is dictated by the IT skill of the team members. Considering the IT skill of the Project Team members, Mr Grant suggested that the team uses VB.
- ii. The choice of the database is dictated by the distribution system of the products. Considering that the product will not be a client server, Mr Grant suggested the use of Microsoft Data Access Component.
- iii. The team should make a use case analysis, perform the test and assess the risks.

Please refer to Annex 1 for more details

Mr Grant also stressed that:

- i. The software developer (project team) should define the business requirement and present it to the client (WRC).
- ii. The test should be performed against what was agreed in the business requirement. Criteria that will be used to test the software should therefore be clearly indicated by the project team.
- iii. The client and the developer should bear in mind that they are risks attached with any software

3.2. The attendees raised the following comments With reference to Mr Grant presentation

- a. The Project Manager asked if Ms Access could handle the data needed to build the DSS. Mr Grant indicated that Ms Access uses NDB files of 2GB and that a single file should easily handle the data.

4. DATE OF THE NEXT MEETING

4.1. The next meeting was not scheduled.

5. CONCLUSION OF THE MEETING

5.1. The Project Manager thanked the attendees for their attendance and inputs.

The Project Manager declared the meeting closed at 10:30.

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Project Manager

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SECRETARY

.....
DATE

APPENDICE B 2: MINUTES OF MEETING OF 26 APRIL 2006 AT WITS

MINUTES OF MEETING WITH JOHAN ROCKSTRÖM, EXECUTIVE DIRECTOR OF STOCKHOLM ENVIRONMENT INSTITUTE AND CO-SUPERVISOR OF THE PHD RESEARCH SCHOLAR OF THE WRC PROJECT ON WATER RESOURCES MANAGEMENT IN RAINWATER HARVESTING: AN INTEGRATED SYSTEMS APPROACH, HELD IN THE UNIVERSITY OF THE WITWATERSRAND, SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING, HILLMAN BUILDING, SECOND FLOOR, ROOM 203, JORISSEN STREET, BRAAMFONTEIN, JOHANNESBURG ON 26 APRIL 2006 AT 08:30.

PRESENT:

Prof. A. E. Taigbenu	:	Wits University
Ass. Prof. J. Rockström	:	Stockholm Environment Institute
Mr Mwenge Kahinda	:	Wits University
	:	

1. CONSTITUTION OF THE MEETING

1.1 The Chairman (Prof. A.E. Taigbenu) welcomed Ass. Prof. J. Rockström and thanked him for attending this meeting while in transit in Johannesburg.

2. ANNEXURE A – THE PHD RESEARCH PROPOSAL

2.1 The Chairman noted that the PhD research proposal of the PhD research scholar (Mr. J. Mwenge Kahinda) had been presented and accepted by the School of Civil and Environmental Engineering. He indicated that the objective could not change. However they could adjust the methodology if necessary.

2.2 The PhD research scholar presented the PhD research proposal.

2.3 The Co-Supervisor (Ass. Prof. J. Rockström) noted that he read the proposal and found it very challenging and raised the following comments

a) The Co-Supervisor asked what RWH techniques will be analysed. The PhD research scholar indicated that DRWH, IRWH and ERWH will be analysed.

b) The Co-Supervisor advised the scholar to disregard DRWH and to concentrate his work on FRWH. The chairman noted that DRWH could not be disregarded since it is part of the TORs of the WRC project K5/1563 under which the PhD research project is funded.

- c) With reference to the Decision Support System, the Co-Supervisor noted that the Boston office of Stockholm Environment Institute developed the Water Evaluation and Planning System (WEAP) a Decision Support System that might be used for the PhD. He however noted that there was no RWH module at present but, the PhD research scholar can build that module. The PhD research scholar answered that he will analyse the SEI DSS and report back on it. The chairman noted that if the SEI DSS can not be used in the project K5/1563, it can always be a good benchmark for a RWH DSS to build.
- d) The Co-Supervisor advised the PhD research Scholar to study key RWH techniques rather than all the techniques. The PhD research scholar noted that he intended to focus on EFRWH with storage system, DRWH and IRWH as key RWH techniques.
- e) To the key RWH technique cited by PhD research scholar, the co-supervisor added Runoff generated techniques (EFRWH). The co-supervisor advised to avoid going into too much details during the modelling of those key RWH techniques.

3. ANNEXURE B – THE PRELIMINARY CONCEPTUAL MODEL OF THE RWH DSS

- 3.1 The PhD research scholar presented the preliminary conceptual model of the RWH DSS.
- 3.2 The Reference Group raised the following comments on Annexure B.
 - a) The Co-Supervisor asked what hydrologic model was selected for the study. The chairman answered that a number of hydrologic model had been considered and three hydrologic models were further analysed (ACRU, SWAT and WRSM2000).
 - b) The Co-Supervisor cautioned the PhD research scholar on the choice of the model. He noted that most hydrologic models are not suited for RWH since their resolution can not account for sheet flows and rill flows that are the flow considered when talking of RWH. He recommended modelling the technique with a hydrologic model of finer resolution and then feed the hydrologic models with the output. He suggested that the PhD research scholar reads the PhD thesis of Mr. S. Ngigi who faced the same modelling problem.
 - c) The co-supervisor noted that both ACRU and SWAT were physically based models but were not suited to model RWH. He found SWAT to have the advantage to be GIS based but was concerned about the cost of the software. The PhD research scholar answered that SWAT might be free for academic researcher. The chairman advised the PhD research scholar to confirm that information.

4. CONCLUSION OF THE MEETING

- 4.1 The Chairman thanked the Co-supervisor for his inputs.

4.2 The Chairman declared the meeting closed at 5:00 PM.

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CHAIRMAN

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SECRETARY

27 April 2007
DATE

APPENDIX C: THE PROJECT TEAM

The project team is composed of professionals and academics under the following collaborating organisations:

1. Source Strategic Focus (Pty) Ltd (Lead Organisation)

- Jean Boroto (JB)
- Edwin Lillie (EL)
- Gugu Mazibuko (GM)
- Guy Pegram (GP)
- W Pitman (WP)
- B Haarsbroek (BH)

2. School of Civil and Environmental Engineering, Wits University

- A Taigbenu (AT)
- JM Mwenge Kahinda (Ph D candidate) (JMK)
- B Sejamoholo (MSc Candidate) (BS)

3. AWARD

- T Cousins (TC)
- T Maluleke (M Sc Candidate) (TM)
- S Pollard (SP)

4. ISCW, Agriculture Research Council

- JJ Botha (JJB)
- T Zere (TZ)
- M Hensley (retired) (MH)