Investigating Operational Indigenous Knowledge of Water and Waste Management, and Establishing Ways to Integrate them into Water Services Management

Report to the
Water Research Commission

by

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EXECUTIVE SUMMARY

Water Research Commission (WRC) commissioned a research topic, 'Investigating operational indigenous knowledge (IK) of water use and waste management, and establishing ways to integrate them into water services management', which aims to access and share information on indigenous water use and waste management practices that have not been acknowledged or recognised in the past.

Although we are well into the millennium, many municipalities have still not met the water and sanitation backlogs as outlined in the Strategic Framework for Water Services. While Government tries to find a balance between providing the minimum services and maintaining existing services, the poor in South Africa remain without access to clean water and no sanitation facilities. Since the introduction of the Free Basic Services Policy, municipalities are under enormous pressure to meet service delivery targets resulting in many municipalities implementing ill-conceived and unsustainable technology solutions. Many bitter and expensive lessons have since been learnt however, it has also created the platform for engineers and planners to explore a broader range of alternate technologies including indigenous practices in the water and waste management fields. This research is aimed at introducing communities, municipalities, practitioners, etc. across South Africa to alternative ways of managing water and to allow indigenous knowledge to inform future policies.

The approach to the study included literature review to establish local and international trends, consultation with key stakeholders, identifying and documenting local and international case studies, compiling a research report and preparing content material for a coffee table book.

The history of Indigenous Water and Waste Management (IWWM) in South Africa is dominated by water as a collective good and a finite resource therefore it was carefully protected and conserved. Very little written literature is available on the history of pre-colonial South Africans in relation to water and sanitation practices. The early indigenous nomads of South Africa had no need to construct elaborate water supply systems and irrigation was unknown, they believed that fountains and springs would run eternally. The typical knowledge of a South African nomad consisted of a sophisticated understanding of water sources, water bearing plants and ideal locations for shallow wells. Their predictions were based on in-depth knowledge systems inherited from their ancestors and when elders predicted weather

anomalies they reacted by organising and executing uNomkhubulwane (Zulu 'Princess of Rain') ceremony (Haarhoff et al., 2007: 133).

During the stakeholders consultation process it became clear that there is not a well-accepted definition of IK amongst the specialists in the field. Some referred the use of traditional knowledge to indigenous knowledge while many thought the definition should be expanded to include indigenous innovation. It was explained that one of the challenges of working in the area of traditional knowledge is not the lack of appropriate terminology, but the diverse meanings and connotations associated with existing terminology. For the purpose of this research study, IK will be used. It was agreed by all interviewed that although literature may exist on IKS and practices in South Africa almost no literature is available on IWWM practices in the country.

35 IWWM practices were identified and assessed in terms of its economic, environmental and social sustainability and its ability to be replicated in South Africa.

Of the 35 IWWM practices evaluated only 3 were found to be financially unsustainable (low significance). These included the Khoi San Ostrich Eggs, Karaisali Waste Water Management and clay pots practices. The use of ostrich eggs and clay pots for storing water is not practical in today's conditions while the Karaisali Waste Water Management is not applicable in South Africa because in urban areas there is limited space available and in rural areas the vast distances between households renders the system economically unfeasible. Given that only 12% of the IWWM practices remain economically inefficient does bear testimony to the conclusion that IWWM practices are feasible, practical and are not financially demanding to construct, operate and maintain.

All IWWM practices evaluated fall in the medium to high significance range from an environmental point of view. There is no practice of the 35 identified practices that will have a negative impact on the environment. 71% has a high environmental significance rating, leaving 29% with a medium environmental significance rating. This finding is in line with general consensus that indigenous practices are environmental sustainable. These practices were developed at a time when people understood and relied on natural resources, therefore the thought of abusing such resources was unthinkable. However, it must be cautioned that if these IWWM practices are not managed it will result in environmental degradation for instance if the hydraulic noria is replicated, water conservation will be necessary. Adapting IWWM

practice to suit current conditions requires that planners understand the full local environmental implication of the technology before it can be implemented.

There are no IWWM practices that are socially insignificant, implying that although the practices are developed by a particular ethnic group; the evaluation demonstrates that these can be applied to communities without the fear of offending or alienating anyone. IKS is a result of people, across the globe, responding to local challenges. The resulting indigenous practice is influenced by the traditions, social constraints and prejudices, superstitions and cultural values of the people. This implies that not all indigenous practices will automatically meet with the same approval by other cultures. Therefore, 57% of the IWWM practices are sociably sustainable only if adapted to reflect the needs of different ethnic groups.

43% of the IWWM practices can be implemented without being adapted to local social conditions. In principle the IWWM practices analysed imply fair access to livelihood, education, and resources; full participation in the cultural life of the community and self-determination in meeting fundamental needs for everyone. The practices are open to everyone and everyone can profit from them.

34% of the IWWM practices evaluated can be replicated without any problems in transferring the practice to another group or area. These include the hydraulic noria, stone lines, planting pits, terracing, traditional teras cultivation, roof tanks and wells, the Zai System, the Ngoro and Matuta Soil and water conservation systems, the Gawan System, the Caag System, Nguni handwashing and traditional medicine for handwashing.

Although the hydraulic noria is used in Syria for irrigation it can easily be used to supply rural community with water. Water from a river can be pumped to a tank for consumption. Women and children will not have to walk long distances to collect water and no operating costs will be involved. The shortfall of the system is that it is dependent on very specific conditions to ensure adequate head in the system to pump the water.

In many rural areas in South Africa, people use their free basic allowance of water to water their food gardens. Stonelines, planting pits, terracing, traditional teras cultivation, roof tanks and wells, the Zai System, the Ngoro and Matuta soil and water conservation systems, the Gawan System, the Caag System will assist in water efficient agricultural practices. These solutions will leave the householder with more water for domestic purposes in addition it will contribute to water conservation practices.

Currently, waterborne diseases affect a large part of the South African population. The Nguni handwashing technique and traditional medicines for hand cleaning will assist in decreasing number of people who are affected by these diseases.

The use of aloe juice for hand cleaning in the absence of water should be investigated further. Should it prove successful, people living in informal settlements who do not always have access to water or have limited access to water could use this as dry hand cleaning option.

Only 9% of the IWWM practices evaluated are not recommended for replication, these include using ostrich egg shells and clay pots for storage and the Karaisali Waste Water Management system. All three practices are economically, environmentally and socially sound practices however the ostrich eggs and clay pots are not practical due the volume of water that they can contain at a time and the Karaisali Waste Water Management system is very specific to the conditions in Turkey.

The remaining 57% of the IWWM practices can be replicated but will require varying degrees of adaptation. This could include modification to the design to take into account location conditions, education programmes to teach people how to use the system, etc.

It was concluded that IWWM could assist in addressing various challenges currently facing the water sector. Only 5 of the identified 35 IWWM practices originated in South Africa, therefore the team concluded that there was insufficient material for a coffee table book.

The following recommendations were made:

- The Department of Arts and Culture should invest in a national scale awareness campaign that is necessary to market South African IK.
- The existing policies developed to protect IK should be demystified and translated into an action plan for the water sector.
- The Department of Trade and Industry should invest more money in trying to commercialise some IK which will serve to promote South African IKS.
- All future water sector policies must include a section on IKS. This can be done as a standalone section or addressed through crosscutting issues. Future policies and strategies must be required to demonstrate that IKS were considered.
- Better alignment is needed between the Department of Agriculture, Forestry and Fisheries, the Department of Water Affairs and the Cooperative Governance and

Traditional Affairs in designing and implementing policies and strategies to include IKS.

- The Department of Science and Technology, Department of Trade and Industry and the Department of Arts and Culture have a joint responsibility to ensure effective monitoring and evaluation of the implementation of IKS.
- Below, is a list of some current water sector policies that could benefit from IKS, This list, however, does not mention or make reference to indigenous practices. These document should be reviewed to include IKS include:

    - Rainwater Harvesting;
    - Water Conservation/Water Demand Management Strategy;
    - Waste Discharge Charging System;
    - Integrated Water Resource Management Plan Guideline;
    - The Private Land Guideline;
    - Guideline for the Provision of Water for Small-Scale Multiple Uses;
    - Guideline for the Development of a Provincial Water Sector Plan;
    - The Free Basic Services Policy;
    - Water Services Policy Database and Toolbox;
    - Strategic Framework for Water Services;
    - National Water Resources Strategy;
    - Water Services Development Plan Guideline;
    - Health and Hygiene Strategy;
    - Water for Growth and Development; and
    - Water Sector Strategic Assessment Report.

- Current, there is no national greywater policy, however, should one be developed, it should include comment on indigenous greywater practices.
- The Water Services Act, (Act 107 of 1998) is currently under review, this provides an ideal opportunity to include comment on the consideration of IKS in future planning.

ACKNOWLEDGEMENTS

The project team would like to thank all parties that completed the questionnaires and agreed to be interviewed.

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LIST OF ABBREVIATIONS

CBOs	Community-based Organisations
DST	Department of Science and Technology
EQI	Environmental Quality International
IK	Indigenous Knowledge
IKS	Indigenous Knowledge Systems
IWWM	Indigenous Water and Waste Management
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WIPO	World Intellectual Property Organisation
WRC	Water Research Commission
WWC	World Water Council
WWF	World Water Forum

1. INTRODUCTION

We are well into the millennium and still many municipalities have not met the water and sanitation backlogs as outlined in the Strategic Framework for Water Services. While Government tries to find a balance between providing the minimum services and maintaining existing services, the poor in South Africa remain without access to clean water and no sanitation facilities. Since the introduction of the Free Basic Services Policy, municipalities are under enormous pressure to meet service delivery targets resulting in many municipalities implementing ill-conceived and unsustainable technology solutions. Many bitter and expensive lessons have since been learnt however, it has also created the platform for engineers and planners to explore a broader range of alternate technologies including indigenous practices in the water and waste management fields. Further, increased demand for water, greater potential of pollution of current resources, water intensive and unsustainable development patterns and decreasing rainfall patterns in parts of the country has made it necessary for us to reflect on how water and sanitation were managed centuries ago if we are to still provide water and sanitation services to all in South Africa under trying conditions.

There is literature consensus that these solutions can be derived from indigenous know-how developed over centuries of adaptation to arid conditions that is on the verge of disappearing (EQI, 2001). Indigenous knowledge (IK) is now recognised internationally and locally as valid knowledge to respond to these challenges; despite the fact that modern (scientific) knowledge still dominates. In South Africa, Hart and Vorster (2006) note that the situation is changing as decision-makers are beginning to realize that IK is the single largest resource not yet mobilized to inform policies and strategies for management of scarce resources such as water and waste.

With the arrival of tap water and modern techniques of waste management, most of these indigenous techniques have been abandoned. The abandonment of traditional techniques has resulted in loss of awareness of the importance of water conservation and increased pollution of water tables (EQI, 2001). Through the integration of Indigenous Peoples' knowledge with the emerging science of water and sanitation supply, there is an important opportunity to influence water and waste management policies, set the stage for new

environmental management approaches based on sustainability and ecological resiliency and create a platform for municipalities to meet their service delivery goals.

In 2004, the Department of Science and Technology (DST) developed the Indigenous Knowledge Systems (IKS) Policy to stimulate and strengthen the contribution of indigenous knowledge to social and economic development in South Africa. The DST found that it was necessary to implement a co-ordinated approach to harnessing IK as such knowledge was neglected in the country leaving South African IK and practice vulnerable to abuse by commercial entities.

In March 2009, the World Water Council (WWC) organised the 5th World Water Forum (WWF) in Istanbul, Turkey with the theme of 'Bridging Divides for Water'. The Forum placed particular interest on increasing recognition of the value of local knowledge for natural resource management, among other key objectives of the Forum. The Forum facilitated discussions around how best to attain proper protection of indigenous interests in water and explored how indigenous knowledge can be recognised as specialist knowledge and used together with modern knowledge in water management systems.

Understanding and documenting Indigenous Water and Waste Management (IWWM) will provide communities and municipalities with alternative solutions to the current water and sanitation challenges facing the country. In addition, IK and practices may inform future water and sanitation policies and strategies. For the purposes of this study water and waste management includes the following aspects:

- Water management includes water collection, transportation, storage and treatment; while
- Waste management includes wastewater collection, treatment and disposal. Wastewater is water from the toilets, kitchens and bathroom.

Dlamini (2005) notes that 80% of the world's population depends on IK to meet their medicinal needs while at least half rely on IK for food security. It is not just poor countries or poor people that benefit from IK of the world's biodiversity. Instead IK has helped to fuel innovation and development of several industries, ranging from agriculture and pharmaceuticals to chemicals, paper products, energy, and others.

While modern science separates different kinds of knowledge, IK integrates the spiritual, environmental, agricultural and all other kinds of knowledge within a culture, it becomes a way of life.

1.1 Aims and Objectives of the Research

The main objective of this study is to identify and investigate local indigenous practices in water and waste management, thereafter, determine if these practices can be adapted to satisfy current conditions or inform current water sector policies in South Africa. Therefore, the aims of the study are as follows:

- Identify and document IWWM practices;
- Develop and populate a database of indigenous water management practices;
- Assess the sustainability of each practice in terms of how it can contribute to future water and waste management approaches;
- Compile a research report on the findings of the study and make recommendations for current and future policies and practices; and
- Develop content material for a coffee table book on the indigenous practices and its history.

1.2 Approach to the Study

IK around IWWM throughout the world in general and South Africa in particular, was not well recognized or documented in the past. It is only recently acknowledged by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Intellectual Property Organization as an essential tool for participatory development. By investigating these practices; communities and municipalities in South Africa will be exposed to alternative ways of managing water and wastewater. Through documenting these practices, indigenous knowledge can thus be used to inform future policies. It enables knowledge to be shared and passed down to new generations who may only be exposed to new technology.

In order to realise the project aims the following approach to the study was adopted:

- National policies and legislation protecting IK were reviewed;
- International trends and perspectives on IK were reviewed
- Key stakeholders, involved in the field of IK, were interviewed;
- Both international and national IK case studies identified and reviewed; and
- The outcome of the above-mentioned approaches is presented in the research report such that it can lend itself to a coffee table book.

1.3 Assumptions and Limitations

The following assumptions and limitations were made during the study:

- Given, that it is not the intention of this investigation to date the origin of the IWWM practice, the authors have included all IWWM practices which were identified in SA in the research report. It is not claimed that the indigenous practices presented in this report originated in South Africa, instead in many instances it is knowledge brought into the country through the immigration of people from other countries;
- Due to time and budget constraints it was not possible to document all indigenous practices in the country;
- Various stakeholders requested to complete a questionnaire, in many instances not response was received despite various attempts to contact the interviewee. In these cases it is assumed that the individual or organisation had no contribution to make to the research topic; and
- It is assumed that indigenous practices have evolved in the course of time to respond to changing times. Hence, the practices discussed in this report are the practices as implemented by communities at the moment or in the recent past.

2. OVERVIEW OF INDIGENOUS KNOWLEDGE (IK)

2.1 Introduction and Definition of Indigenous Knowledge

Bruinsma (2003) defined indigenous knowledge as the knowledge that people in a given community have develop over time, and continue to develop: local, traditional knowledge adapted to local situations, frequently tested over centuries of use. Indigenous knowledge is significant; it often tends to be sustainable and more efficient than that introduced by outsiders.

Warren (1991) defines IK as knowledge that is unique to a given culture or society and has developed over time, and continues to develop.

Stiles quoted by Cheserek (2005:25), defines indigenous knowledge as the systematic body of knowledge acquired by local people through accumulation of informal experiences and intensive understanding of their environment in a given society.

It is argued in UNESCO, 2006 that IK is related to a common practice seen in communities that are indigenous to a specific area traditional knowledge the focus is the long history of the practice.

For the purposes of this research report, IK is defined as a large body of knowledge and skills that are developed outside the formal educational system and is embedded in culture and is unique to a given location or society. Both traditional and local knowledge is included in the definition of IK.

Although there are many definitions, experts agree that IK contrasts with scientific knowledge systems generated by universities and research institutions as IK is informed by local/tribal people, whose values systems and knowledge base is not always understood by western society and is often said to be based on non-scientific principles.

It is well accepted that in the past IK was the foundation for local-level decision-making in water use, agriculture, health care, food preparation and daily activities. However, IK is not well documented or studied therefore Anthropologists have reviewed and continue to review

folklore and beliefs, ceremonies, customs, dances, music, folk recipes, medicines, oral history and living history to in the hope of uncovering more IK and practices . UNESCO (2006) has commented that the situation of indigenous people as follows:

"....indigenous peoples have suffered from a situation of colonization or invasion and currently have a non-dominant status in society. It is true that indigenous peoples have been and are continuing to be subjected to colonization, invasion and exile within our own territories. It is also true that we are not dominant in wielding political power. However, in social weight, in number, I assure you that the groups that are being colonized and subjugated in our own countries comprise over half the world population".

There is a strong belief by many traditionalists that modern knowledge and science has emerged from IK. However, during the colonisation period, people opposed IK in favour of modern knowledge. Today, there is increasing literature recognising the importance of indigenous practices for sustainable development. Indigenous and modern (scientific) knowledge should be investigated with equal importance if one is to work towards more efficient future development.

There is an urgent need to correct the imbalance of mainstream-thinking by actively integrating IK into modern solutions to time old challenges like water and waste management. However, this may not be a simple task given that IK is complex and has many aspects; communities have their own indigenous methods for imparting knowledge, just as they have indigenous ways of deriving a livelihood from the environment. Information, insight and techniques that are passed down and improved from one generation to the next cover such topics as medicine, animal breeding and production, water management, soil conservation, and pest management. IK was and still remains the information base for a society, which facilitates communication and decision-making. Indigenous information systems are dynamic, and are continually influenced by internal creativity and experimentation as well as by contact with external systems.

Throughout Africa traditional communities practiced water conservation strategies particularly among pastoral communities that suffer from water scarcity for their livestock and domestic use. The recognition of the value of indigenous knowledge (IK) is clearly gaining ground world-wide, but also in South Africa where it is ensconced in governmental policies

relating to IKS in general, living heritage, trade and industry, biodiversity, science and technology, traditional health practitioners and traditional leadership, governance and sustainable development (Mosimege, 2005).

2.2 Characteristics of Indigenous Knowledge

Although there are varying definitions of IK, a number of authors including Cheserek (2005:25), Bruinsma (2003) and Warren (1991: 43) agree that IK has the following common characteristics:

- Locally bound, indigenous to a specific area and generated within a community;
- Location, culture- and context-specific;
- Non-formal knowledge;
- Orally transmitted and rural in nature, and generally not documented;
- Holistic in nature;
- Closely related to survival and subsistence for many people worldwide and has been the basis for decision making and survival strategies;
- IK concerns critical issues of human and animal life: primary production, human and animal life and natural resource management; and
- IK is dynamic and based on innovation, adaptation, and experimentation.

2.3 Importance of Indigenous Knowledge

Warren (1991:26) commented that indigenous knowledge systems (IKSs) have made positive contributions in agriculture; health care; medicine; food preparation and preservation; land use; management of natural resources such as water, education and a host of other activities in both rural and urban communities. It provides the basis for problem-solving strategies, self-efficiency for local communities and the sustainable use of resources. IK embodies a significant part of universal knowledge on development issues and is widely recognise today as an underutilized resource for sustainable development.

Adapting indigenous water and waste management practices with current and modern practices may assist municipalities in addressing water and sanitation service delivery

challenges until such time that a permanent solution is found. This approach will provide a productive context for communities to gain access to services.

Sharing IK practices locally and internationally can help enhance cross-cultural understanding and promote the cultural dimension of development.

According to Dlamini (2006:16) IKSs can assist in the following areas:

- Ecology (provide background to local conditions for combination planting that will assist in organic farming methods);
- Beliefs (religious festivals, ceremonies);
- Health (healers' tests of new plant medicines);
- Human resources (local organizations such as kinship groups, councils of elders, or groups that share and exchange labour0;
- Education (traditional instruction methods; apprenticeships; learning through observation);
- Communication (story-telling);
- Agriculture (animal husbandry and ethnic-veterinary medicine);
- Food and technology (fermentation);
- Practices and technologies (seed treatment and storage methods);
- Tools (equipment for planting and harvesting; cooking pots and implements); and
- Arts and crafts (handcrafts like mat making).

2.5 Advantages of Indigenous Knowledge

The failures of scientific or modern knowledge to ensure sustainable development and to manage certain scarce natural resources such as water and limit the effects of poor waste management on the environment has made it necessary for engineers and planners to examine the benefits offered by indigenous practices. IK is significance in development; preserving traditional identities, linking the past and the present, and translating survival practices into everyday strategies to cope with a changing environment. Understanding and accepting IK has the following potential advantages:

- IK contributes to local empowerment, legitimacy and credibility, increases self-sufficiency and strengthens self-determination;
- IK has a valuable contribution to make to other knowledge systems;
- IK can mobilize to change indigenous practices that may pose a constraint to the social wellbeing of a local community;
- IK provides problem-solving strategies for local communities, especially the poor. It represents an important component of global knowledge in development issues;
- It helps to assure that the end-users of specific development projects are involved in developing technologies appropriate to their needs;
- It encourages participatory decision-making and the formulation and effective functioning of local organizations;
- Indigenous knowledge has two 'powerful advantages over outside knowledge, it has little or no cost and is readily available';
- Indigenous knowledge systems and technology are found to be socially desirable, economically affordable and sustainable, it involves minimum risk to rural farmers and producers, and they are widely believed to conserve resources.

One of the main advantages of IK, in respective of the water sector, is that indigenous practices may provide an intermediate solution to water and sanitation backlogs. In the long term it may be possible to adapt some to the practices to provide a sustainable solution to conventional water and sanitation service delivery options and to managing our current natural resources in an environmental sound manner.

2.6 Limitations of Indigenous Knowledge

Although, IK is currently used as a tool for local development and natural resources management such water and waste; it is not subject to critiques for the simple reason that it is often argued that indigenous peoples have a monopoly of local knowing, good understanding of natural resource, because they are living in the area for the generations therefore, they are familiar with their natural resources and local environment. However due to the migration of people across different ecological zones in search of work and a better living has resulted in people not fully understanding their new environment. This has contributed to an incomplete IK base and altered indigenous practices.

Given that indigenous originate in cultural believes and customs it is possible that some practices based on the mistaken beliefs, faulty experimentation, or inaccurate information can be dangerous and may even be a barrier to improving the wellbeing of other people

The social structures, which generate indigenous knowledge and practices can break down due to pressure on indigenous peoples to integrate with larger societies, as a result IK can be eroded by wider economic and social forces. In some instances, social prejudices by different religious and cultural beliefs may put pressure on indigenous people to be ostracized for indigenous practices that are not seen as modern or Christian practices. In these cases one is likely to encounter social resistance to a particular indigenous practice.

Sometimes IK that was once well-adapted and effective for securing a livelihood in a particular environment becomes inappropriate under conditions of environmental degradation;

When change is particularly rapid or drastic, the knowledge associated with them may be rendered unsuitable and possibly damaging in the altered conditions.

It is necessary to understand the limitations of IK before it can be adapted for current practices.

2.7 Measures to Preserve Indigenous Knowledge

Due to rapid socio-cultural, environmental, economic and political changes worldwide, it is likely that IK may be lost eternally. More specifically in Africa were IK is not well documented instead it is story telling transmitted from generations to generations. An African saying is, ‘when an elder dies, it is like a library burning’.

Globalization has introduced new generations to different lifestyles and values resulting in a breakdown of indigenous networks. Elders no longer pass their knowledge onto children, in some cases, the actual existence of indigenous people themselves is threatened. This phenomena is recognized globally as a threat to preserving and saving IKS’s and IK itself. In 1998 the World Bank introduced the following techniques to preserve IK:

- Record and use IK: document IK so that both the scientific and local community has access to it and can utilize it in the formulation of sustainable development plans.
- Raise awareness in the community about the value of IK: record and share IK success stories in songs, plays, story-telling, videos and other traditional or modern means of communication. Encourage people to take pride in their knowledge.
- Help communities record and document their local practices: Get local people involved in recording their IK by training them as researchers and providing means of documentation.
- Make IK available: disseminate IK back to the community through newsletters, videos, books and other media.
- Observe intellectual property rights: have agreements so that IK is not misused and benefits return to the community from which it originated.

IK can only successfully be preserved if Governments commit to protect IK through policies and legislation and actively monitor the abuse of indigenous practice for commercial gain.

3 INDIGENOUS KNOWLEDGE POLICY TRENDS: AN INTERNATIONAL PERSPECTIVE

In recent years the international community has moved towards more open and collaborative policy and legislation formulation, this includes consultation with and recognition of the contribution made by indigenous representatives. The World Water Council and the World Commission on Dams has given prominence to the land and water rights of indigenous peoples and has endorsed the principle of protecting the rights of indigenous people. This support has contributed to the debate on indigenous practices and its relevant to the development of projects. The 2003 World Water Forum in Kyoto was a milestone in that Indigenous Peoples were invited to contribute to key decisions in the water sector. This approach was further supported in the 2009 The World Water Forum in Mexico City and Istanbul.

The use and exploitation of IK by other nations has become a subject of conversation at many international forums. Intergovernmental organizations have opened debates on the possible protection of IK. Led largely by debate from developing nations, UNESCO formulated the Convention on the Protection of the Diversity of Cultural Contexts and Artistic Expressions which was recently adopted recently by the member states.

Unfortunately, negotiations at the 2006 World Trade Organisation meeting on amendments to the agreement on Trade Related Aspects of Intellectual property Rights surrounding IK failed. Many Developed Countries oppose the formulation of treaties and agreements on the protection of indigenous practice without a better understanding of its implications. Subsequently an Intergovernmental Committee was established to initiate discussion on the protection of IK, genetic and biological resources and folkore using intellectual property systems.

The United Nations Environment Programme (UNEP), which is the custodian of the Convention on Biological Biodiversity, has requested the international community to consider the protection and benefits of local communities that have contributed to an invention or intellectual property development. Furthermore, regional organizations such as the African Union have started to issue treaties and conventions regarding the regulation of IK.

In 2003, at the 3rd World Water Forum held in Kyoto, Japan it was acknowledged that in order to stimulate global awareness of water problems, to progress policy debates, to help generate action from the debates and ideas centred around the World Water Vision, and to contribute to concrete solutions of world water problems, the forum had to focus on improvement of lives of the poor by using local expertise and knowledge. The Forum's secretariat has initiated the "Water Voice" project aimed to solicit grass-root views on water problems and solutions, which has so far drawn an estimated 30,000 messages from both individuals all over the globe who suffer from water problems as well as those who value water resources. Through this project it can be demonstrated that local communities implement their own solutions when governments fail to act. These solutions are largely informed by IK of the area and indigenous practices.

At the 4th World Water Forum held in Mexico City in 2006 a call was made for indigenous people to be actively involved in areas were private sector involvement on water provision failed.

In March 2009, the WWC organised the 5th World Water Forum (WWF) in Istanbul, Turkey with the theme of 'Bridging Divides for Water'. The Forum placed particular interest on increasing recognition of the value of local knowledge for natural resource management, among other key objectives of the Forum. The Forum facilitated discussions around how best to attain proper protection of indigenous interests in water and explored how indigenous knowledge can be recognised as specialist knowledge and used together with modern knowledge in water management systems.

It can be concluded that there is open recognition from the international community that IK and indigenous practices must be protected and incorporated into scientific solutions.

4. INDIGENOUS KNOWLEDGE POLICY TRENDS: A SOUTH AFRICAN PERSPECTIVE

4.1 Overview

IK in South Africa was previously not recognised however, it has recently received more attention after our new found democracy in 1994. Although, this is seen as a step in the right direction, much more still needs to be achieved to integrate IK into South African policies and legislation for future development. The focus of indigenous practices in South Africa is on traditional medicine and agricultural practices, very little literature is available on IWWM. According to Hart & Vorster (2006:16), approximately 80% of the African population use traditional medicines to meet their healthcare needs and the vast majority of sub-Saharan Africans dependent on resource-poor agriculture for their livelihoods. The South African Government has therefore taken an aggressive approach to protecting local IK and practices through recent policies.

In 2004 the Department of Science and Technology introduced the IKS Policy which was approved by the South African Arts and Cultural Portfolio Committee.

South Africa's approach to IK is hailed as progressive and comprehensive when compared to other African States. However, there are still some gaps especially in terms of practical implementation. Current policies discuss the need to integrate IKS into the education system, but do not propose how this can be done, although the IKS Policy does discuss the transformation of a content-driven syllabus to a problem solving one as creating impetus for the recognition of IKS.

4.2 Review of South African Legislative Framework

4.2.1 Indigenous Knowledge Systems (IKS) Policy, 2004

Against a background of mounting international pressure to consider IK in development solutions, the South African Government decided to formalise its initiative to enhance and protect IK in the country through existing systems such as the intellectual property systems, databases and registers. However, it was agreed that these systems fall under the mandate

of different government departments and has crosscutting implications. After much consultation it was decided that the only way of ensuring a cohesive approach was to develop an IKS Policy. Hence, in 2004 the IKS Policy was introduced as a commitment from the South African Government to the recognition, promotion, development, protection and affirmation of IKS in the country. The Policy is the product of extensive consultation, scholarly reflection, debate and participation from a range of stakeholders including practitioners and owners of IK. The IKS is seen as a framework to stimulate and strengthen the contribution of IK to social and economic development in South Africa. There are four key drivers advocated in the IKS Policy, namely:

- The affirmation of African cultural values in the face of globalization, a clear imperative given the need to promote a positive African identity;
- Practical measures for the development of services provided by IK holders and practitioners, with a particular focus on traditional medicine, but also including areas such as agriculture, indigenous languages and folklore;
- Underpinning the contribution of IK to the economy, the role of IK in employment and wealth creation; and
- Interfaces with other knowledge systems, for example IK is used together with modern biotechnology in the pharmaceutical and other sectors to increase the rate of innovation.

To implement this policy, the following functions, institutions and legislative provisions are made:

- An Advisory Committee on IKS, reporting to the Minister of Science and Technology;
- A development function; including, academic and applied research, development and innovation in respect of IKS;
- A recordable system for IK and IK holders; where appropriate, to pro-actively secure their legal rights;
- The promotion of networking structures among practitioners, to be located in the Department of Science and Technology; and
- Legislation to protect intellectual property associated with indigenous knowledge, to be administered by the Department of Trade and Industry.

4.2.2 Protection of Indigenous Knowledge through the Intellectual Property Policy

In 2006 the Department of Trade and Industry introduced the Protection of Indigenous Knowledge through Intellectual Property Policy. The aim of the policy is to:

- Describe how the various forms of the South African intellectual property systems, trademarks, geographical indications, patents, designs and copyright can be used to protect IKS;
- Present a business and economic case as to why there is a need to protect and commercialise issues pertaining to IKS; and
- Present conclusions and recommendations on how best to implement this protection, including the amendments of intellectual property legislations to be aligned with the objectives of the IKS Policy.

The purpose of the Protection of IK through Intellectual Property Policy is to argue for the protection of IK using present Intellectual Property systems. Thus far, the Protection of IK through Intellectual Property Policy has not been used to protect any IK, but has in fact been used to deter the use of IK without benefitting the knowledge holders. The benefits of the Protection of IK through Intellectual Property Policy include the improvement of livelihoods of IK holders and communities, to benefit national economies, to conserve the environment, to prevent bio-piracy and to provide legal protection.

From the above it can be concluded that South Africa has created a policy environment that is conducive for the enhancement of IKS.

5. STAKEHOLDER CONSULTATION

5.1 Key Stakeholders

Identifying IKS in South Africa requires detailed consultation with a broad audience of specialists including Historians, Archaeologists, Anthropologists, Traditional Healers and Practitioners, Research Institutions, Museum Curators, the Department of Science and Technology, the Department of Trade and Industry, IK holders, Missionary Officials and community elders, etc. In order to meet the project timeframes and work within the project budget, key stakeholders were identified. A questionnaire was sent to each stakeholder and an interview was held.

Traditional authorities are the formal custodians of the customary values of the communities, which are historically and constitutionally entrusted to them. The existence of traditional leadership in the IWWM field is significant; in fact, no IWWM strategy will work if indigenous leaders and local communities are not directly or actively involved.

Local Government in South Africa has constitutional responsibilities for the provision of water and sanitation services. Many municipalities have local economic development programmes in place to develop IK while creating an environment for sustainable livelihoods such as indigenous agricultural practices in rural areas to ensure food security. The focus of indigenous practices by Local Government is on agricultural practices, use of medicinal plants to treat certain ailments and the inclusion of IK in the school curriculum. Little to no information was found at a Local Government level to support IWWM.

Local communities are essential to identifying and understanding IKS. Although various community leaders were approached, the team was unable to identify any current uses of IKS. In addition, many elders explained that they could not remember any stories from their elders that could provide information on water and sanitation management in the past. Although it was very clear that everyone understood the need to protect the water resource from any form of pollution and the need to treat water from rivers before use.

Various scholars and academics were interviewed to tap into their vast IK pool. Several academic and researchers lecture on IK and its impact on environmental management.

Researchers and academics have a world view on the new paradigm shift that IK should inform policies for water use and waste management.

5.2 Interviews

Individuals and organisations were identified from the list of key stakeholders mentioned above. Each individual was requested to complete a questionnaire, in addition an interview was held either telephonically or in person with each individual. The intention of the interview was to identify potential indigenous practices in South Africa that could be documented hence provide the content material for a coffee table book.

Below is a list of key stakeholders identified as part of the study.

Table 1: List of Key Stakeholders

Name and Surname	Organization
Dr Queeneth Mkabela	Indilinga African Journal of Indigenous Knowledge Systems (Editor in Chief)
Professor Mashela	University of Limpopo: Department of Science and Agriculture
Mr Khanyile	University of KwaZulu-Natal
Professor Bob	University of KwaZulu-Natal
Professor Mark Dent	University of KwaZulu-Natal
Dr David Henson	HSRC
Professor Chris van Vuuren	University of Witwatersrand
Prof David B. Coplan	University of Witwatersrand
Stephen Tollman	University of Witwatersrand
Professor Jona Kruger	North West University
Professor Maselesele	North West University
Lesley Green	University of Cape Town: Social Anthropology
Alex Schoeman	Wits: Department of Archaeology
Prof Chris.Boonzaaier	University Pretoria: Department of Anthropology and Archaeology
Prof Johann D Kriel	University Pretoria: Department Anthropology and Archaeology
Mrs Lynn Cable	University of Cape Town: Department of Archaeology
Mrs Sharon Cloete	University of Cape Town: Centre for African studies
Mrs Alicia	University of Stellenbosch: Department of Geography and Environmental Studies
Prof Hannes van der Merwe	University of Stellenbosch: Department of Geography and Environmental Studies
Mr Jan Peyper	University of the Free State: Department of Anthropology
Mr Molefi Makola	University of Witwatersrand: Department of Anthropology

Name and Surname	Organization
Mr D Bekker	Rhodes University: Department of Anthropology
Professor Mugsy Spiegel	UCT: Department of Humanities
Professor Robin Palmer	Rhodes University
Dr Penny Bernard	Rhodes University
Michelle Cocks	Rhodes University: Institute of Social and Economical Research
Graham Ward	Award Training Skills Development: Managing Director
Nonzukiso Vinjiwe	Award Training Skills Development
Candy Godfrey	Award Training Skills Development
Professor Andre Duvenhage	North West University
Professor Rob O'Donoghue	Rhodes University
Professor Eric Nealer	North West University
Professor Johann Tempelhoff	North West University
Professor Elize van Eeden	North West University
Justice (referred by Queeneth Mkabela)	KwaZulu-Natal Women Co-Operative
Agnes Rankoana	University of Limpopo
Quraishia Merzouk	KZN Department of Agriculture and Environment
Sonja Blignaut	The Narrative Lab
Dr Pieter van Eeden	Eco Monitor CC
Kate Rowntree	Rhodes University
Tim Hart	Centre for Poverty, Employment and Growth
David Morris	Wits Archaeology Department
Jonathan Coplan	Archaeologist
Dr Gilbert Motlalepula Matsabisa	Indigenous Knowledge Research Unit
Queeneth Mkabela	Editor of the Indilinga African Journal of Indigenous Knowledge Systems
Prof C Vogel	Department of Geography & Environmental Studies University of Witwatersrand
Dr J Mugabe	African Commission on Science and Technology National Research Foundation
Dr O Ntsoane	Department of Culture University of North West
Ms B Njobe-Mbuli	Department of Agriculture Agriculture Building
Mr AJ Hay	Engineering Council of South Africa (ECSA)
Mr D Botha	Executive Director South African Institution of Civil Engineering (SAICE)
Prof HC Jatti Bredenkamp Chief Executive Officer Of IZIKO Museum	IZIKO Museums of Cape Town
Sipho Zulu Research Officer	ULWAZI Sharing Indigenous Knowledge
Prof Sandile Gxilishe	Section Head (African Languages) University of Cape Town

Name and Surname	Organization
Professor Robert James Thornton	Department of Anthropology University of the Witwatersrand
Dr Anand Singh	University of KwaZulu-Natal
Dr Andreas Gerhardus (Dries) Velthuizen	Centre for African Renaissance Studies, University of South Africa (Academic Associate)
Prof Chris Buckley	Pollution Research Group/School of Chemical Engineering, University of KwaZulu-Natal, Durban, South Africa
Dr Zoë Wilson	Pollution Research Group/School of Development Studies, University of KwaZulu-Natal, Durban, South Africa and Massachusetts Institute of Technology, USA,
Rob O'Donoghue	Rhodes University, South Africa

5.3 Outcome of the Interview Process

Identified stakeholders were requested to provide input on indigenous practices on water collection, transportation, storage and treatment; and wastewater collection, treatment and disposal. Wastewater was defined as water from the toilet, kitchen and bathroom.

In excess of 30 questionnaires were administered however only 5 were completed. The response from the stakeholder consultation process was disappointing. This does not suggest that stakeholders are not keen to assist, however the response bears testimony to the lack of documented IK on IWWM in South Africa. Many stakeholders could not provide any information on IWWM in South Africa because there is no literature available. When no completed questionnaires were forthcoming, the researchers decided to abandon the approach and focussed time on individual interviews.

Below is a summary of the outcome of the interviews.

Table 2: Summary of Interviews

No	Aspect	Comment
1	Definition	Stakeholders could not agree on whether IK or traditional knowledge was more appropriate to describe local knowledge and practices in South Africa and many could not agree on a common definition of IK. Many stakeholders did not accept that there is a difference between IK and innovation which often sparked a debate on what is the line between the two concepts. It was explained that one of the challenges of working in the area of traditional knowledge is not the lack of appropriate terminology, but the diverse meanings and connotations associated with existing terminology. Many of the words used to describe issues in this field have different meanings in different localities with a single language, let alone regions with a variety of languages. Furthermore, since words or phrases have often developed very specific connotations in specific, local contexts, it is often difficult to translate the linguistic context of a word into another language. It is therefore not surprising that different international fora and processes working in the field of IK have adopted diverse definitions and South Africa has not provided a fixed definition of IK. Although IK and traditional knowledge are used interchangeably there is a subtle difference between the two terms. For the purpose of this research study, IK will be used. In addition, there isn't a well-accepted definition for IK in South Africa. Individuals and institutions use varying definitions.
2	Legislative and Policy Framework	Everyone interviewed agreed that although South Africa has a created an enabling environment for implementing IKS not much has been done. The IKS Policy and the Protection of Indigenous Knowledge through Intellectual Property Policy provide a platform for advancing IK in South Africa however an action plan is needed to implement these policies.
3	IWWM Case Studies in South Africa	Everyone interviewed, except the traditional healers and a few archaeologists could identify any IWWM practices in South Africa. The archaeologists made the following claims: • The use of clay pots to transport and store water dates back many centuries in South Africa; • Although it is no longer practiced, the Koi San people in the Northern Province used

No	Aspect	Comment
		ostrich egg shells to collect water from dry river beds; • Stories about water serpents were often told and it is thought that these stories were used to deter people from polluting the water; • Indigenous people often settled close to a water source to limit the transportation of water; and • Water sources were not polluted therefore there was limited need to treat the water before consuming it. The Traditional Healers Organisation identified the following IWWM practices in South Africa: • Indigenous Nguni people used Jin and Aloe juice to treat before use; • Another technique of purifying water among Nguni people is to add ash from wood or palm trees with ½ teaspoon of Jin in boiled water which is allowed to cool for two hours before it can be used. • Nguni use leaves from the Umsutane tree to clean and wipe their hands after attending a ceremony. This is seen as removing bad luck and to clean your hand. • Also the Isganamba plant is added to water before cleaning one's hands. The plant acts as a disinfectant. Although not directly linked to IWWM practices T Hart explained that every year, before the rains would start and mark the beginning of the farming period, an environmental cleansing ritual was performed. The chief, counsellors and traditional doctors were responsible for ensuring that the environment was purified, so that when the rains started, the dirt was removed from the forest and veld, and the water did not carry carcasses into wells and rivers.

No	Aspect	Comment
		It was agreed by all interviewed that although literature may exist on IKS and practices in South Africa almost no literature is available on IWWM practices in the country. I
4	Recommendations	The Department of Arts and Culture should invest in a national scale awareness campaign is necessary to market South African IK. The existing policies developed to protect IK should be demystified and translated into an action plan. The Department of Trade and Industry should invest more money in trying to commercialise some IK which will serve to promote South African IKS. Many interviewees indicated that the coffee table book should include both international and national case studies. This project has the benefit of sharing knowledge on IWWM practices which remains undocumented at the moment. The findings of this research study should be assessed to determine it can be adapted for the South African environment.

6. INTERNATIONAL IK CASE STUDIES RELATED TO IWWM PRACTICES

Initially the research team focused on identifying as many indigenous practices related to the water and sanitation field. These include indigenous land-use systems to encourage labour-sharing arrangements among farmers, using IK to increase the efficient use of natural resources, understanding indigenous institutional practices, etc. The aim was not only to identify international case studies but to assess how indigenous practices have adapted and responded to current conditions.

Below is a summary of some of the international case studies. Please note that the case studies may not all be related to IWWM practices instead they may be related to the water sector at large which includes agricultural use.

6.1 The Hydraulic Noria

The hydraulic noria remains one of the most significant Syrian contributions; the system is an installation which, using the power of the river raises water to irrigate fields which are usually at a higher level than the level of the water. The system is composed of two main parts, a wheel and the aqueduct. The wooden wheel has the base submerged in the river and turns because of the current. Water is transported through compartments or pots placed on the periphery of the rim of the wheel, and are carried into the channel on the top of the aqueduct, and are directed to irrigate fields and gardens. The Orontes valley, in West Syria, has been the ideal place for the development of numerous hydraulic norias. They were employed for irrigation until the 1960s when they were replaced by modern pumps**.** This system has significant environmental advantages, it is an economical and clean technology. It allows irrigation requiring no petrol or oil, but exploiting the power of the river. The installations are also well integrated into the landscape, using materials easily available in the area.

6.2 Qanat (Iran)

Due to the geographical location and climatologically condition, Iran has arid and semi-arid environment, covering about 90% of the country. In dry lands quantitative and qualitative water resource limitations have been one of the main obstacles in sustainable development. Since ancient times oasis inhabitants developed an understanding for the need to adapt to the dry environment, and, in order to access the sustainable development goals, using their indigenous knowledge and experiences, have innovated traditional methods for rational water resources usage and management such as the Qanat (ibid).

The concept Qanat (from a Semitic word meaning "to dig") is a mostly developed Iranian old indigenous irrigation system used in a dry environment due to the geographical location and climatologically condition. As illustrated in the figure 1 below, the Qanat system consists of underground channels that convey water from aquifers in highlands to the surface at lower levels by gravity and supplies 75% of all the water used in Iran, providing water not only for irrigation but also for house-hold consumption (Reij, 1991). Usually Qanat is constructed underground at infinite toil and expense, through a large tract of country and brought water to the desert from sources that were mysterious to the people who use the water now. To establish a Qanat would require a source of water, this can be a real well, an underground reservoir or a water-bearing geological layer accepted as a damp area through this source, a tunnel is cut to the farm or village that needs the water.

Figure 1: Inside View of Qanat, Source: http://www.livius.org/q/qanat/qanat.html

6.3 The Khoi San People

The San, also known as *Bushmen* or *Basarwa* (in Botswana) are former hunter-gatherers living today in Botswana and Namibia, and to a lesser extent in South Africa, Angola, Zimbabwe and Zambia. Residing primarily in small, scattered settlements in remote areas, or as farm workers, the Khoi San people are more likely to carry the tradition of indigenous practices than most other grouping of people in South Africa.

The San tribe of Southern Africa have used for thousands of years the 'ostrich eggs shells' as water containers for water collection and storage technology in desert areas. They made use of tortoise shells to transport the water while the ostrich egg shell container was left in the river bed to collect more water.

Figure 2: Ostrich Eggs Containers; Source: Tihalefang and Oduaran (2006)

The Basarwa store water in egg shells buried in the ground. The Basarwa have developed a system of locating water sources. Adult men taught younger boys how to locate water sources. Firstly, the men would trap a baboon or a monkey and tie it on a tree for a long period of time. Secondly, the animal is fed with salt to induced thirst. Thirdly, after sometime on closer observation, the animal is released and tracked, it is believed that the animal would always lead them to a water source.

6.4 Stone Lines

It is usually in Niger, stone lines (Houssa term: gandari) have been laid out mainly by the people living on the plateaus to conserve water and trap windblown sand. They are often laid out in straight lines, but in some cases efforts are made to follow contour lines. It is impossible to establish how many hectares have been treated with gandari as they are dispersed over a large area (Reij, 1991).

Figure 3: Illustration of Stone Lines

The stone lines lay along the contours of gently sloping farmland to catch rainwater and reduce soil erosion (ibid).

6.5 Planting Pits

Planting pit is mostly practiced in Mali by farmers to retain more water around crops. This practice has been introduced since 1985 (Reij, 1991). The pitting of crusted barren land is increasing rapidly.

Figure 4: Planting Pits Method, Source: Google image

According to Reij (1991) Planting Pits method is largely used in the areas where farmers do not have access to irrigation; therefore, they rely on rainfall for all their crop production, and thus, are subjected to the recurrent problem of insufficient and unreliable rainfall. Planting pits are also known as zai (or zay) pits or 5x9 pits depending on shape and their dimensions. The method involves growing field crops in holes of various sizes and they are recommended for relatively low rainfall areas, or where moisture conservation is desired, to enable a crop survive drought and increase production.

6.6 Terracing

Terracing is one of more practiced indigenous water harvesting in Morocco; the expansion of the terraces is related to the cultivation. According to Reij (1991) the materials used for the construction of terraces include: clay and stone is most commonly used in the construction of terrace risers and benches.

Pandit and Balla (2004) note that there is several type of terraces – in steeply sloping areas, farmers preferred to construct outward sloped terraces; the construction of level or reverse sloped terraces in the higher slope classes requires more cutting and filling of earth. Outward-sloped terraces were the most common, comprising 55% of the total, followed by level terraces, with 35% of the total number of terraces. Reverse-slope terraces were least frequently observed, with only 10% of the total; they occurred only on the higher class slopes.

6.7 Traditional Teras Cultivation

Teras is largely practiced in Sudan, it is a track form of water harvesting used extensively in the day plains of Eastern Sudan, The word teras itself refers to the eastern bund which surrounds three sides of each cultivated plot and impounds runoff from the plains. Essentially, water falling on a plot of land is contained on the site by constructing bund walls around the site to impound the water.

6.8 Tabias and Rock Bunds

A tabias is an earthdam which is usually 2,5 m high and is approximately 100 m long. The tabias is often constructed across a valley floor, to control and contain floodwater.

A rock bund is a micro-catchment rainwater harvesting system mostly practiced in Western Africa. It is used for several years to trap water for crops during the rainy season. The rock bunds are placed on contour lines. Their length is variable (the bunds must not be too long), with wings folded in the upslope direction. There exist several ways of constructing rock bunds: with or without ditches, with single rows of stones or with more stones piled up against each other. Rock bunds depend on soil type, on the position of the field on the top sequence, and – not least – on rainfall. Rock bunds influence yields both in the short as in the longer run. In the short run, rock bunds especially seem to improve the water balance; in the longer run nutrient availability may gradually increase.

6.9 Elders Stories and Experiences

Many IK practices and IKS are recorded in stories told by elders to young children. This was the main medium for communicating and maintaining cultural and traditional history.

Below, are some typical stories containing IK.

In India, certain types of caterpillars (*Helicoverpa sp.*) are a big problem for farmers who grow pigeon peas (*Cajanus cajun*). Until a few years ago, most farmers in the Mahabubnagar district of Andhra Pradesh State used chemical pesticides to control the caterpillars, which were polluting open water sources. The chemicals were expensive and not very effective. Then an elderly farmer named Mister Bitchappa told the pigeon pea growers about a story he was told as a boy. When the caterpillars came to the field the elders would go out and move around the field and gently shake the caterpillars off the plants, they would collect the caterpillars in a sheet or a large piece of cloth. One person would drag the sheet along the ground in the space between the rows of plants, while the other two people would shake the plants. The hens in the community would be herded into the field and to walk behind the men shaking the trees.

For a long time, the method that Mr. Bitchappa describes was not well accepted by agricultural scientists. They thought that this method was inefficient, and expensive because of the cost of labour. But recently a major scientific institution in India did a study on the shaking method, they found that it was both economical and efficient. It is cheaper than using chemical sprays, even with the labour costs included. It's also more effective. As a result, many Indian farmers in India are returning to this old method.

Gonese, (1999) noted that in a place called Zimuto, in Zimbabwe, water is scarce and droughts are common. Droughts cause crop failures, declining herds and depleted groundwater. People grow crops that will survive droughts, such as groundnuts, millet and sorghum. In Zimuto, traditional beliefs and customs help people to care for the wetlands. There is the story of a nearby wetland called *Chitafina.* People believe that this wetland was created when a traditional ceremony was held. After the ceremony, lots of water began seeping out of the ground. From that time on the wetland grew. Soon after the wetland was created, women made ridges on the wetland so they could plant tubers. But then a lion was seen stretching himself on the ridges. The people understood this as a sign to stop growing crops there. Local spirit mediums recommended abandoning the ridges. People were forbidden to enter the area. From that time on the wetland developed well. Many plants grew – including some important medicinal plants. There was plenty of water in the wetland. But once again when the people began to disturb the wetland, it began to dry up. Vegetation disappeared. People again interpreted this as a sign from the spiritual world. So they revived the traditional way of using the wetland. Medicinal plants started to grow again. The wetland is again flourishing. It is an important source of water in the area.

6.10 Roof Tanks and Wells

In many rural area and in certain case urban areas of Africa including in the Democratic Republic of the Congo; a network of indigenous individual roof tanks and wells have developed over the centuries which enabled the population to benefit from seasonal rainwater and from the underground water table. Water collected in the roof tanks is used for drinking and cooking, while water from the wells is used to satisfy other domestic needs such as bathing, washing, cleaning, etc. The necessity of preserving these resources from all sources of pollution imposed strict community hygiene rules that are respected by all.

6.11 The Zai System

The “Zai “is an indigenous water harvesting and soil fertility management practised by Mossi ethnic group farmers in Yatenga Province in Burkina Faso. Boven and Morohashi (2002) noted that the *zaï* method of water harvesting is seasonal, practised each year as necessary and it is used to rehabilitate degraded land known as *zî-peele*, which is frequently found on relatively flat land on which no crops can be grown. Early during the dry period, Mossi farmers use traditional picks to dig holes 10-20 cm deep and 20-40 cm in diameter; the consequential superficial pits are spaced 80-120 cm apart throughout the area being treated and the earth removed from each pit is carefully piled in a half-moon shape along the pit’s lowest edge so that runoff water will flow downhill into the pit. It is a form of pitting which consists of digging holes that have a depth of 5-15 cm and a diameter of 10-30 cm. Manure and grasses are mixed with some of the soil and are applied in combination with bunds to conserve runoff.

According to Boven and Morohashi (2002), in early May, with the first rainfall, farmers begin to prepare the pits for planting. In each one they put about two handful of organic waste, generally from animals; attracted by the organic matter, termites dig deep tunnels beneath the pits, which by now are shaped like funnels. Through the practice of *zaï*, both water and nutrients are concentrated in the pits, where in early June the farmers plant the seeds. The increased water retention capacity of the soils helps crops tide over drought spells during the rainy season – the following year the practice is repeated, except that new pits are dug between the old ones – within five years, an entire area of land that had been degraded and useless can be totally rehabilitated to produce yields where previously nothing could be harvested (ibid).

6.12 The “Daldal” System

The “Daldal” system, practised by Irob ethnic group in northern Tigray, Ethiopia, is an indigenous dam constructed to trap silt and water. The, Irob ethnic group are pastoral people who survive on the exchange of cereals for their livestock products. They have developed site-appropriate methods to capture soil and water for cropping by building a series of check dams in the seasonal watercourses, they raise and lengthen the walls every year and then they create step-like terraces that are now about 8 m wide and up to 10 m high, with about 20 m between dams.

6.13 Water Treatment Using the 'Moringa oleifera' Tree

According to Boven and Morohashi (2002:104), Moringa is an indigenous tree largely cultivated and in wide use by health workers and individuals in the Casamance region of southern Senegal. The tree is also found throughout the world in the tropics and sub-tropics. The fruit and leaves of the tree featured in the diets of many African countries and India. Seed kernels of the tree act as a natural flocculent and are used by people in Sudan to purify the turbid waters of the Nile.

6.14 The Deccan Trap

The Deccan Trap originated in the Deccan plains of India. The system is a combination of indigenous water conservation practices adapted to modern approaches to water-resource management. The practice includes various barriers and shallow excavations at right angles to the slope to arrest the flow of surface runoff, as well as contour hedging and the replanting of non-agricultural land. The technologies also uses masonry tanks to contains water from springs, seepage and wells that are dug are deepened to make better use of existing aquifers and water from the roofs of dwellings and domestic wastewater is used to irrigate small kitchen gardens adjacent to dwellings.

6.15 Fishing Traps

Indigenous fishing traps were extensively used by the Oba ethnic group along the Ose River in Nigeria. It is said that because people were dependent on fish as a staple protein source, the water resource was treated with great respect. It was never polluted or overused, there a natural sense of balance between human consumption and what the natural river could provide.

As indicated in the figure 4 and 5, there are two forms of traps fishing among the Oba including – small trap fishing is usually done during the rainy season, from April to October, when the tide is high and there is a lot of water in the forest ecosystem – big trap fishing is done during the dry season, from November to March, when bigger fish that come in with the tide are left behind in small pockets of water in the forest when the tide recedes (Boven and Morohashi, 2002).

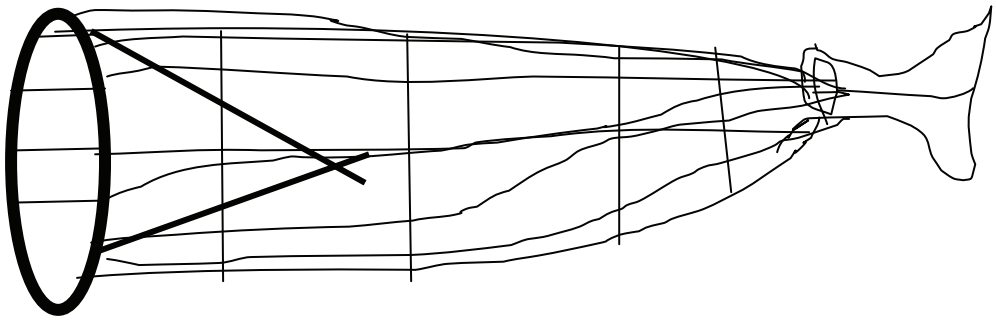

Figure 5: Small Fish Trap, Source: Boven and Morohashi 2002: 62.

6.16 The Ngoro and Matuta Soil and Water Conservation Systems

Indigenous farmers in the Mbinga district combined indigenous soil and water conservation techniques to increase their productivity to form the Ngoro and Matuta systems. The Ngoro system facilitates farming of land with steep slope (10-60%) reducing soil erosion, preserving productiveness and increasing the moisture content of the soil, containing water in the soil. In the Matuta system plant residues is piled into ridges and laid into furrows before being covered with soil dug from old ridges. The Matuta system has the advantage of increased soil fertility, soil improvement and the organic material acts as mulch hence decreasing water consumption for irrigation purposes.

6.17 Siwan Waste Water Management Practices

Siwa in Egypt is characterised by abundant groundwater resources, with as many as 220 natural springs and 1600 artesian wells. The Siwan people soon realised that their underground resources are subject to pollution from poor sanitation practices. In response, the Siwan toilet was created which is a form of composting no-flush carriage toilet. The toilet is similar to a pit latrine, but instead of digging a hole in the ground, the toilet seat is raised 1.5 to 2 meters above the ground. After each use, a batch of sand and a handful of ashes is used to cover the excreta. The process goes on for as long as two years until the chamber is filled with sand. The chamber is then emptied and the product used as a fertilizer.

6.18 Karaisali Waste Water Management

Like Siwa, Karaisali in Southern Turkey developed a wastewater management system that is still in use. The Karaisali system uses decentralized treatment through pond systems which discharge treated wastewater into existing irrigation channels for soil enrichment (EQI, 2001).

6.19 Gravity Water Tanks, Canals and Public Fountains

The City of FEZ in Morocco was declared a universal historical site by UNESCO in 1980 because of its significant and vibrant indigenous practices and its role in the development of Morocco. The City has a rich background in indigenous water resource management and is well endowed with a broad matrix of traditional water systems such as household gravity water tanks, community distribution canals, and public fountains that facilitated storage and filtration of sufficient water supplies.

6.20 The Gawan System

The Gawan system is a water harvesting system commonly practiced in Somalia; it holds rainfall effectively in situ and where runoff is harvested; it works best where an overflow is provided for, around side bunds (Reij, 1991). The Gawan system is used where the land is almost flat and where is less runoff. Small bunds are made which divide plots into "grids" of basins.

6.21 The Caag System

Caag is a water harvesting system largely practiced in Somalia. Environment Quality International (2001) noted that the Caag is a micro-catchment water harvesting system used where slopes are above 0.5% and there is significant runoff to be harvested. These are long slope, external catchment systems. Water may be diverted into the plot, commonly from small toogs or even road drains. Caag system uses diversion channels to redirect small water courses, gullies or roadside drains into the cropping area through the use of earth bunds.

6.22 Rainwater Storage Ponds “Lacs Collinaires”

Rainwater storage ponds called “lacs collinaires” of Tunisia and Algeria are reservoirs created by small earth dams traditionally used for agricultural purposes as well as for watering livestock and other domestic animals. These lakes are integrated naturally into the landscape and provide rural communities with real opportunities for small scale multiple uses of water. The construction of rainwater storage ponds had a multitude of benefits namely: protection against floods and against the degradation of downstream infrastructure (towns, roads, agricultural areas, etc.), dissemination of water points in the landscape (food, livestock watering, irrigation, etc.), regulation and conservation of water flows (catchment runoff, groundwater recharge, etc.), improving the environment (creation of oases, extension of afforestation and fight against soil erosion, development and improvement of farming (orchards, vegetables, livestock, etc.) and creation of new economic activities (fishing, recreation areas, second homes, tourism, etc.).

6.23 The Meskat System

The Meskat system is a traditional water harvesting system largely practiced in the Sahel region of Tunisia, where semiarid to arid climate with mean annual rainfall of about 300 mm prevails. The "Meskat" micro-catchment system consists of an impluvium called a "meskat", of about 500 m^2 in size, and a cropping area of about 250 m^2; both are surrounded by a 20 cm high bund, equipped with spillways to let runoff flow into the cropping area plots” (Palmback, 2004).

Figure 6: Meskat System, Source: Prinz, 1996

This form of water harvesting also allowed sheep, pigs and cattle farming which sustained a large stationary population, often wealthy, which created enough crops to generate a surplus.

6.24 The Mgoud Technique

The Mgoud technique is the traditional floodwater diversion technique commonly practiced in Central Tunisia. Floodwater is diverted from its natural course in wadi beds by solid dikes and lateral channels with minimal slope (“mgoud”) and then distributed by an extensive network of drainage channels to the nearby fields.

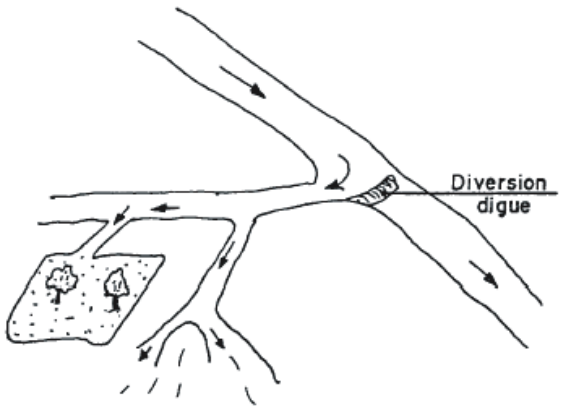

Figure 7: Mgoud Technique, Source: Prinz, 1996

6.25 The Khattara Water User Organization

Khattara is a traditional and contemporary water harvesting technology used in Morocco which falls under the supervision of the traditional khattara organization, composed of water users. A leader from the indigenous khattara representing a few hundred water users, will carry out khattara maintenance and rehabilitation works by fairly distributing their workloads and financial burdens proportionate to the water rights of each individual (EQI, 2001).

6.26 The Jessour System

The Jessour system is a traditional water harvesting system largely practiced in Tunisia. It is mostly used in mountainous areas, where the system is often built into wadis which can also be constructed on plains. The system is based on a series of stone and earth walls retention dams built perpendicular to the runoff. The dams collect and retain run-off water and silt washed down hillsides by rainfall, forming terraces in a stair-step fashion down the natural slope. The water is used to irrigate crops, mainly fruit trees.

Figure 8: Jessour System, Source: Belgacem cited by Meinzinger (no date)

6.27 The Cistern System

A cistern is a man-made hole in the soil with gypsum or cement coating to avoid vertical and lateral infiltration losses (Meinzinger, no date). A cistern is micro-catchment rainwater harvesting system built to collect and store rainfall. The water is used for different purposes including domestic consumption, irrigation and for livestock (EQI, 2001). The cistern is characterised by an underground reservoir with a capacity of 1 m^3 to 70000 m^3. In a natural environment the impluvium is demarcated by one or more grooves or small stone bunds conveying the runoff water towards the opening of the storage tank (Meinzinger, no date).

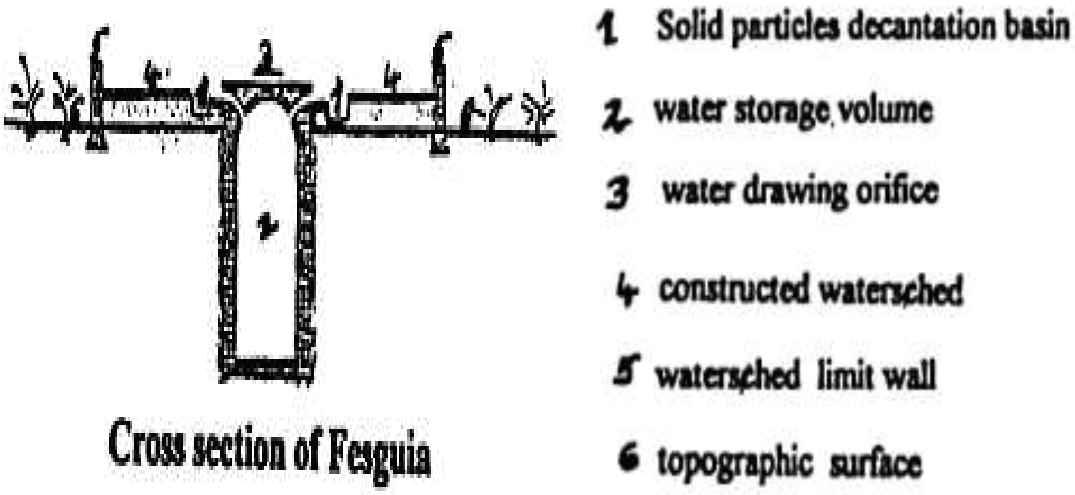

Figure 9: Cistern Systems Cross section of Fesguia Cited quoted by Meinzinger (no date)

6.28 Gabion Check Dams

Gabion Check Dams are the structures used for the purpose of slowing down the run-off flow so as to increase the infiltration rate to the underground water tables, and also in order to divert a portion of the run-off to neighbouring cultivated fields (EQI, 2001).

6.29 Recharge Wells System

Recharge Wells are micro-catchment water harvesting systems built to conserve water in many areas in Africa. When the permeability of the underlying bedrock is low, casting tubes may be drilled into the wadi beds to create recharge wells to enhance the infiltration of run-off water to the ground aquifer (EQI, 2001). This technique intends to increase recharge rate

of groundwater by facilitating the process of recharging rainwater. This scheme is highly significant not only because of its capacity to recharge shallow aquifers but also economically affordable for the local people. It construction is cheap and simple; it does not require scientific knowledge.

Figure 10: Recharge Well Technique: Source: http://www.indiawaterportal.org/node/6270

6.30 The Karez System

Karez is an indigenous water harvesting system largely practiced in the Turpan region of China. According to Environmental Quality Management (EQI, 2001), the karez system was designed to harvest, store and channel the valuable melting and flood water and provide irrigation water during the main growing season; where water is transported through gravity along the natural slope of the foothills at 900 m elevation towards the deepest part of the Turpan Basin. In China, the combination of a desert climate, abundance of groundwater, and suitable topographic conditions presented ideal conditions for the development of the karez system in the Turpan Depression.

7. IWWM CASE STUDIES IN SOUTH AFRICA

In 2005, the then Minister of Water and Environmental Affairs, Buyelwa Sonjica, said, “Our challenge is not so much to invent as it is to alter the way we think and act on how we use our water.,” “We don’t have the luxury of choice and time unfortunately — we must act now and do that decisively”. However, water use in South Africa requires a mind change for water users and service providers as well as a policy shift toward sustainability environment practices which includes considering IWWM practices.

The history of IWWM in South Africa is dominated by water as a collective good and a finite resource therefore; it was carefully protected and conserved. Very little written literature is available on the history of pre-colonial South African in relation to water and sanitation practices.

The early indigenous nomads of South Africa had no need to construct elaborate water supply systems and irrigation was unknown, they believed that fountains and springs would run eternally. The typical knowledge of a South African nomad consisted of a sophisticated understanding of water sources, water bearing plants and ideal locations for shallow wells. Their predictions were based on in-depth knowledge systems inherited from their ancestors and when elders predicted weather anomalies they reacted by organising and executing uNomkhubulwane (Zulu ‘Princess of Rain’) ceremony (Haarhoff et al., 2007: 133).

During drought periods, indigenous people planted the Umdolofiya tree which bears fruit that similar to a watermelon that has high water content. People used this fruit to quench their thirst.

Below is a summary of the some of the related Indigenous Knowledge (IK) practices identified through the consultation process and literature review.

7.1 Indigenous Water Collection

The early indigenous nomads of South Africa, women were responsible for collecting water from various water sources. Water was collected in clay pots, gourds and ostrich eggshells.

During heavy rains women were not advised to collect water from a river, common sense told people to put out pots to collect rain-water. River water was again being collected four days after the rains stopped and the water had cleared.

7.2 Indigenous Water Purification

Water cleaning and purification is central to indigenous South Africans, because clean water is necessary for both warding of bad spirits and daily living requirements.

According to the Traditional Healers Organisation water was and still is traditionally treated by adding aloe juice to the water before it can be boiled and consumed. In addition, another technique of purifying water is to add ash (from burnt wood or palm trees) to boiling water. The water is allowed to cool and the ash settles to the bottom of the container before it can be consumed.

7.3 Indigenous Water Storage

The early indigenous nomads of South Africa used instruments such as: gourds, ostrich eggs and indigenous clay pots (handmade using clay soil) to store drinking and cooking water. Women had mastered a skill of carrying large quantities of water using these instruments. Clay pots were considered excellent water storage vessels as it prevented the water from being contaminated with insects and household dirt. Clay pots were filled with water and covered with a collecting bowl, a piece of skin or a mat made from incema (Juncas kraussii) grass. The water would thus stay cool and fresh.

Cow skin containers were also used to store water especially during travels because the water does not evaporate.

Furthermore, Mbhatha et al. (2008) noted that traditional Zulus used water from rivers for washing and bathing while drinking water was collected from fountains and springs. It was believed that the water from a fountain or spring was purified by the soil. History on the Zulu people does not mention any historical records of waterborne diseases experienced. The Zulu tribe also used clay pots to store water.

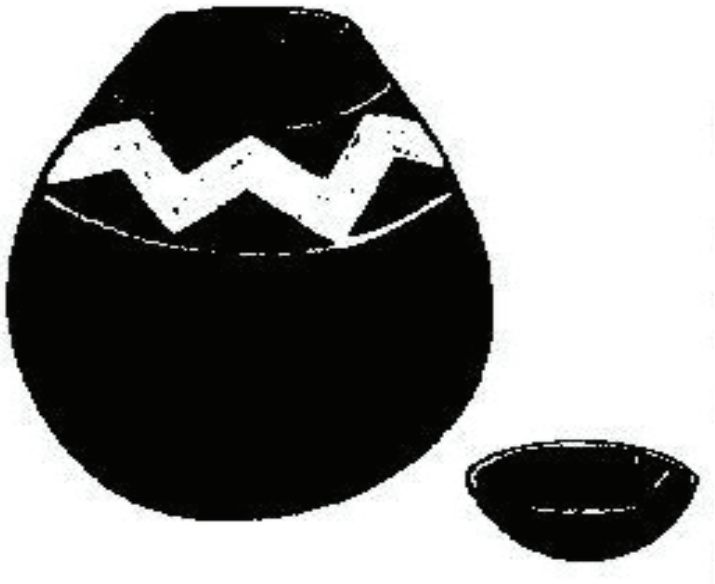

Figure11: Illustration of Zulu Clay Pot, Source: Mbhatha et al., 2008

The Luos clay pot is an adaptation of the conventional clay pot. It has a narrow mouth and flat base so that the pot is more stable for the storage of water. Water is drawn from the pots using a calabash or a cup to avoid contamination which is often the cause of diarrhoeal diseases. According to Boven and Morohashi (2002), the intention of the modified Luos' clay pots is to reduce the re-contamination of treated water during storage, and thus to decrease the incidence of waterborne disease transmission often the cause of diarrhoea in children under five years old.

Figure 12: Illustration of the Luos Clay Pot, Source: Google images

7.4 Indigenous Handwashing Practices

The early indigenous nomads of South Africa used handwashing as a historical legacy to promote healthier practices amongst the indigenous poor communities and to contain the spread of diseases. According to O'Donoghue (2005) the Nguni people washed their hands before preparing and sharing food, before entering the home, before greeting strangers and after attending a traditional ceremony such as a funeral. This practice was necessary to guard against 'kuhabula', the breathing in of bad air or spirits.

The indigenous South African hand-washing has protected local communities from hand-to-hand and hand-to-mouth diseases. It is currently advocated as part of a handwashing campaign to limit the spread cholera in many South African provinces in spite of scientific and local barriers (ibid).

7.4.1 Traditional Medicine for Handwashing

Indigenous South African used aloe juice for handwashing in the absence of water.

The leaves of the Umsutane tree crushed into a paste and mixed into a container of water, which is then used for hand washing. It is believed that the Umsutane tree has antiseptic properties. Similarly the Isganamba (plant which looks like onion) is put into water before hands are washed. Although it is said that the Isganamba plant will ward off bad spirits it is also thought to have antiseptic qualities.

7.4.2 Morning Dew used for Handwashing

Many South African indigenous peoples mostly those living in rural areas use morning dew for handwashing.

Morning dew is source of water in the form of droplets that appears on thin, exposed objects in the morning or evening http://en.wikipedia.org/wiki/Dew. It is generally exposed surface cools by radiating its heat, atmospheric moisture condenses at a rate greater than that at which it can evaporate, resulting in the formation of water droplets. The temperature at which droplets can form is called the Dew Point (ibid).

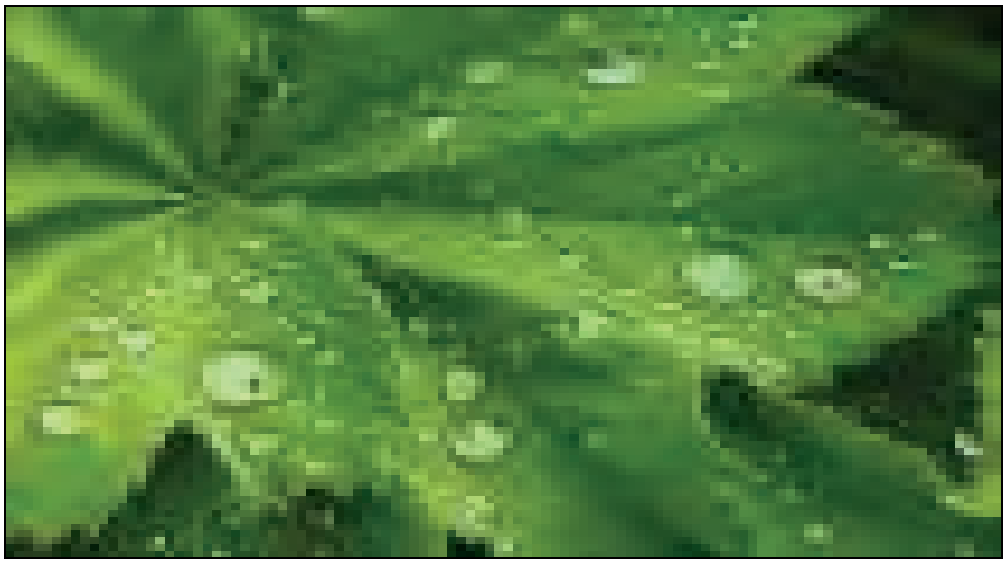

Figure 13: Illustration of Dew on the leaves, Source: Google images

Morning dew is generally formed easily on surfaces which are not warmed by conducted heat from deep ground including: leaves, grass, railings, bridges, etc.

In the morning, when surface temperature drops, eventually reaching the dew point, atmospheric water vapor condenses to form small droplets on the surface, what is called morning dew largely used in the South African rural areas for face and handwashing.

7.5 Indigenous Protection of a Water Source

The indigenous South African peoples have demonstrated a great importance and significance for water and importantly its source. They collected water in the areas where people could hear it running over stones or dripping down rocks. If a spring was for human use, it was protected by a circle of rocks with a small outlet.

The areas of water sources were cleaned and cleared so that water animals and insects cannot reach water sources. Cattles and other domestic animals were not allowed in the drinking water source areas, they drank elsewhere. This was another way of preventing water contamination as animal often defecate near water sources, thus contaminating the water and increasing the chances of the spread of diseases.

O'Donoghue (2011) commented that Indigenous South African people did not construct toilet and defecated in the veld or the forest. They were very discrete in terms of disposing bodily waste. The wastes were disposed far from water source areas. This would be piled up with leaves swept off from the cleared sitting space around the huts where ash from the old fires, chewed sorghum stalks, pumpkin skins and seeds where thrown.

7.6 Indigenous Wastewater Treatment

The Traditional Healers Organisation mentioned that holes are drilled into a container which is layered with sand, ash and stones. All wastewater from the kitchen and bathwater is poured into the drum. The clean water is use to irrigate the garden.
The early South African peoples cleaned their water with wood ash and Jik to kill all germs and make water purified and cleaned.

7.7 The Sotho Indigenous Water Harvesting System

Sotho is a South African ethnic group which include Basotho and Tshwane. The Sotho consider water to be an infinite resource, it will forever be available and they have developed basic water harvesting techniques which include earth dams' construction and roof tanks and water resources (springs, rivers and wells) are regarded as special places (Tshabalala, 2008). The earlier Bantu which include (Ngudi, Sotho, Shona, mbundu, etc.) like most subsistence farmers have developed a range of management practices such as rotational grazing management (*lebolla* System) which is dependent on the season and on local conditions. The Sotho relies on magical rain making techniques to ensure water supply for their crops (ibid). The indigenous Sotho process of making water will be discussed below in the case studies section.

7.8 Nguni Water Use and Handwashing Practices: A Case Study

7.8.1 Profile of indigenous community

The Bantu speaking tribes' genealogy originate from three main regions including Nguni, Sotho and Shona. In South Eastern with Sotho group (Basotho, North Sotho, Sotho and Tswana); Nguni group (Xhosa, Zulu and Swazi and Venda group). In Western region, there are Mbundu, Ambo and Herero and South Central region with Shona (Tshabalala, 2008).

Indigenous Bantu tribes have developed several practices regarding water use and waste management to keep their environment clean and sustainable. The next section analyse some of Bantus' indigenous practices and the case studies of successful indigenous water use and waste management practices in South Africa; this including Nguni water use and handwashing, Aloe water purification and handwashing and Sotho rain making.

7.8.2 Summary of the Indigenous Practices

The Nguni peoples have used handwashing as a historical legacy to promote healthier practices amongst the indigenous poor communities and to contain the spread of diseases. Rob O'Donoghue from the Environmental Education and Sustainability Centre (EESU) and Professor of Rhodes University Education Department indicated that: the indigenous Nguni

handwashing practices reflect today a sustaining coherence that is culturally inscribed in history but has become somewhat fragmented as modern life has differing hand washing processes used for heritage practices led education programs (O'Donoghue, 2011). The Nguni people washed their hands before preparing and sharing food, before entering the home, before greeting strangers and after attending a traditional ceremony such as a funeral.

Commented that in their earlier handwashing practices, Nguni peoples did not submerge their hands in a container of water when washing instead they would either lifted water in a cupped palm or pour for each other into cupped hands to use water sparingly and avoid contamination. The Nguni people washed their hands before preparing and sharing food, before entering the home, before greeting strangers and after attending a traditional ceremony such as a funeral. This practice was necessary to guard against 'kuhabula', the breathing in of bad air or spirits.

The indigenous Nguni hand-washing has protected Nguni communities from hand-to-hand and hand-to-mouth diseases. O'Donoghue (2011) noted that the practice has been advocated during cholera outbreak in Eshowe Town in KwaZulu-Natal 2001 by South African Department of Health with input from the Department of Water Affairs and the Department of Education, but it was not implemented because of scientific and local community's barriers. It has been presented as strategy to contain the spread of diseases in several areas including in Eshowe in 2001 and in Venda, Limpopo Province. The Nguni handwashing practices are not currently because it encourages not a good relationship with others especially strangers.

7.8.3 Research design and methods

A qualitative, exploratory, descriptive and contextual research approach was used to assess the Nguni water use and handwashing practice. The interviews were conducted with Professor Rob O'Donoghue environmental education specialist from Rhodes University and Clare Peddie from Wildlife and Environment Society of South Africa (WESSA) regarding indigenous Nguni water use and handwashing; how sweet water was gathered by Nguni people and how early Nguni people prevented the spread of Cholera.

7.8.4 Methods of data collection

Unstructured interviews were used to explore and obtain information regarding practices of Nguni handwashing in South Africa. The method helped to produce more in depth information on beliefs, practices and attitudes than could be obtained through any other data-gathering procedure. The desktop study was conducted and Nguni water use and waste management information were gathered from Wildlife and Environmental Society of South Africa's publications.

7.8.5 Discussion of findings of interviews

Most of the indigenous water use and waste management practices discussed in this case study are Professor Rob O'Donoghue's field works and unpublished sustainable practices materials which are available through Share-Net of the Wildlife and Environment Society of South Africa (WESSA). Interview with Professor Rob O'Donoghue on indigenous Nguni water use and waste management has revealed that the implementation of Nguni water use and handwashing in South Africa is subject today of several scientific and local communities' controversies and barriers (O'Donoghue, 2011).

The indigenous Nguni handwashing practices reflect a sustaining coherence that is culturally inscribed in history but has become somewhat fragmented as modern life has differing hand washing processes used for heritage practices led education programs (ibid).

7.8.6 Indigenous Nguni Sweet Water

The story of sweet water and early Nguni people including the pictures as contained in the educational document Grade 6, 8 and 12 activities of Water Research Commission (WRC) (2008: no p n) as well as WESSA shared-net have revealed some indigenous water practices of early Nguni people of South Africa. The early Nguni people of South Africa had common-sense ways of collecting and storing sweet water, not unlikely early human in other parts of the world. Water source of cleaned, cleared and keep ways from water animals and waste.

Figure 14: Story of Sweet Water and Early Nguni People, Source: WESSA Shared-net

The early Nguni people, drinking water was considered as a precious good; it was collected and conserved with respect. Prior to the time of the Zulu King, Shaka, sweet water was called *amanzi amnandi*. Shaka's mother was called Nandi and it is said that because it was not considered respectful to use the queen mother's name in this way, Shaka referred to sweet water as *amanzi amtoti* (WRC, 2008: no p n). Both terms are currently used and many people of Nguni origin will sniff smile and hold up sweet water, collected from a river, spring or well for their daily household needs**.** The protection of fresh drinking water source against germs has kept indigenous people from water contamination; their drinking water was good, clean and fresh. This demonstrated water has great importance and significance for Nguni people (O'Donoghue, 2005).

In the past, water was collected in areas where people could hear it running over stones or dripping down rocks. If a spring was for human use, it was protected by a circle of rocks with a small outlet. Cattle drank elsewhere. An area nearby was cleared and the site soon became a meeting place for young people. Young men would hang around these water collection sites, playing musical instruments and admiring the maidens who came to collect water. The girls would saunter along slowly and gracefully, singing and flirting (O'Donoghue and Janse Van Rensburg, 1999). Water collecting was rarely seen as a tiring or boring chore because of the prospect of courtship (WRC, 2008: no p n).

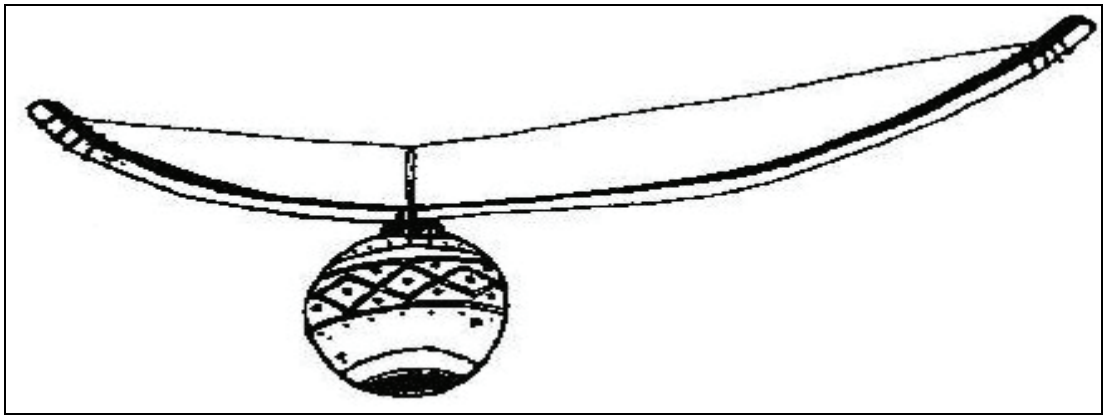

Figure 15: Illustration of musical instruments, source: WESSA Share-Net, accessed on May, 2011

This story translates the value of water resource (fountains and springs) as places of clean and fresh water commonly used by Nguni community for cooking and drinking.

According to O'Donoghue and Janse Van Rensburg (1999) in another South African story, to ensure proper sanitation, the elders told a story about a man who broke the community rule about squatting next to the drinking well. He developed a tail that grew so long he could no longer wear trousers. He became a joke in the village because he could only wear silk aprons. Through this indigenous Nguni people learn how to respect water.

They commented that Indigenous Nguni peoples always approached a water source with care so as not to frighten crabs and other small water animals. When disturbed, their movement would stir up sediments and the collector would have to wait for the silt to settle. The surface film was brushed aside for "sweet water" to be collected (ibid).

There were many other customs and traditional practices surrounding water. Children were warned that urinating in a river would change them to the opposite sex! (ibid)

The Nguni community had several indigenous strategies to protect and conserve water thus; it can remain clean and fresh out of all diseases.

Indigenous Nguni peoples were given a great importance to water from its source, collection and storage.

An area nearby was cleared and the site soon became a meeting place for young people. Young men would hang around these water collected sites, playing musical instruments and admiring the maidens who came to collect water. The girls would saunter along slowly and gracefully, singing and flirting. Water collecting was rarely seen as a tiring or boring chore because of the prospect of courtship (ibid).

Figure 16: Illustration of Area of Water Collection, source: WESSA Share-Net, accessed on May, 2011

Clay pots were filled with water and covered with a collecting bowl, a piece of skin or a mat made incema grass. The water would this stay cool and fresh. Even today many rural areas in African use clay pot for water storage, water is kept fresh and cold as from a fridge.

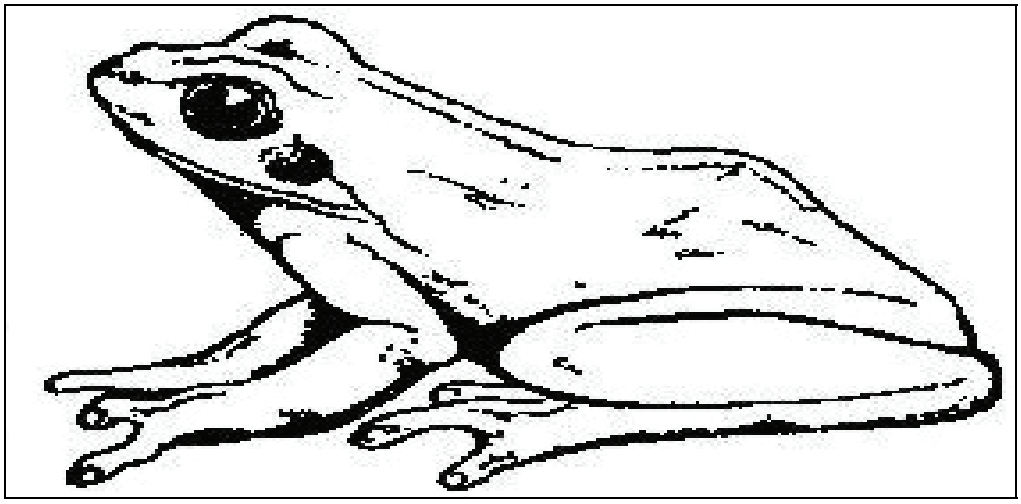

Figure 17: Illustration of Crabs and Small Water Animal, source: WESSA Share-Net, accessed on May, 2011

Nguni water collector say that there are frogs one does not find sweet water. Frogs are eaten by hammerkops (uthekwane, the lighting bird) and the prospect of collecting water while being watched by a witch bird must have been terrifying in earlier times when spirits, myth and mystery had a more central place in everyday social life. Children were told that if they killed this bird or stole its eggs their homes would go up in flames (O'Donoghue and Janse Van Rensburg, 1999).

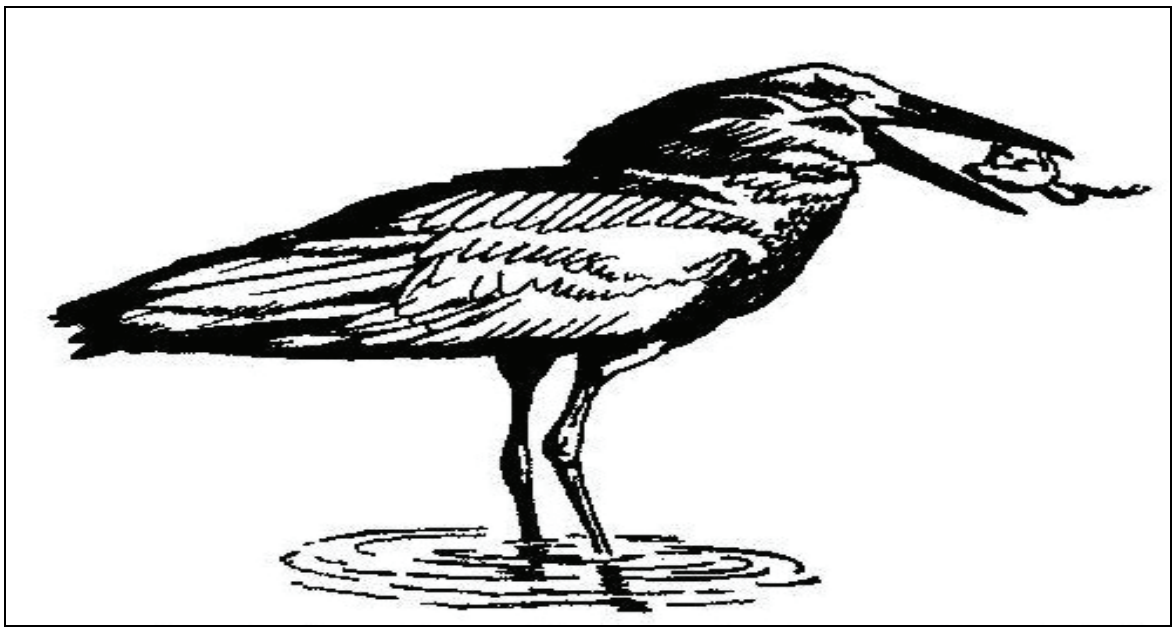

Figure 18: Illustration of Crabs and Small Water Animal, source: WESSA Share-Net, accessed on May, 2011

O'Donoghue and Janse Van Rensburg, (1999) noted that indigenous Nguni common sense was also said that it was not advisable to collect water from river after heavy rain at the start of the annual rainy season. Indigenous common-sense told people to put out pots to collect rainwater. River water would again be collected four days after the rains stopped and the water had cleared.

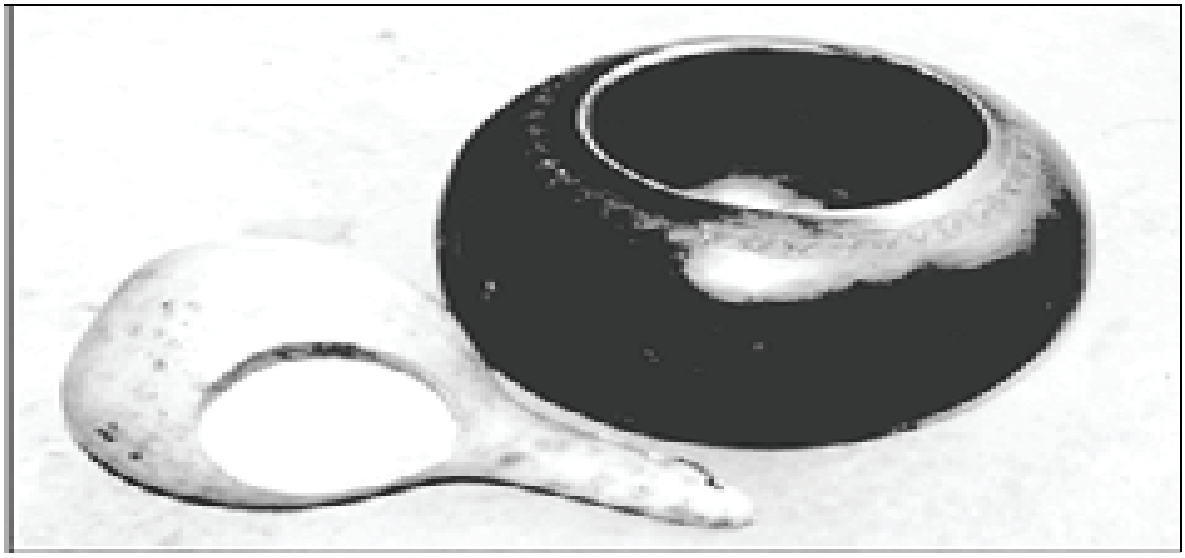

Figure 19: Illustration of Pot to collect rainwater, source: WESSA Share-Net, accessed on May, 2011

7.8.7 Indigenous Nguni ways of purifying water and handwashing

In their earlier hand-washing practices, Nguni peoples did not submerge their hands in a container of water when washing instead they would either lifted water in a cupped palm or pour for each other into cupped hands to use water sparingly and avoid contamination (O'Donoghue 2005). According to O'Donoghue (2005) the Nguni people washed their hands before preparing and sharing food, before entering the home, before greeting strangers and after attending a traditional ceremony such as a funeral. This practice was necessary to guard against 'kuhabula', the breathing in of bad air or spirits. Indigenous Nguni people were sensitive about handshaking. They avoided shaking hands of their enemies and if they had no choice they always washed their hands immediately as an enemy could bewitch them through your hands as well. When one had been out of the house people would always washed their hands before returning and doing anything in the house.

O'Donoghue, (2011) commented that to purify their water, Nguni people have a common and a popular use of wood ash to purify water. Ash was used when one had a pick-up, to cook vegetables such as Okra commonly eaten by indigenous Nguni. When faeces where spotted in an area when they shouldn't be they were covered up with soil or ash. Ash was popularly known to be capable of purifying.

Figure 20: Illustration of Woods Ash, source: Google images

7.8.8 Indigenous Nguni ways of Preventing Diseases

Personal communication with Claire Peddie from (WESSA) commented on indigenous Nguni source water protection that: animals were never allowed to drink water from water collection points. This was another way of preventing the spread of diseases as animal often defecate near water sources, thus contaminating the water and increasing the chances of the spread of diseases.

The ways earlier Nguni people were dispose their rubbish are very different with the modern waste disposal ways. The indigenous Nguni dump their rubbish far in an area called "etaleni" which lay a short distance from the huts. This would be piled up with leaves swept off from the cleared sitting space around the huts where ash from the old fires, chewed sorghum stalks, pumpkin skins and seeds where thrown. The rain seasons would come and pumpkin

seeds germinated and produced the best pumpkins (O'Donoghue and Janse Van Rensburg, 1999).

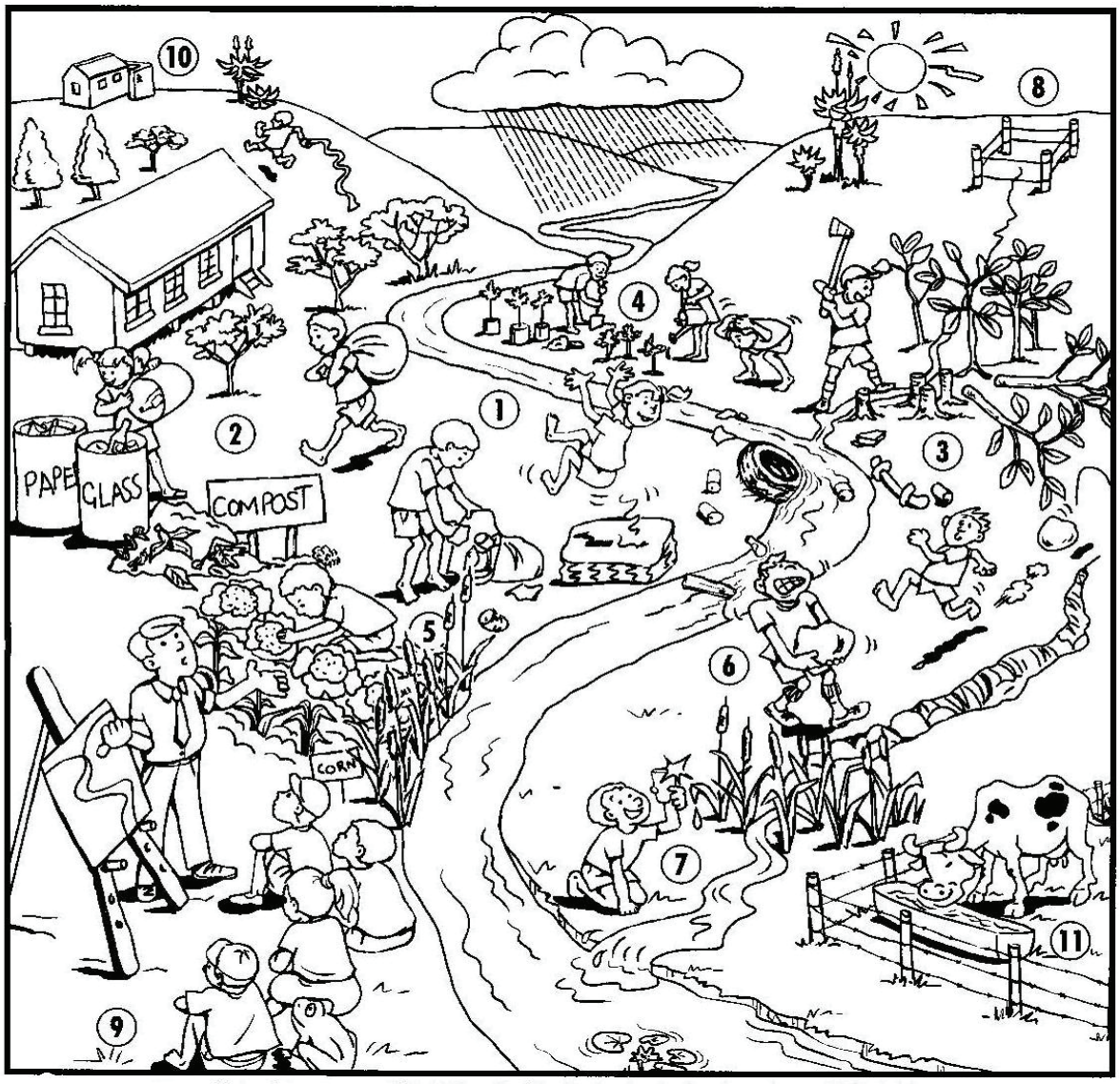

Figure 21: Illustration of the Water Sources, Source: WESSA Share-Net, accessed on May, 2011

Commented that the early Nguni people did not construct pit latrines and defecated in the veld or the forest. They were very discrete in terms of disposing bodily waste. They never defecated or spot where their faeces and saliva could be discovered for fear that their enemies could use it for witchcraft. These meant grass and forestland were favoured. Busy places like water collection places were avoided because of their potential as meeting areas for males and females. Males hung around them in anticipating of meeting young ladies who had come to fetch water.

O’Donoghue (2011) noted that to preventing diseases transmission from mother to child; the Kuhabula (the breathing in of bad air/bad spirit) was used to guard against and new mothers took great care that their children were safe from bad air. They never left the house unless the family felt they were strong enough and necessary ceremonies had been performed. Right after the baby had been delivered they were discouraged from cooking and performing any household chores so that they do not infect other member of homestead nor pick up others infections. Breastfeeding was compulsory except in times extreme sickness. A mother had to first wash her breast and squeeze out the first milk before breastfeeding her baby.

Children suckled until they were toddlers, which strengthened their immunity systems. Running tummies were always associated with itching gums just like puppies. Care was taken immediately when a swelling was noted on a child’s gums as an indicator of teething. A mother who has been away from the house was forbidden to pick up her baby before washing her hands and her breasts and had to squeeze out the first milk before breastfeeding (O’Donoghue and Janse Van Runsburg,1999).

To prevent diseases and keep their environmental safe and clean the early Ngami’s visitors were always offered something to eat or drink out of the politeness after announcing his/her arrival his/she could say, a stomach of traveller is not much, and it is size of a bird’s sac. This was because the visitors were always offered something. People would shake hands and sit down to chart, which will followed by a bowl of hot water for washing the hands before was served. People ate with their hands and children usually ate together out of the big bowl and the food was not touched before the hands had been washed (ibid).

Furthermore, when drinking the local brew after pouring the beer into a smaller clay pot, the pot was again cleaned with water before the wife would take a sip to display that it was good to drink as she passed it on she would swipe the spot where she drank with her wet hand.

7.8.9 Indigenous Nguni ways of Preventing Cholera

According to O'Donoghue and Janse Van Rensburg (1999), the indigenous Nguni peoples believe that cholera germs are found in the faeces of infected people and they multiply rapidly in water, poor sanitation habits cause cholera to spread – cholera spread when sanitation habits are bad and people defecate near water sources and wash infected baby's nappies in water – people have a good chance of getting cholera when contaminated water from river is used and the rain washed the faeces into the water and the children swimming in the water can get cholera.

People will not get cholera when their sanitation habits are good and hygienic.
This entails:

- a toilet built far from water sources will not contaminate water
- Hand washing get rid of germs: wash hand after defecating, before preparing or eating food and after touching things that might be dirty.
- Water that is cleaned with Jik or boiled kills cholera germs.

7.9 Traditional medicines used for water purification and handwashing: A Case Study of Orange Farm

7.9.1 Profile of indigenous community

Orange Farm is one of youngest township and the largest informal settlement in South Africa located approximately 45 km from Johannesburg Gauteng province. The original inhabitants; laid off farm workers, taking up residency in 1988 (Wikipedia, no date). The Figure 12 below shows view of Orange Farm Extension 10.

Figure 22: Open View of Orange Farm Extension 10

The inhabitants of Orange Farm are people of diverse cultures such as Zulus, Sothos, Vendas and Tsonga-speaking peoples and some Malawites and Zimbabwean ethnic groups. The Orange Farm has clinics in which health care facilities are inadequate and expensive; therefore several inhabitants rely on indigenous medicines for their wellbeing.

7.9.2 Summary of the Indigenous Practices

Water cleaning and purification is central to Orange farm residents, because clean water is necessary for daily living requirements. During site interview with Traditional Healers Organisations (THO), Gogo Nkembule local traditional healer believed that: *"There are no any plants or herbs which can replace water".* Therefore, indigenous peoples in the Orange Farm have developed several practices to protect, purify and conserve water.

Aloe juice and other abovementioned traditional medicines are used by Orange farm residents to disinfect and purify water and to wash hands even where there is no water. They also used for other purposes including to remove badly lucky and poison. Aloe has such unique healing abilities, proven traditionally even scientifically, like no other plant.

The actual value of these Aloe substances and other traditional medicines in helping to improve pathologic conditions, relieve complaints and restore health has been debated from antiquity to the present. Orange Farm inhabitants used other indigenous medicines primarily as protection from evil spirits, for luck both in a general sense as well as in relationships and

in the court room, for cleansing the blood, for removing poison inflicted through witchcraft, and for other mainly customised purposes.

7.9.3 Research design and methods

Methods used to collect the information including: qualitative, exploratory and descriptive research was conducted in the context of the people of Orange Farm. Random sampling was considered a suitable method for this case study because of lack of accurate data in the area. The research in this case study identify the traditional healers, the head of households both men and women and a relative number of young both ladies and boys.

7.9.4 Methods of data collection

Semi-structured interviews were used to obtain information regarding efficacy of Aloe's family and other traditional medicines (i.e. African Potatoes, Isikenama, ukutwasa, Umsutane and uMathula**)** as well as its inconvenient for human health. The method helped to produce more in-depth information on beliefs, practices and attitudes than could be obtained regarding Aloe and other traditional medicines.

7.9.5 Discussion of findings

The interviews on Orange Farm's indigenous medicines practices for water purification and handwashing have gained the contribution of the two local traditional healers called Gogo Elizabeth Nkambelu and Gogo Nora Madbaso, both registered with traditional healer organisation as well as a member of traditional healer organisation who are illustrated in the Figure 14 below.

Figure 23: Members of Traditional Healers Organisation in Orange Farm

Discussion with Gogo Elizabeth and Gogo Nora Madbaso both traditional healers have revealed that traditional medicines have played an indispensable role to improve environment sustainable as well as human health wellbeing of Orange Farm inhabitants.

During site interviews, the local traditional healers have mentioned that Aloes, African Potatoes, Isikanema, Jik, umuthula, etc. keep them and their environment sustainable, long live and being always healthier. They mentioned that Aloes, African Potato and umuthula have strong anti-bacteria and are strong immune booster plant adequately used for water cleansing and handwashing as well as other purposes including remove bad lucky.

In addition, Gogo Nkambelu (traditional Healers) has mentioned that, *in absence of water, the traditional Orange farm residents use morning dew for handwashing and to wash face*. The morning dew is also used for spirit purposes when someone wants to chase its bad lucky. The process include waking up early in the morning before everyone and start to collect the morning dew and wash with it hands or/and face.

The interviews with traditional healers have revealed that, despite some indigenous plants, trees or fruits are used for handwashing; nothing can replace water. Many traditional healers rely on water for their traditional healings.

7.9.6 Aloes

There are different types of Aloes, used for unlike purposes including water purification and handwashing. However, our focused is on those used for water purification and handwashing. The Figure 6 below illustrates *Aloe marlothii*, a variety of Aloes used to disinfect water and hand washing.

a. Aloe marlothii

Family: Asphodelaceae

Common names: mountain aloe (Eng.); bergalwyn (Afr.); inhlaba or umhlaba (Zulu)

Description

Aloe marlothii is a large, perennial, succulent, single-stemmed aloe, usually 2-4 m tall (occasionally up to 6 m), with old dried leaves remaining on the stem below the upper living leaves. Leaves are large, broad and succulent, light green to greyish green to blue-green, up to 1500 x 250 mm, having a broad base tapering to a sharp point, covered with spines on upper and lower surfaces and maroon-coloured teeth with orange tips along leaf margins.

Figure 24: Aloe marlothii recorded in Orange Farm

Conservation status

Not threatened.

Distribution and habitat

Aloe marlothii occurs from the North-West Province, Gauteng, Limpopo, Mpumalanga, Swaziland, Zimbabwe, Botswana and Mozambique to KwaZulu-Natal north of Durban, from sea level to 1 600 m.

It is found mainly in bushveld vegetation along mountainous areas, rocky terrain and slopes where temperatures are warmer and frost infrequent. Mountain ranges of the Drakensburg, Lebombo, Zoutpansberg and Waterberg have large populations of the species. It is thus not surprising that the common names bergalwyn or mountain aloe have been applied. At high altitudes however, the species does not occur in very cold areas, but the species does exhibit tolerance to frost.

Uses and cultural aspects

Leaf and root decoctions are used by the Zulus for roundworm infestations and by other cultures for stomach problems and horse sickness. *Aloe marlothii* will grow easily and with very little care in most South African gardens and is recommended for gardens where the species occurs naturally. Bear in mind this is a summer rainfall species and therefore naturally thrives under warm wet summers and warm to cool, dry winters. Thus grown within its natural distribution range, plants may require less water care. In cultivation the species can tolerate additional watering in both summer and winter rainfall gardens and often as a result the species may appear quite different from the natural forms (i.e. leaves lighter green and less thorny). It is not necessary to deprive your specimens of water, only be aware that over-watering will steadily deteriorate their general health. Prerequisites for success include:

- Full sun-choose a warm spot. Rockeries are ideal for capturing extra heat.
- Watering-a sign of over-watering is over-inflated leaves, excessive over-watering will lead to rot. Under-watering results in thin, harder, less green leaves. Compensate accordingly. Water once a week for the first month following planting and reduce watering thereafter. Well-established plants can survive for several months without water. Be sure not to over-water in heavy clay soils.
- Well-drained soil-no strict soil mix needs to be adhered to for planting, however at least one fourth compost should be incorporated into the soil. One quarter river sand and one quarter compost mixed in equal quantities will improve drainage in heavy clay soils. If you are unable to provide your plant with regular watering, and the soil consists of heavy clay, plant directly. This method will however slow or even stunt the growth of the plant and may lead to rot. Bone meal can be added in generous quantities when planting.
- Size-realize this is a large aloe and needs room to grow.
- Position-planted in the correct position the mountain aloe makes a prize specimen. Plants can be used as living pillars along driveways or fences or less formally as scattered feature plants in the garden landscape.
- Pests and diseases-avoid planting near infected aloes or choosing infected nursery specimens.

Look out for:

- ❖ White scale is unsightly and can virtually cover the entire plant with a white-dotted, paint-like appearance. Control by scrubbing either with soapy water or soap and oil or nicotine sulphate and soap. As a last resort spray with a contact insecticide.

- ❖ Aloe rust fungus forms black spots on the leaves and cannot be controlled by spraying. It is recommended that infected leaves are removed and plants kept healthy by feeding. Alternatively remove entire plants if severely affected.
- ❖ Aloe cancer is caused by mites and leads to deformed leaves and inflorescences. It is best to remove the entire plant form the garden to prevent disease spread.
- ❖ Snout beetles reap havoc by burrowing into the stem and depositing their eggs and subsequent developing larvae. Larvae hollow out the stem leading to collapse of the plant. Treat by drilling a tiny hole in the stem and injecting systemic insecticide.

- Aloe marlothii can be grown from seed with relative ease. Use a nursery seed tray, pot or any container with drainage holes. Fill the bottom of the container with a layer of stones and a thin layer of compost to ensure drainage and prevent soil escaping from the drainage holes. Sow seeds in spring, directly in river sand by evenly sprinkling the papery seeds over the surface. Cover seeds with a light sprinkling of sand (just enough to cover seeds). Water with a fine rose spray to prevent seeds and sand becoming displaced and place in a warm sunny position. Place under cover such as eves, cold frame or greenhouse in a well-ventilated position. It is important to use sterilized soil and containers to avoid disease setting in. To avoid seedlings damping-off from the wilting fungus, a preventative fungicide can be applied.

- Water seeds of A. marlothii daily until germination, thereafter reducing watering to every few days. Do not water in the late afternoon or evening as this will promote damping-off. As the seedlings begin to show their succulence and aloe shape they require less watering, however they will develop faster with regular watering and care. Transfer seedlings at any stage from several months to two years into small pots with a more loamy soil mix. Place a layer of stone chip with a few centimetres of compost at the bottom of the pot. Various potting mixes work provided they are well

drained (i.e. two thirds of soil comprising river sand and compost and one third nursery potting mix or rose and shrub mix). Liquid organic fertilizers will improve general vigour and resistance to disease attack.

a. Aloe striatula

Family*:* Asphodelaceae

Description

Aloe striatula is closely related to *Aloe commixta* but it is easily distinguished from it by it's recurved leaves, more distinctly cone-shaped racemes that is more densely packed with flowers. Flowers are also slightly curved.

Figure 25: Aloe Striatula recorded in Orange Farm

There is only one recognised variety, *Aloe striatula* var. *caesia* which has shorter straighter flowers and leaves that are more closely paxked and a greyish-green colour. Aloe striatula is quite a robust rambling Aloe that forms a shrub that can be up to 2 meters in height and several meters wide. Stems are 20 mm in diameter. Leaves are dark-green colour and they are recurved, leafs surfaces are deeply channelled and the leaf surfaces are smooth, leaf margins are armed with numerous small white teeth, leaf sheaths are distinctly marked with thin, green lines that run parallel to one another. Some forms have leaves that die back leaving shrivelled black leaves.

The specie name '*striatula*' means 'striations' and it refers to the thin, green, parallel lines that are present on the leaf sheaths. Aloe striatula is grown mainly for it's foliage, with time large multistemmed bushes are formed.

Grow plants in beds or areas with good drainage and it should thrive.

Conservation status

Not threatened.

Distribution

Plants can be found to the west of Graaf-Reinet in the Karoo to Queenstown and Lady Grey in the eastern parts of the Eastern Cape of South Africa.

b. Bulbine latifolia

Family name: Asphodelaceae

Common names: Rooiwortel

Description

Rapid growing succulent plant, aloe-like in appearance, forming solitary rosettes up to 20 cm high. Roots fleshy, yellowish, terete (circular in cross-section).

The leaves are triangular-lanceolate190-400 x 30-60 mm green, with faint lines, firm, ascending, older leaves becoming recurved; upper surface flat, slightly channelled towards the end; lower surface flat to somewhat rounded margin acute, and bearing a minute fringe of hairs (minutely ciliate). The point tapers to an acute point.

The inflorescence consist of 1-4, densely flowered racemes 400-1017 mm tall. The flowers are carried on the upper half, (up to 8 flowers opened at a time). Flowers about 7-12 mm in diameter, crowded bearing membranous bracts. Flower stalks 12-14 mm long, terete. The 6 petals are yellow, spreading and 7 mm long. The filaments of the stamens are bearded which distinguishes it from Bulbinella, a genus with which it is often confused. Style 6 mm long. Plants flower in spring.

Fruits are small capsules, rounded and when ripe releasing small blackish flattened wind dispersed seed.

Conservation Status

Bulbine latifolia is a very common species in the Eastern Cape thicket vegetation. It is often a pioneer and attractive flowering en masse.

Distribution and Habitat

Bulbine latifolia is widely distributed in the south-eastern parts of South Africa from Knysna in the Western Cape. It is widespread in the Eastern Cape Province, and often found in dry river valleys and rocky gorges. It grows in soils derived from shale or sandstone, but always on well drained sites. Populations can be seen along the National Road from Port Elizabeth towards Grahamstown and roads north of Port Elizabeth. It is also often found on cliffs.

Uses and cultural aspects

Bulbine latifolia is popular among the traditional healers. The roots are used, taken orally to quell vomiting and diarrhoea, but also for a number of other ailments (Van Wyk et al., 1997).

Aloe is used in Orange Farm by many residents for water purification and handwashing. The process of water purification with aloe as practiced by the Orange Farm dwellers and their local traditional healers involve to cut aloe into pieces and put it into unclean water, it will kills all germs. Therefore water will be cleaned and purified ready for drinking, cooking and handwashing.

In addition, aloe is used for spirit purposes. For instance, when someone got lost or don't want to come back home; the sangomas evoke with aloe to bring him back home.

Figure 26: Other variety of Aloes found in Orange Farm

7.9.7 African Potatoes

African Potatoes as illustrated in the Figure 18 below are traditional medicine from Aloe family largely used to clean water and handwashing. It is used by traditional healers in

Orange Farm to kill germs and to purify it for drinking, cooking and washing. African potatoes are used by local traditional healers and Orange farm dwellers as an immune booster. It can be prepared by a Sangoma or someone who bought it up from Sangoma. It is allowed to boil African potatoes; it must be eaten fresh.

Figure 27: African Potatoes recorded in Orange Farm

Pull up the bottom of the African potatoes, cut them and put them into a container of unclean water, they will kill all germs and will purify water which is then used for drinking and hand washing. The leaves or top of African potatoes are poison; therefore they must not be used or contact fresh water.

7.9.8 ISikenema

Isikenema as illustrated in the Figure 19 below is from aloe family largely used as an immune booster for water purification and handwashing. The Isikanama (plant which looks like onion) is put into water before hands are washed. Although it is said that the Isikanama plant will ward off bad spirits it is also thought to have antiseptic qualities. It is used on water only, both to clean water and to remove badly lucky. For instance, if you are from funeral ceremony; Isikenema is put into water for everyone coming from funeral wash hands to remove badly lucky and bad spirit of death.

Figure 28: Isikenema recorded in Orange Farm

7.9.9 uMathula

Umathula is an anti-bacterial largely recommended by local traditional healers to clean water. The process includes cutting umathula and putting it into water to kill any germs containing in water. Many traditional healers in Orange Farm use umathula for water cleansing. It contains efficacy anti-bacterial able to kills any kind germs contained in water.

Figure 29: Umathula recorded in Orange Farm

The process include to cut umathula leaves into pieces, dig lip the bulb and put it into unclean or dirty water; it will purify water by killing all germs contained in the container; therefore water will ready for any uses.

7.9.10 uMsutane, Imbiza and uKutwasa

Orange Farm inhabitants used the leaves of the Umsutane tree crushed into a paste and mixed into a container of water, which is then used for hand washing. It is believe that the Umsutane tree has antiseptic properties. uMsutane is also used in the area to hunt bad spirit.

7.10 The Rain Queen: A Case Study of Sotho Water making

One of the most critical threats against the wellbeing of a South African society history was failure of the rains. South Africa is a semi-arid country, which since centuries has drought problems. When the rain does fall there are excellent opportunities for grazing cattle and developing agriculture. However, the Rain Queen (Sotho) of southern Africa has a supreme

being who is responsible for the weather; rain rituals are predominantly directed towards the ancestors. This is specifically to the ancestors of the chief who were interceded on the people's behalf and drought would occur when they were negligent (Scholes, 2010).

7.10.1 Profile of indigenous community

Balobedu is a tribe of the Northern Sotho group which has its own kingdom ruled by a female (the Rain Queen Modjadji) located in Sehlakong forms part of Greater Letaba Local Municipality within Mopani District Municipality in Limpopo Province. According to Scholes 2010, rain Queen is the only traditional ruling queen in Southern Africa; her Kingdom is situated between the Venda, other North Sotho speaking peoples and the Tsonga-Shangaan, Balobedu culture originated to the north, in what is today Zimbabwe.

Lobedu peoples live among the mist-covered mountains of northern Transvaal; their reputation was, and still is, great among the Bantu of South Africa; their queen (Rain Queen Modjadji) was held to be the most powerful of all rain-makers; many African kings send their emissaries gathered at her court, bringing cattle or daughters or sisters to win the favour of rainwater during drought (ibid).

7.10.2 Summary of the Indigenous Practices

Scholes (2010) noted that Rain Queen Modjadji was known as an extremely powerful magician, able to bring rain to her friends and drought to enemies. Her position as paramount ruler is based on this power. Modjadji have been feared and respected for centuries. Not a single African king would seek her wrath, fearing punishment meant drought. Shaka Zulu sent top emissaries to request her blessings. Several neighbour areas always brought Modjadji gifts and tribute, including cattle and their daughters as wives, to appease her so that she would bring rain to their regions. The custom is allied to an emphasis on fertility of the land and the population.

Commented that the *Mudjadji* is considered to be the living embodiment of the rain goddess and is also known by the title *Khifidola-maru-a-Daja* ('transformer of clouds'); She is considered the embodiment of the rain, guarantor of the yearly seasonal cycle, and her very

emotions are said to be paralleled by the weather. Amongst her other royal duties she presides over an annual rain ceremony held each November.

Rain Queen rain-making is a matter enshrouded in the greatest secrecy and her highest kingdom. Mr Molokwane indicated that, it is doubtful that anyone other than the queen is in possession of the secrets as they are bound up with the title and power to succeed to the throne. He commented that, the secrets are always imparted to the successor just prior to the death of the chief, via a tradition of suicide.

Regarding Lobedu's magical water ritual, Scholes (2010) noted that when a chief dies, her body is left for some days in the hut so that when rubbed in a certain way, the skin falls away. The skin is kept and later added with many other ingredients to mehago rain pots. From time to time a black sheep is killed, to be washed with water into these magical pots, but it is said that this is just a modern day substitute for a human being, usually a child, whose brains were used for the washing. The mehago pots are never seen by the public. Typical rain rituals in the time of drought would involve the sacrifice of a black bull, the use of powerful medicines and even the beating of royal graves with sticks.

7.10.3 Research design and methods

A qualitative, narrative, exploratory, descriptive and desktop research approach was used to understand how Sotho does make rain. The case study was based on the people of Sehlakong village (Balobedu) which is part of Northern Sotho cultures. Random sampling was considered a suitable method for this study because no census of the study population existed. In this case study the population of interest comprised: Modjadji's councillors, traditional healers and representatives of different organisations.

7.10.4 Methods of data collection

Unstructured interviews were used to explore and obtain information regarding water making rainwater harvesting practices in the area. This produces more in-depth information on beliefs, practices and attitudes than could be obtained in the Kingdom of Balobedu regarding rainwater making. The leading question for the interviewees during data collection was "what Rain Queen does to make rain?

7.10.5 Discussion of findings

Rain Queen

The discussion with Mr Molokwane from Modjadji Rain Queen Tour Guide confirmed that, the Rain Queen is the hereditary queen of Balobedu and female leadership tradition of Africa; it is ethnic group within Limpopo Province in South Africa (Molokwane, 2011). The Rain Queen Modjadji, which reflects the power engendered in a woman who has absolute sovereignty with a leadership role intimately connected with her ability to invoke rain.

The succession to the position of Rain Queen is matrilineal, meaning that the Queen's eldest daughter is the heir, and that males are not entitled to inherit the throne at all. The Rain Queen is believed to have special powers, including the ability to control the clouds and to make rainfall even during drought seasons. Currently there is no ruling Rain Queen as the previous Rain Queen Makobo Modjadji died on 12 June 2005 at the age of 27 years (Wikipedia, no date). According to tradition, the rain queen may not marry, but a suitable man from the family is designated for her by the royal council when she decides to have a child. The rain queen is served by so-called "brides", whose children are also regarded as hers (Molokwane, 2011).

Lobedu people

Ms Malomane Regent Personal Assistant from Modjadji Traditional Authority indicated that Balobedu *(ba Lobedu ba gaModjadji)* is a South African tribe of the Northern Sotho ethnic group; the central tribal village is Sehlakong in the district of Balobedu. They have their own kingdom, the Balobedu Kingdom, within the Limpopo Province of South Africa with a female ruler, the Rain Queen Modjadji.

According to Scholes (2010), the Balobedu are situated between Venda and Northern Sotho speaking people, as well as the Tsonga and others; Khilobedu has become more and more similar to Sesotho since the language of the schools in the region is Northern Sotho. However, the Balobedu culture originated to the north, in what is now Zimbabwe, and their

language contains sounds that do not exist in Sesotho and they have their own customs and traditions including traditional dances called sekgapa for women and dinaka for men and the way of praising and talking to their God. They sit next to a traditionally designed circle in their homes and start calling the names of their ancestors (Wikipedia, no date).

The area of Balobedu consists of many villages and every village has a male or female ruler who represents Modjadji, the rain queen. The queen is believed to have powers to make rain. The Balobedu Kingdom consists of a number of small groups tied together by their queen. The latest Queen Makobo Modjadji died on 12 June 2005, leaving the kingdom without a queen (Malomane, 2011).

In history of South African indigenous peoples, the Rain Queen was known as an extremely powerful magician who was able to bring rain to her friends and drought to her enemies; therefore people from all over Africa were coming and bringing to her gifts and tribute, including cattle and their daughters as wives, to appease her so that she would bring rain to their regions (ibid).

What Rain Queen does to make rain?

Mr Molokwane indicated that what the queen does to evoke rain is a matter enshrouded in the greatest secrecy. The Rain Queen's mystical rain making powers are reinforced by the beautiful garden which surrounds her royal compound. Surrounded by parched land, her garden contains the world's largest cycad trees which are in abundance under a spectacular rain belt. One species of cycad, the Modjadji Cyrad, is named after the Rain Queen.

Commented that the Rain Queen can only communicate with her people through her male councilor; She must shun public functions and presides over annual rain-making ceremony at her royal compound in Khetlhakone every Village November. Commented that many African kings would seek her wrath, fearing punishment meant drought; they use to send their emissaries to request Rain Queen Modjadji her blessings. They brought Modjadji gifts and tribute, including cattle and their daughters as wives, to appease her so that she would bring rain to their regions.

8. ASSESSMENT OF THE SUSTAINABILITY OF IWWM PRACTICES

There is increasing awareness on the role of indigenous people and their practices on environmental management. Adaptation of IK and indigenous practices may be answer to many development challenges facing municipalities. This section assesses the sustainability of significant IWWM practices in terms of it potential to contribute to future water and waste management solutions.

8.1 Sustainability Assessment of IWWM Practices

The sustainability of IWWM practices were assessed according to four criteria namely environmental sustainability, social equity, economic efficiency and ability to be replicated.

Table 3: Indigenous Water and Waste Management Assessment Methodology

Assessment Criteria	
Environmental Sustainability	The focus will be on appraising the potential of IWWM practice to maximize the use of renewable water resources, promote conservation, and on selecting wastewater management systems that entail minimal energy use and minimal disturbance to the eco-system balance in the area where treated wastewater is discharged.
Social/Cultural Equity	The assessment focused on the needs of different ethnic groups of South Africa to ensure that IWWM benefits all members of the population concerned, regardless of income and gender.
Economic Efficiency	Simplicity and cost-effectiveness in terms of construction, operation and maintenance will be essential criteria in evaluating the systems. The economic feasibility and the potential for cost recovery of the practice will be considered here. Affordability and willingness to pay will therefore be two of the key variables included in assessing the economic feasibility of the systems.

Assessment Significance	
1 =Low	It is not likely to be sustainable.
2 = Medium	It has the potential to be sustainable, but will need to be adapted to the area.
3= High	It will be sustainable anywhere, regardless of any adaptations.
Assessment of Dissemination and Replication	
1	It would be no problem at all to transfer the practice to another group/culture/sector, etc.
2	It would be rather easy to transfer the practice, although some adaptations might be necessary
3	It would be possible to transfer the practice, but there certainly would be conditions and prerequisites to consider.
4	It would be difficult to transfer the practice. It would require a lot of adaptations and even then it would be difficult.
5	It would be impossible to transfer the practice. It is too specific and only possible at a particular place and level.

Each indigenous practice is assessment below based the criteria outlined above.

Table 4: Sustainability Assessment of Indigenous Water Use and Waste Management Practices

No	Practices	Country	Sustainability Variables			
			Economic Efficiency	Environmental Sustainability	Social/Cultural Equity	Dissemination and replication
1	The Hydraulic Noria	Syria	3	3	3	1
2	Qanat	Iran	2	2	2	3
3	Khoi San Ostrich Eggs	Botswana/South Africa	1	2	3	5
4	Stone Lines	Niger	3	3	3	1
5	Planting Pits	Kenya	3	3	3	1
6	Terracing	Morocco	3	3	3	1
7	Traditional Teras Cultivation	Sudan	2	2	2	1
8	Tabias and Rock Dams	Somalia	2	2	2	3
9	Roof Tanks and Wells	Democratic Republic of the Congo	3	3	2	1
10	The Zai System	Burkina Faso	3	3	3	1
11	The Daldal System	Ethiopia	2	2	3	4
12	Water Treatment Using the *"Moringa oleifera"* Tree	Senegal	3	3	2	3
13	The Deccan Traps	India	3	3	3	2
14	Fishing Traps	Nigeria	3	3	3	3

No	Practices	Country	Sustainability Variables			
			Economic Efficiency	Environmental Sustainability	Social/Cultural Equity	Dissemination and replication
15	The Ngoro and Matuta Soil and Water Conservation Systems	Botswana	3	3	2	1
16	Siwan Waste Management Practices	Egypt	2	3	2	3
17	Karaisali Waste Water Management	Turkey	1	2	2	5
18	Gravity Water Tanks, Canals and Public Fountains	Morocco	2	2	2	3
19	The Gawan System	Somalia	3	3	3	1
20	The Caag System	Somalia	3	3	3	1
21	Rainwater Storage Ponds “Lacs Collinaires”	Tunisia	3	2	2	2
22	The Meskat System	Tunisia	3	3	3	2
23	The Mgoud Technique	Tunisia	2	2	2	3
24	The Khattara Water User Organisation	Morocco	2	3	2	3
25	The Jessour System	Tunisia	2	2	2	4
26	The Cisterns System	Tunisia	2	3	2	4
27	Gabion Check Dams	India	2	3	2	4
28	Recharge Wells System	Africa	2	3	2	4
29	The Karez System	Pakistan	2	3	2	4

No	Practices	Country	Sustainability Variables			
			Economic Efficiency	Environmental Sustainability	Social/Cultural Equity	Dissemination and replication
30	Nguni Handwashing	South Africa	3	3	2	1
31	Traditional Medicine for Handwashing	South Africa	3	3	2	1
32	Clay Pots	South Africa	1	3	3	5
33	Traditional Water Treatment	South Africa	2	3	2	3
34	Protection of the Resource	South Africa	3	3	3	3
35	Sotho Indigenous Water Harvesting	South Africa	3	3	3	2

8.2 Critical Analysis of the Use of IWWM Practices

IK today is recognised both internationally and locally as valid knowledge to respond to development challenges saving governments despite the advances made by the scientific community. The recognition of the value of IK is clearly gaining ground world-wide; with countries adapting traditional practices. However, these gains are largely in the agriculture, food and pharmaceutical sectors, little to no recognition is given to IWWM practices.

The literature review of IWWM practices reveal that the IK in the water sector is not well documented, conceptualised, developed and disseminated compared to modern knowledge. The IWWM practices both locally and internationally is less discussed or known when compared to traditional medicines (traditional healing) which is more practiced and structured worldwide. This research study hopes to change this situation and provide more information on IWWM. Below, is a discussion on the outcome of the critical assessment of 35 identified IWWM practices and its implications for service delivery in South Africa, improving agricultural practices and supporting efficient and sustainable development while using water.

8.2.1 Economic Efficiency

Of the 35 IWWM practices evaluated only 3 were found to be unsustainable (low significance). These included the Khoi San Ostrich Eggs, Karaisali Waste Water Management and clay pots practices. The use of ostrich eggs and clay pots for storing water is not practical in today's conditions while the Karaisali Waste Water Management is not applicable in South Africa because in urban areas there is limited space available and in rural areas the vast distances between households renders the system economically unfeasible.

Given that only 12% of the IWWM practices remain economically inefficient does bear testimony to the conclusion that IWWM practices are feasible, practical and are not financially demanding to construct, operate and maintain.

8.2.2 Environmental Sustainability

All IWWM practices evaluated fall in the medium to high significance range. There is no practice of 35 identified practices that will have a negative impact on the environment. 71% has a high significance rating, leaving 29% with a medium significance rating.

This finding is in line with general consensus that indigenous practices are environmental sustainable. These practices were developed at a time when people understood and relied on natural resources therefore the thought of abusing such resources was unthinkable.

However, it must be cautioned that if these IWWM practices are not managed it will result in environmental degradation for instance if the hydraulic noria is replicated, water conservation will be necessary. Adapting IWWM practice to suit current conditions requires that planners understand the full local environmental implication of the technology before it can be implemented.

8.2.3 Social Equity

There are no IWWM practices that are socially insignificant, implying that although the practices are developed by a particular ethnic group; the evaluation demonstrates that these can be applied to communities without the fear of offending or alienating anyone. IKS is a result of people, across the globe, responding to local challenges. The resulting indigenous practice is influenced by the traditions, social constraints and prejudices, superstitions and cultural values of the people. This implies that not all indigenous practices will automatically meet with the same approval by other cultures. Therefore, 57% of the IWWM practices are sustainable only if adapted to reflect the needs of different ethnic groups.

43% of the IWWM practices can be implemented without being adapted to local conditions.

In principle the IWWM practices analysed imply fair access to livelihood, education, and resources; full participation in the cultural life of the community and self-determination in meeting fundamental needs for everyone. Everyone who uses the practices will gets

what's right for them. The practices are open to everyone and everyone can profit from them.

8.2.4 Replication

34% of the IWWM practices evaluated can be replicated without any problems in transferring the practice to another group. These include the hydraulic noria, stone lines, planting pits, terracing, traditional teras cultivation, roof tanks and wells, the Zai System, the Ngoro and Matuta Soil and water conservation systems, the Gawan System, the Caag System, Nguni handwashing and traditional medicine for handwashing.

Although the hydraulic noria is used in Syria for irrigation it can easily be used to supply rural community with water. Water from a river can be pumped to a tank for consumption. Women and children will not have to walk long distances to collect water and no operating costs will be involved. The shortfall of the system is that it is dependent on very specific conditions to ensure adequate head in the system to pump the water.

In many rural areas in South Africa, people use their free basic allowance of water to water their food gardens. Stonelines, planting pits, terracing, traditional teras cultivation, roof tanks and wells, the Zai System, the Ngoro and Matuta soil and water conservation systems, the Gawan System, the Caag System will assist in water efficient agricultural practices. These solutions will leave the householder with more water for domestic purposes in addition it will contribute to water conservation practices.

Currently, waterborne diseases affect a large part of the South African population. The Nguni handwashing technique and traditional medicines for hand cleaning will assist in decreasing number of people who are affected by these diseases.

The use of aloe juice for hand cleaning in the absence of water should be investigated further. Should it prove successful, people living in informal settlements who do not always have access to water or have limited access to water could use this a dry hand cleaning option.

Only 9% of the IWWM practices evaluated are not recommended for replication, these include using ostrich egg shells and clay pots for storage and the Karaisali Waste Water Management system. All three practices are economically, environmentally and socially

sound practices however the ostrich eggs and clay pots are not practical due the volume of water that they can contain at a time and the Karaisali Waste Water Management system is very specific to the conditions in Turkey.

The remaining 57% of the IWWM practices can be implemented but will require varying degrees adaptation. This could include modification to the design to take into account location conditions, education programme to sensitive people to certain issues, etc.

9. IMPLICATIONS OF IWWM ON EXISTING AND FUTURE WATER SECTOR POLICIES AND STRATEGIES IN SOUTH AFRICA

As a point of departure is it necessary to acknowledge the comments made during stakeholder engagement,

- "Stakeholders could not agree on whether IK or traditional knowledge was more appropriate to describe local knowledge and practices in South Africa. In addition, there isn't a well-accepted definition for IK in South Africa. Individuals and institutions use varying definitions.
- Everyone interviewed agreed that although South Africa has created an enabling environment for implementing IKS not much has been done.

Therefore, for the water sector a common definition for IK is necessary. The sector must be able to demonstrate how existing future policies and strategies will take into account IKS.

All future water sector policies must be include a section on IKS. This can be done as a standalone section or addressed through crosscutting issues. Future policies and strategies must be required to demonstrate that IKS were considered.

It is accepted that it may not be possible to change existing policies and strategies however when they are being reviewed they should take into account IKS.

From Section 8 of the report it is clear that IK practices have a lot to offer in terms of future water planning, health and hygiene, water conservation, etc. It also clear that IKS can have a large impact on current small scale agricultural practices hence better alignment is needed between the Department of Agriculture, Forestry and Fisheries, the Department of Water Affairs and the Cooperative Governance and Traditional Affairs in designing and implementing policies and strategies.

The Department of Science and Technology, Department of Trade and Industry and the Department of Arts and Culture have a joint responsibility to ensure effective monitoring and evaluation of the implementation of IKS.

Below, is a list of some current water sector policies that could benefit from IKS but do not mention or make reference to indigenous practices. These documents should be reviewed to include IKS include:

- Rainwater Harvesting;
- Water Conservation/Water Demand Management Strategy;
- Waste Discharge Charging System;
- Integrated Water Resource Management Plan Guideline;
- The Private Land Guideline;
- Guideline for the Provision of Water for Small Scale Multiple Uses;
- Guideline for the Development of a Provincial Water Sector Plan;
- The Free Basic Services Policy;
- Water Services Policy Database and Toolbox;
- Strategic Framework for Water Services;
- National Water Resources Strategy;
- Water Services Development Plan Guideline;
- Health and Hygiene Strategy;
- Water for Growth and Development; and
- Water Sector Strategic Assessment Report.

Current, there is no national greywater policy however should one be developed it should include comment on indigenous greywater practices.

The Water Services Act, (Act 107 of 1998) is currently under review, this provides an ideal opportunity to include comment on the consideration of IKS in future planning.

10. CONCLUSIONS AND RECOMMENDATIONS

It is possible to adapt IWWM practices to address the challenges currently facing the water sector. It was concluded that IWWM could assisting in addressing various challenges currently facing the water sector. Sharing IK practices locally and internationally can help enhance cross-cultural understanding and promote the cultural dimension of development. While modern science separates different kinds of knowledge, IK integrates the spiritual, environmental, agricultural and all other kinds of knowledge within a culture, it becomes a way of life.

35 IWWM practices were identified and assessed in terms of its economic, environmental and social sustainability and its ability to be replicated in South Africa. Of the 35 IWWM practices evaluated only 3 were found to be unsustainable (low significance).

Only 5 of the identified 35 IWWM practices originated in South Africa therefore the team concluded that there was insufficient material for a coffee table book.

Water sector partners should consider the following IWWM in detail: the hydraulic noria, stone lines, planting pits, terracing, traditional teras cultivation, roof tanks and wells, the Zai System, the Ngoro and Matuta Soil and water conservation systems, the Gawan System, the Caag System, Nguni handwashing and traditional medicine for handwashing.

The following recommendations were made:

- The Department of Arts and Culture should invest in a national scale awareness campaign is necessary to market South African IK.
- The existing policies developed to protect IK should be demystified and translated into an action plan for the water sector.
- The Department of Trade and Industry should invest more money in trying to commercialise some IK which will serve to promote South African IKS.
- All future water sector policies must be include a section on IKS. This can be done as a standalone section or addressed through crosscutting issues. Future policies and strategies must be required to demonstrate that IKS were considered.
- Better alignment is needed between the Department of Agriculture, Forestry and Fisheries, the Department of Water Affairs and the Cooperative Governance and

Traditional Affairs in designing and implementing policies and strategies to include IKS.

- The Department of Science and Technology, Department of Trade and Industry and the Department of Arts and Culture have a joint responsibility to ensure effective monitoring and evaluation of the implementation of IKS.
- Below, is a list of some current water sector policies that could benefit from IKS but do not mention or make reference to indigenous practices. These document should be reviewed to include IKS include:

    - Rainwater Harvesting;
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    - The Free Basic Services Policy;
    - Water Services Policy Database and Toolbox;
    - Strategic Framework for Water Services;
    - National Water Resources Strategy;
    - Water Services Development Plan Guideline;
    - Health and Hygiene Strategy;
    - Water for Growth and Development; and
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- Current, there is no national greywater policy however should one be developed it should include comment on indigenous greywater practices.
- The Water Services Act, (Act 107 of 1998) is currently under review, this provides an ideal opportunity to include comment on the consideration of IKS in future planning.

11. REFERENCES

Akullo D., Kanzikwera R., Birungi P., Alum W., and Batwogeza M., 2007. Indigenous Knowledge in Agriculture: A case study of the Challenges in Sharing Knowledge of the Past Generations in A globalisation Context in Uganda, National Agriculture Research Organisation, Uganda. Available at: http://archive.ifla.org/IV/ifla73/papers/120-Akullo_Kanzikwera_Birungi_Alum_Aliguma_Barwogeza-en.pdf

Boven K. and Morohashi J. (eds) 2002. Best Practices Using Indigenous Knowledge, Nuffic, The Hague, The Netherlands and UNESCO/MOST, Paris France.

Bredenkamp, G.J. & Van Vuuren, D.R.J. 1987. Note on the occurrence and distribution of *Aloe marlothii* Berger on the Pietersburg Plateau. *South African Journal of Science* 83: 498-550.

Brulliards N., 2009. South Africa's Water Conundrum. Climate Change and economic Growth Drain South Africa'Low Water Supplies. GlobalPost Johannesburg. Available at: http://www.globalpost.com/dispatch/south-africa/090710/south-africa-water-shortages

Bruinsma W., 2003. *An introduction to indigenous knowledge.* Unpublished presentation to the workshop 'World Water Wisdom' held at IHE, The Hague, 19th February 2003.

Cheserek, G., 2005. Indigenous Knowledge in Water and Watershed Management: 'Marakwet' Conservation Strategies and Techniques**,** School of Environmental Studies, Moi University, Kenya.

Cooper D., and Jockson S., 2008. Preliminary Study on Indigenous Water Values and Interests in the Katherine Region of Northern Territory. A Report prepared for NAILSMA's Indigenous Water Policy Group, Northern Territory.

Dietz, T., 1987. Pastoralists in Dire Straits: Survival strategies and external interventions in semi-arid region at Kenya – Uganda border western Pokot (1900-1986). University of Amsterdam Press.

Dlamini, D.N. B., 2005. The Management of Indigenous Knowledge in Swaziland, with Specific Reference to the Swaziland National Library Service (SNLS), Unpublished Dissertation Submitted to University of Western Cape South Africa.

Department of Science and Technology (DST) 2004. Indigenous Knowledge Systems. Department of Science and Technology, Pretoria.

Department of Trade and Industry (DTI) 2006. The Protection of Indigenous Knowledge through the Intellectual Property Systems. A Policy framework. Department of Trade and Industry, Pretoria.

Department of Water Affairs and Forestry (DWAF). 1997. *Overview of water resources availability and utilisation in South Africa*. South Africa. May 1997.

Eberhard, R 2001. Urban water pricing: a critical-realist approach. PhD thesis; School for Oriental and African Studies. London, University of London: 275.

Environmental Quality International (EQI) 2001. Building on Indigenous Knowledge: Traditional Water and Wastewater Management Techniques in North Africa and the Middle East. Proposal to GDN—August 2001 Cairo Egypt.

Groenfeldt, D., 2009. Integrating Indigenous Knowledge Into Water Policies. Water Initiative Santa Fe, New Mexico USA.

Izugbara C.O. and Umoh J. O., 2005. Indigenous Waste Management Practices among the Ngwa of Southeastern Nigeria: Some Lessons and Policy Implications. Department of Sociology & Anthropology, Faculty of Social Sciences, University of Uyo, P.M.B. 1017, Uyo, Akwa Ibom State, Nigeria

Haarhoff, J., Petri J & Harri M., 2007. A Short Comparative History of Wells and Toilets in South Africa and Finland, in Petri Juuti, Tapio Katko, Harri Mäki, Ezekiel Nyangeri Nyanchaga, Sanna-Leena Rautanen and Heikki Vuorinen (eds). Governance in Water Sector – Comparing development in Kenya, Nepal, South Africa and Finland, Tampere, Finland: Tampere University Press, e-Publications, pp. 128-148

Hart, T. & Vorster, I., 2006. Indigenous knowledge on the South African Landscape. (Urban, Rural and Economic Development Research Programme, Occasional Paper 1). Cape Town: HSRC Press.

Hart, T and Baiphethi, M., 2008. Tshepo Khumbane – Growing South Africa's women and landscape. In Agenda, 78. pp156-162.

Hardy, D.S. 1989. A note on the ultilisation of *Aloe marlothii* by kudu during drought. *Aloe* 26,3: 55.

Hays, J., 2006. Learning Indigenous Knowledge Systems, University of Tromso.

Hoedeman, O. et al. 2006. Water Justice Project. The Tide Turns But Pro-privatisation Currently Remain Strong. Observation on the World Water Forum in Mexico City.

Hutchings, A., Haxton Scott A., Lewis, G. & Cunningham, A. 1996. *Zulu medicinal plants-an inventory.* University of Natal Press.

Gonese, C., 1999. "Bio-cultural diversity in Zimbabwe", *COMPAS Newsletter* No. 2, October 1999, pages 7-9. Compas, P.O. Box 64, 3830 Leusden, the Netherlands.

Groenfeldt, D., 2009. Integrating Indigenous Knowledge Into Water Policies. Water Initiative Santa Fe, New Mexico USA.

Kayombo K., Dihenga and Ellis-Jones J., 1999. Characteristics and Socio-Economic Evaluation of Two Indigenous Soil and Water Conservation Systems. Selected Papers from the 10th International Soil Conservation Organisation. Meeting held May 24-29 – 1999 at Purdue and the USDA-ARS National Research Laboratory. Botswana.

Malomane Suzan. Personal communication. Rain Queen watermaking. Modjadji Traditional Authority, 07/June 2011.

Mbhatha, S., Wilson Z. And Buckley C., 2008. Zulu Indigenous Practices in Water and Sanitation: Preliminary Field Research on Indigenous Practices in Water and Sanitation conducted at Ulundi. South Africa. WISA 2008 Biennial Conference & Exhibition

Mbiti, S. J., 1969. African Religions and Philosophy. Oxford: Heinermann

Morris D., 2005. Indigenous Knowledge Systems and Teaching of History: Case studies in Museum Archeology Context, McGregor Museum Kimberly.

Meinzinger F. (No date). Lesson B2: Rainwater Harvesting. Institute of Wastewater Management Hamburg University of Technology. Available at: http://www.tu-harburg.de/aww/lehre/wbt/emwater/documents/lesson_b2.pdf

Melchias G., 2001. Biodiversities and Conservation. Enfield: Science Publishers

Molokwane: Personal communication with Modjadji Rain Queen Tour Guide. 8 June 2011.

Morris D., 2005. Indigenous Knowledge Systems and Teaching of History: Case studies in Museum Archeology Context, McGregor Museum Kimberly.

Navroz, K. et al. 2003. Multi-stakeholder Processes: The Legacy of the World on Dams. A watershed in Global Governance? An Independent Assessment of the World Commission on Dams Geneva.

O'Donoghue R. 2011. Personal Communication on the 29th April 2011. Indigenous Nguni handwashing.

O'Donoghue R. 2005. Cholera in KwaZulu-Natal: Probing Institutional Governmentality and Indigenous Hand-washing Practices in Environmental Education Association of Southern Africa, Rhodes University, South Africa.

O'Donoghue R. and Janse Van Rensburg E., 1999. Indigenous myth, story and knowledge in/as Environmental Education Processes. *Indigenous in/as Environmental Education Processes. Environmental Education Association of South Africa Monograph No 3 Howick, South Africa Share-Net.*

Palmback, J., 2004. Traditional Water Harvesting. Spring 2004. *University of Wisconsin – Eau Claire, USA.* http://academic.evergreen.edu/g/grossmaz/PALMBAJP/.

Pandit K., and Balla K M., 2004. Indigenous Knowledge of Terrace Management in Paundi Khola Watershed, Lamjung District, Nepal. Department of Forests and Soil and Environmental Science, Institute of Forestry, Tribhuvan University, Nepal.

Pooley, E. 1993. *The complete field Guide to trees of Natal, Zululand and Transkei.* Natal Flora Publications Trust.

"Postnote 2002. Access to Water in Developing Countries." Parliamentary Office of Science and Technology. Vol 178, (2002): 1-4. http://www.parliament.uk/post/pn178.pdf.

Prinz, D. 1996. *Water Harvesting – History, Techniques and Trends*, Zeitschrift für Bewässerungswirtschaft, 31. Jahrg., Heft 1, pp.64-105

Rajib Shaw 2007. Essentials of Indigenous Essentials Knowledge: An Overview. DRH Idea Workshop in Delhi / 19DRH 19--20 February 200720 2007. Kyoto.

Reij C., 1991. Indigenous Soil and Water in Africa. Institute International for Environment and Development (IIED) Amsterdam, The Netherlands.

Reynolds, G.W. 1982. *The aloes of South Africa.* Balkema, Cape Town.

Rob O'Donoghue 2005. Cholera in KwaZulu-Natal: Probing Institutional Governmentality and Indigenous Hand-washing Practices in Environmental Education Association of Southern Africa, Rhodes University, South Africa.

Scarbourough V., 2003. The Flow of Power: Ancient Water Systems and Landscapes. Sante Fe, New Mexico, USA: School of American Research, 204p

Scholes K., 2010. The Rain Queen. Penguin Group Australia.

Sonjica, B. P., 2005. *National Climate Change Conference: Speech by Minister of Water Affairs and Forestry*, Gallagher Estate, Johannesburg, 18 October. Internet – http://www.dwaf.gov.za/Communications/MinisterSpeeches/2005/ClimateChange 18Oct05.doc – cited 23/02/2009.

Smith, G.F. 1993. Familial orthography: Aloeaceae vs. Aloaceae. *Taxo*n 42: 87-90

Tihalefang G. and Oduaran A., 2006. An exploration of indigenous values influencing learning systems of the Basarwa in Botswana. University of Botswana, Gaborone, Botswana. Available at: http://www.win-hec.org/docs/pdfs/Oduaran%20final.pdf

Tshabala V. M., 2008. Indigenous Knowledge: Lessons for IWRM within Lesotho Water Resources Management

United Nations Educational, Scientific and Cultural Organization (UNESCO) 2006. Water and Indigenous Peoples. Edited by R. Boelens, M. Chiba and D. Nakashima. Knowledges of Nature 2, UNESCO: Paris, 177 pp.

United Nations (UN) 1994. *Draft United Nations Declaration on the Rights of Indigenous Peoples* [Resolution adopted without a vote], chapter XVI, 26th August, 1994

Van Koppen, B. van; Smits, S.; Moriarty, P.; Penning de Vries, F.; Mikhail, M.; Boelee, E., 2009. Climbing the Water Ladder : Multiple-use water services for poverty reduction. The Hague. The Netherlands, IRC International Water and Sanitation Centre and International Water Management Institute. (TP series; no. 52). 213 p.

Van Wyk, B. & Smith, G. 2003. *Guide to the aloes of South Africa,* edn 2. Briza Publications, Pretoria.

Van Wyk, B-E, Van Oudtshoorn, B. & Gericke, N. 1997. Medicinal Plants of South Africa. Briza, Pretoria.

Wageningen A. J., 2000. “Shake off those caterpillars", *Technical Centre for Agricultural and Rural Cooperation* *Spore,* No. 90, page 6. The Netherlands.

Warren, D.M., 1991. *Using indigenous knowledge in Agricultural development; World Bank discussion paper No. 127*. Washington DC: The World Bank.

Water Research Commission (WRC) 2008. Grade 8: Activity 1 – Sweet water and early Nguni people: SOCIAL SCIENCES: HISTORY reading and questioning activity looks at early Nguni people of southern Africa and their commonsense ways of collecting and storing “sweet” water. Available at: http://www.wrc.org.za/Knowledge%20Hub%20Documents/Educational%20Documents/Grade8_Activity1.pdf

Werger, V.A. 1970. *Flower garden diseases and pests.* Purnell, Cape Town. Plants of southern Africa website http://posa.sanbi.org

Wikipedia (no date). Rain Queen, Available at: http://en.wikipedia.org/wiki/Rain_Queen

Wildlife Environmental Society of South Africa (WESSA) Share-Net 2011. Available at: http://www.sharenet.org.za/share-net-resources/indigenous-knowledge/viewdownload/6-other-share-net-resources/59-envirofacts16water7july2010.html

WIPO (2006) Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folkore, Ninth Session Geneva, April 24 to 28, 2006.

World Bank (WB) 1991. Indigenous People. The World Bank Operational Manuel, Operational Directive, OD 4. 20 September 1991. Washington DC World Bank.

World Bank (WB) 1998. Indigenous Knowledge for Development: A framework for Action online available: http://worldbank.org/afri/ikrept.pdf (retrieved, 05/04/2010).

World Water Council (WWC) 2009. Fifth World Water Forum from 16 to 22nd March 2009, Istanbul Turkey. Provisional Programme for the Africa Region.

APPENDIX A

Indigenous SWC Techniques in Africa Adapted from Chris Reij, 1991

Country	Ethnic group	Rainfall (mm)	Indigenous SWC Practices
Burkina Faso (Central)	Mossi	400-700	stone lines stone terraces planting pits *(zay)*
Burkina Faso (South)	Kassena	700-800	stone lines
Burkina Faso (Southwest)	Birifor	1000-1100	stone bunds on slopes; network of earth bands and drainage channels in lowlands
Burkina Faso (Southwest)	Dagari	1000	contour stone bunds on slopes, drainage channels
Cameroon (North)	20 ethnic groups	800-1100	bench terraces (0, 5-3 m high) stone bunds
Cape Verde (S.Antao Island)		400-1200	bench terraces (rainfed, irrigated), contour stone walls *(murets),* floodwater control dams, river bank protection walls *(bardos)*
Mali (Djenné-Safara)	Bambara/	400	pitting systems
Morocco (Anti-Atlas mountains)		100-250	terraces, stone banks and small stone walls
Niger (Ader Doutchi Maggia)	Haussa	300-500	stone lines, planting pits *(tassa)*
Sierra Leone			sticks and stone bunding on fields and in gullies, drainage techniques
Somalia (Hiraan region)	Somali	150-300	earth bunds with upslope wingwalls *(caug)* and earth bunds dividing plots of land into a grid *(gawan)*
Sudan (East)	Hedwenda, Shukriya, etc.	225-400	earth bunds (straight) with upslope wing-walls *(teras),* and water spreading techniques
Sudan (Djebel Marra)	Fur	600-1000	bench terraces
Tanzania (Uluguru mountains)	Luguru	1500	ladder terraces
Tchad (Ouddai)		250-650	various earth-bunding systems with upslope wingwalls, in drier regions with catchment area (water harvesting)
Tunisia		100-200	earth dams *(tabias/jessours)* within

Country	Ethnic group	Rainfall (mm)	Indigenous SWC Practices
(Medénine)			streambeds
Tunisia (Sousse)		200-300	earth bunds *(meskat* system)

APPENDIX B

Some Examples of IKSs' Applications in Africa Adapted from Dlamini, 2005

Country	Application/Use
Angola	Angolans use sugar cane to quench thirst. It is also processed into sugar and sugar cane wine using "Bagasse" as the fermentation agent. The wine making process is an ancestral practice transmitted from generation to generation
Botswana	Natural resources materials are used to produce basketry and pottery from. The knowledge is passed down from generation to generation.
Burkina Faso	Local communities are marketing their agricultural and managing farm credit and reinvestment by mastering accounting and administration systems developed directly in Bambara, a local language.
Lesotho	To heal a headache, a bark of a peach tree is peeled and burned, then the patient is made to inhale the smoke, and the headache goes away.
Nigeria	During the first four weeks after birth, the mother and the child are secluded and relieved of duties and are cared for by the grandmother of the newborn. The new mother is fed a stimulating hot soup made of dried fish, meat, yams, a lot of pepper and a special herbal seasoning called "udah", which helps the uterus contract and helps in the expelling of blood clots.
South Africa	The use of "intuma", a green round shaped fruit to cure toothache. In order for a patient to administer this, a dried mielie corn, which is squeezed into the fruit, is needed. The mielie corn is then lit and the infusions are inhaled through the mouth.
Swaziland	Swazis use kraal manure, poultry litter and swines waste in the fields to prevent soil degradation.
Uganda	IK is being applied for cultural management of "matoke" crops to reduce harmful effects of the "Sigatoka" disease.

Appendix 1: Some Examples of IK Use in South African Agriculture Adapted from Hart and Vorster (2006: 18-22)

Case	Application/Use
Sisal(galboom) chicken nesting boxes – Msinga, KwaZulu-Natal	Local dogs have a habit of eating any chicken eggs that are laid on the ground in the local homesteads in this area. Generations ago local residents developed a means of creating nests which protected chicken eggs from scavenging dogs (Still used).
Protecting sorghum (amabhele) seed heads – Msinga, KwaZulu-Natal	Sorghum (Sorghum bicolour spp) is believed to have its origin in Ethiopia from where it has spread to various other parts of the world. In South Africa it has become internalised in the African culture and is grown locally, used as grain and for making traditional beer. However, the seed head is prone to damage from birds at certain times of the years. Generations ago local households in Msinga developed a means to protect the seed heads by wrapping them with grass (No longer used).
Pruning the pumpkin plant (Cucurbita spp.) to maximise yield – Nkwalini, KwaZulu-Natal	For many generations rural women have been pruning the tips of the pumpkin vines. According to a Nkuwalini farmer, Mrs Ncube, this practice result s in an increase in the size of the pumpkins harvested. She says that there is a belief that in order to get maximum benefit from this practice it is important that it is done by a person with extra fingers or toes (physical deformity) (Still used).
Production of maize seedlings – Bulwer, KwaZulu-Natal	A Bulwer farmer, Mr Mkhize, wanted to ensure that the he had seedlings to plant early October 2001. In order for them to develop the seedlings needed to be kept in a warm environment. However, with the local community nursery failing to produce the services and products that it had planned and with the eventual termination of the projects, this facility was not available to local farmers (Still used).
African vegetable: An indigenous resource – several sites in South Africa.	Many rural communities in South Africa rely on foods that harvested from plants growing in the wild or which occur in their household gardens as seasonal crops. In South Africa, local people formerly ate a diet of meat, milk, wild plants, but lately the Sepedi proverb “Meat is a visitor, but morogo (leaf vegetable) a daily food ‘has become a reality for most rural people. Indigenous peoples have developed knowledge of different plants their leaves as well as fruits which can be used that are important for local culture and livelihoods resources (Still used).