An integrated assessment of socio-economic and environmental issues of the Orange/Senqu River Basin

ORALEASEARN study tour 13-26 November 2005

Funding from UNESCO and the Flemish Government
Flemish UNESCO Science Trust Fund
Executive Summary

1. A group of ten participants undertook a tour of the Orange/Senqu River Basin under the auspices of FETwater, South Africa, and the Desert Research Foundation of Namibia supported by funding from UNESCO and the Flemish Government Flemish Unesco Science Trust Fund.

2. The tour extended from the lesser developed Katse Dam area in Lesotho to the heavily developed region of the Orange-Vaal confluence.

3. Institution arrangements from both countries were analysed. These ranged from the four-country agreement on ORASECOM to the local authorities. Good communication among these institutions was found to be lacking and it is evident that more advisory support from governmental departments is needed.

4. Environmental flow requirements of the systems were investigated further. It was found that there are deficiencies in the implementation of the reserve and a gap analysis should be done to locate areas of importance. A holistic approach is also needed to give effect to the Reserve.

5. The quantitative water requirements for users in the study area were found to be similar to the potential available water indicating that much further development in the area will not be possible. Recommendations for bulk water suppliers, hydro power generation and irrigation were made.

6. Operational procedures were analysed and were found to be very complex due to the interdependency of the different water management areas. Water management plans are needed to give effect to the operationalisation of the Reserve. Implementation of these policies should be an iterative process.

7. The study also looked at the political and social issues which emanate from huge water infrastructure development projects. It was found that while the engineering side of the development was well planned, the social understanding was lacking. Particular attention needs to be paid to the long-term spatial and temporal issues related to people affected by these kinds of projects.

8. While the National Water Act 1998 has good intentions for protecting and conserving water resources, implementation and capacity building remain as challenges for the future. We believe that exercises such as this one serve to capacitate people and develop more understanding of the complexity of issues in the water sector.
Foreword

Sustainable development, millennium development goals, environmental water flows – all are concepts intended to support the improved and equitable access to livelihoods of southern Africa’s people. To service these intended goals, a wide range of enhanced capacities are required with particular emphasis on those who are making decisions on behalf of and in consultation with the area’s residents. In a predominantly arid region such as southern Africa, water is a key element around which enhanced capacities are an absolute necessity.

FetWater, the Framework Programme on Education and Training in support of the Water Sector in the SADC Region, and the Desert Research Foundation of Namibia have joined forces to test a training approach for enhancing understanding and decision making capacity surrounding water management and use. The Framework Programme for Education and Training in the Water Sector has identified the need to improve capacity related to Environmental Water Requirement determinations and the technical integration required to achieve successful implementation.

With particular attention to the identified gap in water management institutions between experienced, senior management and younger, dynamic, eager but less experienced lower and middle management, the focused study tour approach has been designed. Its overall objective is to reinforce analytical assessment capacities including identification of challenges to water management and use and solutions to these challenges. This approach is being pursued through visits and discussions with on-site water managers, lectures and discussions with water management professionals and discussion amongst the participating group of professionals and students involved in the water sector.

The Orange and Senqu rivers were identified as an ideal case study which challenged students to understand the complexities in terms of management and operation of such a system in order to implement Environmental Flow Requirements. The training focussed on the social, economic and environmental aspects.

Funding for this training programme was sourced from UNESCO and the Flemish Government Flemish Unesco Science Trust Fund. Additional support from a wide variety of institutions in the form of time, lectures, facilities, interest and encouragement is greatly appreciated and indicated in the acknowledgements.

FETWater

DRFN
Acknowledgements

From the participants, whose names are listed below, we wish to particularly thank UNESCO and the Flemish Government Flemish Unesco Science Trust Fund who funded this learning experience as well as water managers, experts and professionals who have helped us to enhance our understanding of the components and interrelated complexities of the Orange/Senqu River Basin. We hope that they will feel rewarded by the results of this study tour.

ORGANISERS

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<thead>
<tr>
<th>Name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Mr Dana</td>
<td>Grobler</td>
<td>FETWater RDM Network coordinator, South Africa</td>
</tr>
<tr>
<td>Dr Mary</td>
<td>Seely</td>
<td>Desert Research Foundation, Namibia</td>
</tr>
</tbody>
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PARTICIPANTS

<table>
<thead>
<tr>
<th>Name</th>
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</tr>
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<tbody>
<tr>
<td>Mr Siyabonga N</td>
<td>Buthelezi</td>
<td>CapeNature</td>
</tr>
<tr>
<td>Mr Shadrick M</td>
<td>Luyanga</td>
<td>Department Water Affairs, Namibia</td>
</tr>
<tr>
<td>Ms Celine</td>
<td>Mbuli</td>
<td>DWAF, South Africa</td>
</tr>
<tr>
<td>Mr Komeine</td>
<td>Nantanga</td>
<td>Desert Research Foundation, Namibia</td>
</tr>
<tr>
<td>Ms Anusha</td>
<td>Rajkaran</td>
<td>Nelson Mandela Metropolitan University</td>
</tr>
<tr>
<td>Mr Greg</td>
<td>Shaw</td>
<td>Nelson Mandela Metropolitan University</td>
</tr>
<tr>
<td>Mr Archinton</td>
<td>Thobejane</td>
<td>DWAF, South Africa</td>
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PRESENTERS

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<tr>
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</tr>
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<tr>
<td>Mr Manyanye</td>
<td>Bahaloana</td>
<td>Transformation Resources Centre, Maseru Lesotho</td>
</tr>
<tr>
<td>Mr Frik</td>
<td>Cornelus</td>
<td>DWAF, National office</td>
</tr>
<tr>
<td>Mr Pierre</td>
<td>De Villiers</td>
<td>Department of Environment Affairs Free State</td>
</tr>
<tr>
<td>Mr Anton</td>
<td>Earle</td>
<td>University of Pretoria</td>
</tr>
<tr>
<td>Ms Laura</td>
<td>Forster</td>
<td>Tidasa, RDM network partner</td>
</tr>
<tr>
<td>Mr Willem</td>
<td>Grobler</td>
<td>DWAF, Bloemfontein</td>
</tr>
<tr>
<td>Mr Joseph</td>
<td>Jacobs</td>
<td>DWAF, Hydrology</td>
</tr>
<tr>
<td>Ms Lani</td>
<td>Holtzhausen</td>
<td>WRC, Water Wheel</td>
</tr>
<tr>
<td>Mr Mabusetsa</td>
<td>Lenka</td>
<td>Transformation Resources Centre, Maseru Lesotho</td>
</tr>
<tr>
<td>Ms Delana</td>
<td>Louw</td>
<td>Water for Arica, RDM network partner</td>
</tr>
<tr>
<td>Dr Steve</td>
<td>Mitchell</td>
<td>WRC South Africa</td>
</tr>
<tr>
<td>Mr Sylvester</td>
<td>Mokgoswá</td>
<td>Lange/riev Park, Bains Vlei Treatment Plant</td>
</tr>
<tr>
<td>Mr Tony</td>
<td>Muller</td>
<td>Rand Water, South Africa</td>
</tr>
<tr>
<td>Mr Elias</td>
<td>Nel</td>
<td>DWAF, National office</td>
</tr>
<tr>
<td>Mr Nico</td>
<td>Olivier</td>
<td>Bloem Water, Welbedacht Water Purification Works</td>
</tr>
<tr>
<td>Mr Harrison</td>
<td>Pienaar</td>
<td>DWAF South Africa</td>
</tr>
<tr>
<td>Mr Peter</td>
<td>Pyke</td>
<td>DWAF, Options analysis</td>
</tr>
<tr>
<td>Dr Cecilie</td>
<td>Reed</td>
<td>CapeNature</td>
</tr>
<tr>
<td>Dr Piest</td>
<td>Van der Wall</td>
<td>Ai Ais Transfrontier Park initiative</td>
</tr>
<tr>
<td>Mr Louis</td>
<td>Van Oudthoorn</td>
<td>BloemWater</td>
</tr>
<tr>
<td>Dr Johan</td>
<td>Van Der Merwe</td>
<td>DWAF, Bloemfontein</td>
</tr>
<tr>
<td>Mr Dries</td>
<td>Visser</td>
<td>DWAF, Bloemfontein</td>
</tr>
<tr>
<td>Mr Joseph</td>
<td>UHDA, Katse Dam</td>
<td>DWAF, Gariep Dam</td>
</tr>
<tr>
<td>Ms Charmaine</td>
<td>Eskom, Drakensberg</td>
<td></td>
</tr>
<tr>
<td>Ms Karin</td>
<td>Eskom, Drakensberg</td>
<td></td>
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<tr>
<td>Mr Joseph</td>
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Summaries of Chapters

Introduction        Archinton Thobejane

The South African’s National Water Act (NWA) (Act 36 of 1998) was founded on the principles of equity, sustainable and efficiency, each of which is important for different reasons. And the National Water Resource Strategy (NWRS) as required by the NWA also emphasises the need to protect, use, develop, conserve, manage, and control South Africa’s water resources.

This has given rise to new developments in water legislation and management in South Africa, including the concept of Catchment Management Agency (CMA), Environmental Flow Requirements (EFR) (the Reserve, comprising basic human needs and ecological water requirements), Protection of water resources, Water Conservation and Water Demand Management (WC&WDM), and posed a major challenge to water managers.

The Framework Programme for Education and Training in Water (FETWATER) identified the need for training and capacity building within the water sector to deal with the challenges. imposed by new legislation and the RDM Network initiated the Orange-Senqu Learning (ORASELEARN) Tour. As the study tour name says, the pilot study area was the Orange-Senqu River basin.

The Orange-Senqu River is the most developed of all rivers in the Southern Africa and the strategic importance of the river can be illustrated by reliance of the Gauteng Province on Inter-Basin Transfer (IBT) water, all of which is channelled though the Vaal River.

The Orange-Senqu River basin has a total area of 896 368 km2, with a Mean Annual Runoff (MAR) of 11 200 x 106 m3. Four riparian states share the basin with 5% of the basin area lying in Lesotho (upstream riparian), 60% in South Africa, 10% lying in Botswana, and 25% in Namibia (downstream riparian). The contribution to the MAR by each riparian state is unequally distributed, with 55% coming from South Africa, 40% from Lesotho, 5% from Namibia and 0% from Botswana.

The headwaters of the Orange-Senqu River rise in the Maluti Mountain range in the Lesotho highlands with rainfall as high as 2000 mm/a and annual evaporation of 1200 mm. In its lower reaches, the river is a border between Namibia and South Africa with less than 50 mm/a rainfall and evaporation of > 2400 mm/a.

The experimental learning approach was tested in the upper to middle parts of the Orange-Senqu River basin. For a two-week period, a group of ten experts, water professionals and students visited a number of key sites (See Map 1) in the basin and gained information concerning geography, hydrology, infrastructure, management, water users, environmental water requirements, the Reserve and relevant institutions.
Map: Key sites visited during the tour
Institutional overview

Siyabonga Buthelezi

The development of the Orange-Senqu Committee (ORASECOM) was driven by two different motives: The need for water to meet the needs of the South Africa’s power-house province (Gauteng) and political interest (and later management and utilization of the shared resources). This resulted in bilateral negotiations between South Africa and its two neighboring countries (Lesotho and Namibia, respectively). Botswana was later involved.

Lesotho and South Africa: Lesotho, being a land-locked country, realized that one of the natural resources it has in abundance is water and that it had the potential to boost its economy. The first study, done in the early 1950’s, only became handy in the 1970’s when South Africa realised the need for water argumentation in Gauteng and Free State provinces of South Africa.

Negotiations between the Department of Water Affairs and Forestry (DWAF) of South Africa and Water Affairs/Natural Resources, Lesotho (WAL) started in the 1970’s and the Joint Technical Committee (JTC) was formed in 1978 (Fig. 1). This was the first bilateral agreement in the Orange-Senqu River catchment. The main aim of JTC was to investigate the feasibility of the proposed Lesotho Highlands Water Project (LHWP). In 1986 a treaty was signed, LHWP Treaty (LHWPT) and two parastatals were formed, Lesotho Highlands Development Authority (LHDA) and Trans-Caledon Tunnel Authority (TCTA). The former is responsible for the management of the dam construction and related issues within Lesotho, while the later is responsible for the management of delivery tunnels, transferring water to South Africa. A Joint Permanent Technical Commission (JPTC) was established with the aim of co-ordinating the two parastatals, and to report to the two governments. This reflected the fact that each parastatal was giving the feedback to its respective government. The JPTC was later upgraded to the Lesotho Highlands Water Commission (LHWC). This was the last bilateral commission, in the Orange-Senqu River Catchment, before the ORASECOM, which is a multi-lateral commission.

Namibia and South Africa: The Orange-Senqu River is shared by South Africa and Namibia before it discharges to the Atlantic Ocean’s Alexander Bay. The two countries had been involved in bilateral talks for over 100 years mainly the focused on one specific political issue, the border between these two countries. The focus has, however, changed and concentrated on management and utilization of the shared resources. This led to the formation of JTC in 1987, which was upgraded to a Permanent Water Commission (PWC) in 1992. At the same time (1992) the Joint Irrigation Authority (JIA) was formed, and was subsequently followed by the commissioning of the Orange River Replanning Study (ORRS) in 1994.

The multi-lateral talks between Lesotho, Namibia and South Africa eventually incorporated Botswana and the Orange River Commission was formed in 2000.

Institution related to water use: In South Africa, the Minister of Water Affairs and Forestry is the custodian of all inland water, and the DWAF sells raw water to the Water Boards. This includes both water from systems within South Africa and water from the LHWP. The Water Boards, Rand Water and Bloem Water in the Orange-Senqu River Catchment, then sell raw water to the farmers and treated bulk water to the municipalities. These municipalities then distribute it to the end users who use it for different purposes such as domestic uses and mining.
**Water Management Area:** Of the 19 national Water Management Areas (WMA) in South Africa, 5 of them fall under the Orange-Senqu catchment. There are three on the Vaal: Upper-, Middle- and Lower Vaal WMA, and 2 on the Orange: Upper and Lower Orange River WMA.

Although DWAF remains the custodian of water resources in South Africa, the task of their management will be delegated to the Catchment Management Agencies (CMA) that are going to be established to manage the 19 WMA’s that have been identified.

The CMA’s will comprise of the Catchment Management Board and will be directly communicating with the Water User Associations (WUA), and will also be obtaining input from the water forums. These water forums will be advising the CMA on different water-related issues, while the WUA will be the link between the CMA and the end users (e.g. domestic, irrigation, industry).

**Recommendations:** It is recommended that the government supports multi-lateral committees, such as ORASECOM, for all trans-boundary river systems. It is suggested that different approaches be used when rolling out the CMA’s. This process should take place in a phased manner and should follow a logical sequence, not implementing all 19 CMA’s at once. This could mean starting with areas where there are already water forums or where they can be easily formed. Some areas might also get high priority, e.g. where there is a dire need for a structure that deals with water-related issues, or where there are major developments taking place.

When properly implemented CMA’s can reduce the workload on DWAF officials and can help make the daunting task of water management a little easier.

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**Orasecom institutional structure.**
Environmental Requirements  Greg Shaw

The Southern African region can be regarded as water scarce. The South African National Water Act 36 of 1998 recognizes the fact that water is one of the most limited resources and the Reserve is the only entity that has a right to the water. In the past, it was decided that water should be sourced from Lesotho. The water from the Lesotho Highlands Water Project (LHWP) drives the economic and industrial powerhouse, being Gauteng. Due to previous management practices including the LHWP, interventions need to take place in order to comply with the new act.

Observations: The Katse dam is primarily a storage facility, where 93% of the water is allocated for transfer. Of the remaining percentage an environmental requirement or In-stream Flow Requirement (IFR) needs to be budgeted. This has been done and the releases do take place, however there is no document or audit confirming this. It is also unclear what South Africa requires in terms of water quality and quantity from Lesotho.

The Ash River receives the flow from the outfall in the Katse Dam. This results in extreme flow rates which have changed the geomorphology of the river system. There is also a temperature difference between the water received from the Katse Dam and that naturally in the Ash River. The difference has been recorded as high as 8°C. This has a severe effect on the river ecology. Reports have suggested that there is a decline in the abundance of angling species.

Gariep dam releases are managed by two entities, namely: DWAF and ESKOM. Due to power generation during peak time, the amount of water released through the turbines is similar throughout the year. Water height during these times of flow can increase by as much as 2m. Simultaneous release from the dam and ESKOM would result in mini flood events and result in seasonal variation.

The Bloemhof Dam has a commercial fishery which yields 600t/a. This has great potential for communities living in proximity to the dam. We feel that viability of other dams offering the same resource should be investigated.

Water Quality: Additional nutrients added, in particular, to the middle and lower Vaal, cause eutrophication. This is due to two main reasons. Firstly, the sewage treatment works in the vicinity of the Vaal often do not have capacity to deal with the added volume, due to the adding of infrastructure for residential development before the sewage system could be upgraded. Efficient use of water could also lead to the longevity of the sewage treatment works and upgrading could be postponed.

Secondly, the Vaal-Harts has extremely poor water quality due to the irrigation return flow. However, the irrigation systems are not solely responsible for the water quality problems. The Taung Dam could be managed in order to release unused water to dilute salt concentrations and allow the system to become more healthy and aesthetically pleasing.

Recommendations: Establishing pristine conditions in all rivers is not realistic at this time. It is important, however, that Reserve determinations be done for all types of rivers with the objective of long-term sustainability of the resource. There is, however, limited capacity in the water sector as well as difficulties in monitoring abstraction and water use. Moreover, there is a need for strategies to conserve biodiversity e.g. as is being done in the Kraai River. This is due to the fact that many sections of the Orange River are highly regulated and the biodiversity has been lost or is limited. There is also a need to conserve the resource as a whole and this means that a Riparian Delineation Policy, which will not only protect the water
resource but protect the environment surrounding it, needs to be developed. In order for biodiversity to be conserved and river health to be established, regular monitoring needs to take place so that problems can be mitigated as soon as they occur.

Conclusions: A holistic gap analysis needs to be carried out in order to assess where the reserve can be implemented in an integrated and realistic manner. In areas where the river is highly regulated a water management plan needs to be implemented reflecting the system entirely. Capacity building and training was seen to be a weakness within the water sector and we need to address this generally. Moreover, the Orange/Senqu basin is a unique one and the global community is observing the effectiveness of implementation of our world class legislation.

Learning about the River Health programme near Bloemfontein.
Water Use

Anusha Rajkaran

The National Water Act of 1998 refers to water use as an activity that impacts on water resources. A water resource is described by the amount of water in the resource, the quality and the environment surrounding the resource. The most important priority for water use is the Reserve which includes basic human needs and the environment. Other priorities include water to meet international rights and obligations, water use of strategic importance (e.g. generation of electricity), inter-catchment water transfers and future needs for future generations.

The water users recognized in the National Water Act 1998 include agriculture, bulk storage, forestry, industry, mining, power generation, recreation, rural water services and urban water services. The aims of this summary were to identify the water users in the Orange/Senqu basin and to describe the associated challenges encountered by these users. Recommendations were then made as to how some of these issues could be addressed by proposing future scenarios.

When looking at water requirements for different users, one needs to consider the available water within that specific area. Information taken from the National Water Resource Strategy shows that, within the study area, the requirements and availability of water are very similar and this is an indication that the potential availability of water will not support further development within the catchment. The projections from the Strategy included basic human needs but not the ecological reserve. Considering this situation it will be interesting to see how the projections change and how this will affect the operational capacity of the area.

During this tour we visited the following places directly related to water users. These included bulk water suppliers (Rand Water and Bloem Water), a hydro-electric scheme (Drakensberg Pump Storage Scheme near Bergville) and the Vaal-Harts irrigation scheme.

During this course we have been exposed to and read many documents about the basin, provided by FETwater and the Department of Water Affairs and Forestry (DWAF). Documents about Water Conservation and Water Demand Management Strategies (WC/WDMS) were particularly interesting. The strategies pertaining to the water services sector showed that there was a conflict of interest between the Bulk water suppliers (BWS) and the strategies proposed for the efficient use of the water resource. On the one hand the BWS are business entities that generate revenue from water sales but on the other hand they are tasked with implementing WC/WDMS measures for the efficient use of water. It is recommended that BWS should only be involved with water purification and distribution. They should also be encouraged to collaborate with other institutions to facilitate or sponsor research and monitoring in the water sector and more specifically in water quality issues. One such example is the partnership between Bloem Water and the University of the Free State in the River Monitoring Program.

Our country is continually developing and with this comes a greater demand for power. Hydro pump storage and electric schemes are an environmentally friendly source of power during peak demand times. During the tour of the hydro pump storage facility it was made very clear that these schemes are net users of electricity. Once the water passes through the turbines generating electricity during peak demand the water is then pumped back up to the upper dam where it is stored. This pumping action requires a greater amount of power than that produced. More schemes like this one are on being planned for South Africa and it is our recommendation that these developments should be delayed and more emphasis
should be placed on demand management strategies to reduce electricity demand during peak demand times.

To get an idea of the issues in the agricultural sector, the Vaal-Harts irrigation scheme was visited. The amount of water required for irrigation in the entire Orange River system is 62% of the total requirement for the area. With such a great demand for water there are no incentives for water saving strategies. In fact with the current policy of water allocation (m³/ha/a) for farmers, they just don’t see the need to save water. It is our recommendation that this policy should change to give the farmers the freedom to either only pay for the water they use or to use the surplus water to expand their farms. Water quality, soil quality and groundwater salinisation are greatly compromised by irrigation. It is important to determine how long it will take for these resources to become un-useable. This will have great implications for the sector and the country.

Our final observation is that while South Africa has excellent legislation, policies, strategies and ideas there is very limited implementation and auditing of the implementation. Implementation needs to take place for a variety of levels; policies, demand management strategies and operations. There is also need for a partnership to develop between DWAF and the irrigation farmers. DWAF should put incentives in place to encourage water saving and the farmers should take responsibility for the water quality for their return flows.

I would like to take this opportunity to thank the organizers of this tour for their excellent work under what seems to have been stressful and trying circumstances. The experience, knowledge and energy of both Mary and Dana have been incredible to witness. The tour has been a mind opening experience that will play a significant role in my future professional life. Future tours such as this one should be encouraged as they aim to spread knowledge and build capacity in the water sector.

Oraselearn participants learning about irrigation canals at Vaal-Harts.
The Orange River is the longest river in Southern Africa, stretching from Lesotho down to the Orange River mouth in Alexandra Bay. One of the main tributaries of the Orange is the Vaal River. Analysis from the Water Resources Yield Model shows that 1680Mm³/a of water still enters the Orange from the Vaal: although the Vaal River System is operated such that the outflows from the Vaal River System into the Orange River are minimised. These inflows occur as a result of uncontrolled spills from major dams upstream of the Orange/Vaal confluence, local runoff generated in the intervening catchment downstream of the major dams and upstream of the Orange-Vaal confluence as well as a result of operational losses in the Lower Vaal.

Many transfers occur from the Orange River catchment as well as to and from the Vaal River catchment. The developments that are taking place in the Upper Vaal affect the water quality downstream in the form of return irrigation flows and discharge. Interdependency within the system therefore makes operation complicated and increases the need to operate the Vaal and the Orange River in an integrated systems context.

Water quality in the Lower Vaal catchment is poor; for example in the Harts River before its confluence with the Vaal River. Taung dam on the upper reaches of the Harts River is currently unused. Options to utilize this dam need to be analysed to determine the long term yield of the dam and possibly operating rules could then be determined to efficiently use the dam.

The National Water Act (36 of 1998) requires that water for the Reserve should be allocated before any other developments. Water management plans that will give effect to operationalisation of the reserve need to be developed. For example if from the analysis of determining the options for Phase 2 of Lesotho Highlands Water Project, it is determined that there is surplus water available in Katse Dam, water could then be released from the Dam to improve the situation in the Orange River.

As part of Water Conservation and Water Demand Management, reduction of operational losses needs to be seriously looked at; for example Water Management Plans that prioritize irrigation schemes to install metering systems need to be developed. This will create consumer awareness for effective water use. Rainwater harvesting as recommended in the Orange River Replanning Study will contribute to more effective irrigation schemes, it will also improve socio-economic status of dependent marginalized communities.

Regular liaison among water managers in setting objectives for managing the Orange River basin is necessary. Collaboration needs to be improved to discuss issues of common interest.

To conclude; the complexity of operation of the system in an integrated manner remains a challenge. Implementation of all the policies in place is an iterative process which will have to be tested and periodically updated through involvement of all role-players including environmental scientists and socio-economists. If something doesn’t work out we will have to revisit the strategies and try different ones.
Celiwe Mbuli observing the Katse Dam outfall near Clarens with other participants in the background.
Socio-economic component Shadrick Luyanga

This chapter summarizes the political and social issues which emanate from huge water infrastructure development projects, in this case looking at the issues surrounding the Lesotho Highlands Water Project.

Social and Political Issues: In 1986 a treaty was signed between the Governments of Lesotho and South Africa to give effect to the Lesotho Highlands Water Project. The purpose of this project is to transfer water from Lesotho to South Africa. In turn this will create job opportunities for the citizens of Lesotho, power generation and income in the form of royalties.

Social and Economic Impacts: Public Health-HIV/AIDS: The first phase of the project started with construction of roads which resulted in an increase of people coming to the highlands. Although a few local people were employed on the construction sites, most of the people came from outside the area. This movement led an increase in the spread of HIV/AIDS.

Displacement of community: There is not enough information on the number of people who were affected and resettled as a result of the construction of the first phase of the Lesotho Highlands Water Project. Some reports show that about 27 000 people were affected by the project and at least 4000 households were relocated from Mohale. There were a lot of emotional issues from some families try to cope with the relocation exercise as some families had to move their departed ancestors to be reburied at their new homes.

Unequal distribution of wealth: The project has resulted in some communities becoming worse off through loss of land and income for which they were not properly compensated. At the same time this project has benefited some of the people involved.

Key Issues:
- Social, environmental and engineering issues need to be given equitable consideration
  - We have learned that the engineering part of the project was well planned and a success while the socio-economic and environmental issues were neither analyzed nor addressed in detail.
- Need for a comprehensive information database
  - Not much information is readily available on the livelihoods of the communities before the project and after the project and other statistical information which may be useful.
- Implementation of policy – although a Treaty was signed, the agreement was not well implemented
Katse Dam with Oraselearn participants sharing information with a local school group

Overall Conclusion Archinton Thobejane

We all acknowledge the fact that the NWA has good intentions, but the major challenge is the implementation. The lack of capacity within the water sector (e.g. DWAF-SA, our Namibian and Lesotho counterparts) does not do justice to the situation as the junior and middle water managers do not have the necessary experience in all aspects of water management.

To address the situation, projects like this study tour are encouraged, because

- They provide an overview in terms of hands-on experiential learning
- They enhance understanding and capacity to determine, advise and implement policies and apply them to sustainable use and management of shared water resources like the Orange River.
Bibliography

This is a listing of information made available to participants in the field. Attention of
the participants was drawn to other documentation that was not readily available.
The group also recognised that further information is not synthesised or readily
accessible but should be pursued by those interested in the complexity of the
system. The reports above are partially derived from this bibliography

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Acronyms

DWAF – Department of Water Affairs and Forestry
JPTC – Joint Permanent Technical Commission
LHDA – Lesotho Highlands Development Authority
LHWP – Lesotho Highlands Water Project
LHWP T – Lesotho Highlands Water Project Treaty
ORASECOM – Orange-Senqu Commission
TCTA – Trans-Caledon Tunnel Authority
WAL – Water Affairs (Natural Resources), Lesotho
WUA – Water User Associations