

**Experiences with Micro Agricultural Water Management
Technologies:
Botswana**

Marna de Lange

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**An input to the Study on Agricultural Water Management Technologies for Small Scale
Farmers in Southern Africa: An Inventory and Assessment of Experiences, Good Practices
and Costs**

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1. Introduction

Purpose

Water for agriculture is increasingly recognized as a major constraint to improving the lives of the rural poor and is an important component of rural livelihood programs to be established in Southern Africa. The overall goal is to contribute to improving the lives of rural poor through better and sustainable agricultural water technologies/ practices leading to increased agricultural productivity and incomes for small farmers in Southern Africa. FAO Investment Centre is designing a regional program on agricultural water management on behalf of SADC and the African Development Bank. This project is meant to provide inputs into this larger program.

Specifically, the project aims to identify suitable innovative agricultural water management techniques and approaches and determine the corresponding unit costs as a basis for agricultural water investment planning in the pilot SADC countries. This project is linked to a USAID-funded project, “An Inventory of Agricultural Water Technologies and Practices in Southern Africa and an Assessment of Poverty Impacts of Most Promising Technologies.” The two are being implemented in a way that will ensure synergies between them.

Scope and definition

Agricultural water management embraces a whole range of wider practices including in situ moisture conservation, water harvesting, rainwater harvesting, supplementary irrigation, irrigation, various techniques of wetland development such as treadle pumps, drip irrigation systems, sprinklers systems, etc.

Botswana is a water scarce country. Livestock production is the major agricultural activity for both small-scale and commercial farmers, while the current and potential development of irrigation schemes is limited. In this context, any study on agricultural water use in Botswana would be incomplete without attention to water development in support of livestock production.

This report provides information on the promotion of water management technologies in support of poverty alleviation in Botswana in four categories, namely livestock watering, conservation agriculture, rainwater harvesting and irrigation.

Methodology

The terms of reference required a desk study to identify the most promising technologies, rather than a comprehensive inventory of all the water management technologies used in Botswana. The desk study included an internet search, telephone interviews and a country visit to interview key stakeholders and collect relevant literature.

Limitations

?? This study does not intend to provide a comprehensive representation of all agricultural water management technologies in Botswana. Rather, it focuses on the most commonly promoted and/or most promising technologies.

?? Literature sourced from the internet (on Botswana and other countries) tended to be anecdotal and seldom provided technical specifications, information on costs, or on the details and extent of uptake of technologies.

?? The information on water management technologies in this report is based on the experiences and opinions of the promoters of the technologies. There has been no opportunity to get the viewpoint and experiences of the users of the technologies directly. The author views this as a significant shortcoming in the study.

?? There was no opportunity for fieldwork to obtain first-hand information on indigenous agricultural water management practices in Botswana. This study thus most probably fail to adequately reflect indigenous practices and the rationale for their use.

2. Overview of Food Security, Hunger, Agriculture and Water

The Botswana achievements are best summarized in the words of its President, Mr Festus Mogae in an address to the Institute of Development Studies in February 2005:

Between independence in 1966 and 1999 real GDP grew on average by 9.2% and per capita GDP by 7%. GDP per capita is now over US\$3 500. The national budget has grown from under US\$3 million to US\$3 billion in 2004. Exports have grown from about US\$2 million to US\$2 billion in 2002 and imports from US\$3 million to US\$2 billion. Formal sector employment has risen from 29 000 people to 296 387 in 2004. In addition, life expectancy at birth rose from 48 years in 1966 to 65.3 years in 1991 before declining to 55.7 years in 2001, largely as a result of the HIV/AIDS pandemic. The Infant Mortality Rate has declined from 100 per 1000 live births in 1971 to 55 in 2001. Primary School enrolment rose from 66 100 in 1966 to 327 600 in 2000, representing an average compound growth of 4.8% per annum. Tarmacked roads have gone up from less than 10 kilometres in 1966 to over 10 000 kilometres in 2003. Access to health, education, transport, telecommunication and other services has increased.

The structure of the Botswana economy has also changed significantly since independence. Agriculture accounted for 40% of GDP in 1966 and now accounts for less than 3% of GDP. Mining at just over 33%, is now the largest contributor to GDP. The Botswana economy is very open with Exports plus Imports constituting 79% of GDP. At independence exports primarily consisted of beef, but diamonds exports accounted for over 80% of total exports in 2003. Mineral revenues accounted for 45% of total Government revenue in 2004.

Whilst Botswana has made appreciable progress in economic development, many challenges remain. These include sustained improvement in living standards. Concerted efforts are necessary for poverty eradication, sustainable environmental management, employment creation, macroeconomic stability, as well as sustaining high levels of transparency, accountability and good governance.

One of the greatest single challenges the nation of Botswana faces is the HIV/AIDS pandemic. Preliminary survey results, released in December 2004, indicate that 17.1% of the total population over 18 months of age is estimated to be infected with the HIV virus. A worrying statistic is that the population aged 15-49 years is hardest hit with an infection rate of 34.4%.

Botswana is a country with scarce water resources, both surface and groundwater. Botswana's Vision 2016 recognizes this problem and states that by the year 2016, Botswana must have a national water development and distribution strategy that will make water affordable and accessible to all, including those who live in small and remote settlements. It goes on further to state that Botswana must use water as efficiently as possible by using water efficient technology and various water conservation techniques such as water harvesting from rooftops, and that it must play a full part in negotiating and promoting international agreements concerning water usage and storage at a regional level, to provide a buffer against localised drought, which is not an uncommon phenomenon in Botswana. This vision is consistent with the SADC vision for water, which envisions the utilisation of the regions water resources in an equitable and reasonable manner.

Over 95 % of all households have access to improved water sources, compared to 89% in 1991. The proportion of households without access to improved sanitation decreased from 45% in 1991 to

23% in 2001. Inter-district variations exist in respect of access to improved sanitation. Households without access to improved sanitation in Ghanzi, Ngamiland West and Kweneng West districts represent 88%, 76% and 55%, respectively, of each district's population. There has been an increase in the number of households with access to improved sanitation. However, whilst the proportion of children living in households without access to improved sanitation has been declining, the 2001 level of 30% was still very high. (Unicef Botswana, 2005).

Botswana's National Development Plan 9 (NDP9) policy objectives for agriculture include improvement in food security at both the household and national levels, because Botswana is a net importer of food.

Botswana policy emphasizes diversification of agricultural production and conservation of natural resources. Broad strategies include: Infrastructure, diversification, National Master-Plan on Arable Agriculture and Dairy Development (NAMPAADD), credit, subsidies, pricing, cost recovery measures and human resources strategies.

NDP9 places much emphasis on the need for improved information on vulnerability of households to food insecurity. The following is an extract from the Botswana National Development Plan 9 for 2000-2009 (NDP9) on the Food Insecurity and Vulnerability Information Strategy:

The National Early Warning System (NEWS) serves as a framework for monitoring national food supplies. It also provides information on the status of food insecurity in order to aid decision-making. In the past, there have been limitations in the data collected within the system, particularly with respect to indicators of economic access, status of food security and nutrition at the household level. To this end, a comprehensive Management Information System (MIS) will be established during NDP 9 in order to provide information on household - level food vulnerability; ascertaining household coping strategies and associated nutrition issues, and identifying food un-availabilities in the country. In response to these structural deficiencies, the following strategies will be pursued:

- Providing advance information on food availability, requirements and access.
- Provision of policy information on incidence, nature and causes of chronic food insecurity and vulnerability.
- Rolling-out the National Action Plan on the 1996 World Food Summit commitments.
- Establishing a Food Insecurity and Vulnerability Information Mapping System (FIVIMS) framework to provide a comprehensive national Management Information System (MIS) for food insecurity monitoring.
- Strengthening networking and coordination in NEWS to enhance collaboration in the food security MIS through periodic vulnerability assessments.
- Capturing national food consumption patterns as well as updating the National Food Balance Sheet through inclusion of other food crops as necessary.
- In addition, the problem of lack of reliable statistics within the Ministry of Agriculture will be addressed by establishing a statistical database. The Ministry will also continue to computerize and network Regional and District Agricultural Offices as part of a Ministry - wide information architecture.

Orphan and vulnerable children constituted 19.6% of the child population of Botswana in 2001, made up of 111 512 orphans and 33 380 non-orphans but vulnerable children. The incidence of orphans and vulnerable children varies markedly across districts. The North East District has the highest level, at 25 % while the diamond-mining towns have lowest levels, with just 11% of their child populations being orphans and vulnerable children. In 2001, there were an estimated 8600 child headed households, mostly in the rural areas of Botswana (Unicef Botswana, 2005).

The government recognizes the link between poverty and water availability, and that the worst affected people in terms of poverty in Botswana are women. NDP9 says:

Not much was done during NDP 8 to address this issue. This will be addressed in NDP 9 as part of the National Water Master Plan Review. Support in dealing with this issue will be required from the

3. Analysis of Good Practices in Agricultural Water Use, Micro Irrigation and RWH

3.1 Introduction

This report provides information on the promotion of water management technologies in support of poverty alleviation in Botswana.

The following is an extract from the Botswana National Development Plan 9 for 2000-2009 (NDP9) on Irrigation and Water Development Strategies:

To promote diversification of agricultural production the following strategies will be employed:

- Development of a gender - sensitive Irrigation Policy.
- Establishment of two irrigation schemes using treated effluent at Lobatse and Francistown.
- Establishment of an Irrigation Systems Testing Centre.
- Constructing new dams and assisting farmers in rehabilitating existing dams and, upgrading some to multipurpose status.
- The Well rehabilitation program will continue.
- Development of the Ramotswa Wellfields. An Environmental Impact Assessment (EIA) is planned as a pre-cursor to establishing an irrigation scheme.
- Rainwater harvesting technologies will be explored in settlements to promote backyard gardening.
- Contracting of private companies to complement government efforts in the development of irrigation and water resources.

The government supports a range of developments, with priority to livestock watering. Conservation agriculture, rainwater harvesting and irrigation also receive attention. The following agricultural water management technologies are promoted:

- ?? Water extraction from sand rivers to irrigate 0.5 – 1 ha areas, using sandpoints constructed with concrete rings or perforated pipes in stone filter bedding. These sand rivers are surprisingly prevalent in the Eastern parts of Botswana around Khanye, Thamaga, Gaborone, Mahalapye, Selebi/Phikwe and Shashe near Francistown. In the Maun/Kasane areas, very fine silty soils makes extraction through sandpoints virtually impossible, resulting in clogging even with the use of geofabric around perforated extraction pipes.
- ?? Improvement of hand dug wells and ponds for livestock watering
- ?? Construction of small dams for livestock watering and, where possible, multiple purposes such as fisheries and irrigation.

The current drought, which sees Gaborone Dam being only 17% full in December 2005, has created tremendous interest in rainwater harvesting, especially in the light of results from recent rainwater harvesting pilot testing initiatives by Department of Water Affairs. A range of technologies are being considered in the national strategies and plans.

3.2 Livestock watering: Improvement of hand-dug wells

Description of technology



The first two photographs show traditional wood-lined wells with wooden windlasses, and the photos below show the improvement of these wells through installation of concrete rings, backfilling to ground level on the outside of the rings and installation of a hand pump on the improved well.

During installation of the improved well, the original vertical wooden supports for the old windlass are left intact. Thus, in the event of a pump breakdown, farmers are able to revert to the traditional technology while the hand pump is being repaired. This is done by removing a loose concrete slab that covers the well opening and reinstalling the wooden windlass.

Costs and benefits

The improved wells reduce the labour required for pumping and are safer to use.

The direct costs of the well improvement are shouldered by government. Farmers must commit to provide the labour for the reconstruction of the well or 15% of the cost of reconstruction of the well.

Costs of well reconstruction and fitting comprise the following:

Cost item	Cost range	
Material	P10 000 – 20 000	USD 1750 – 3 500
Casual labour (farmers' contribution)	P4 000 – 7 000	USD 700 – 1 250
Government workers' salaries and allowances	P50 000 – 60 000	USD 8 750 – 10 500
Total	P64 000 – 87 000	USD 11 200 – 15 250

In reality, government's direct cash outlay for well improvement is the material costs of approximately P15 000 per well.

Well reconstruction is carried out by two dedicated government teams, one in the North and one in the South, each consisting of 6 – 7 salaried employees, namely:

Team member	Approximate cost (salary & allowances)	
1 technician (based in Head Office)		P5 000/m
1 team leader	P110/d	P2 620/m
2 pipe fitters	P95/d	P4 370/m
1 builder	P95/d	P2 185/m
1 driver	P95/d	P2 185/m
1 driver (heavy plant)	P110/d	P2 620/m
Total monthly cost per field team		P14 000/m USD 2 450/m
Total monthly cost (including technician)		P19 000/m USD 3 330/m

Currently, the unit has a list of 200 applications from farmers for improved wells. Construction time per well is 25 – 45 days per well, thus the two current teams have an combined annual capacity of 12 – 15 wells, meaning that it could take more than 10 years to complete the current work in hand¹.

If the existing two technicians would each oversee an additional field team each, the cost of deployment of those two additional field teams would be as follows:

[salaries & allowances for two field teams]
2 x P14 000/m x 12 months = **P336 000/a (USD 58 900/a)**

Two such additional teams could reduce the construction period for current applications to approximately 6 years.

¹ Note: Currently, government enables a shortened delivery period by supplying the building material directly to farmers interested in reconstructing their own wells.

Factors contributing to success/failure

- ?? The most significant factor contributing to the success of the improved wells is that it reduces the daily labour requirement for animal watering, because the hand pump is easier to use than the original windlass. On deeper wells, up to three people may have to work together to extract water for the livestock with the old windlass: in the first photograph two people are turning the windlass and the third is operating the bucket. The final photo shows an individual operating the hand pump. However, some farmers have been asking for diesel installations to further reduce the labour requirement and time required for animal watering. There is insufficient experience to know whether users would be able to cope with the recurrent cash requirement for operation and maintenance of diesel installations, which had proved a major problem in neighbouring Namibia.
- ?? The operation of both the old and the new technologies is not dependent on cash, thus there is no disincentive or constraint to the continued use of the new improved well with hand pump.
- ?? The risk of adoption of the hand pumps is low, because users can revert to the windlass should the pump fail or break down.
- ?? The government conditions for support are designed to foster ownership and user responsibility for the improved wells. Farmers must apply for the improvement of their wells and must comply with standard Terms of Agreement to qualify for assistance. These are discussed in more detail below.

Funding and support

Government supplies the material and construction teams for well reconstruction.

Farmers must apply for well development in writing on a standard 'Well Application Form', and must commit to complying to the following Terms of Agreement printed on the back of the Well Application Form:

<i>Conditions printed on the Well Application Form</i>	<i>Experience with implementation</i>
The applicant(s) must produce a valid Land Board Certificate for the well	Government officials assist farmers in obtaining Land Board Certificates
The yield of the well, confirmed by standard pump testing must exceed 0.25 litres/second or be able to water more than 100 LSU per day.	Pump testing is hardly ever performed. Instead, government officials judge the yield of the well based on experience
The applicant(s) must <ol style="list-style-type: none"> Commit themselves to finding an alternative water source during the reconstruction of their well Arrange the removal of the old wooden casing before the construction team arrives Provide the labour required for the reconstruction of the well or 15% of the cost of reconstruction of the well Desilt the well after it has been reconstructed 	Some applicants, especially individuals, request the supply of material only and reconstruct the wells themselves to speed up delivery

The applicant(s) must also agree to

- a) Maintain the hand pump installed at their well
- b) Comply to the stocking rates recommended for the area

Stocking rates are seldom complied with. Although the Agricultural Water Development Policy (Implementation Guidelines 1993, revised 1998) provides for eviction of groups whose performance is not satisfactory, this is impractical to implement.

3.3 Livestock watering: Improvement of ponds

Description of technology

Improvement of existing animal watering ponds, through the following actions:

- ?? excavating the pond to increase its capacity,
- ?? fencing off the pond to protect it from contamination and collapse through trampling, and
- ?? installation of a hand pump and watering trough.



Costs and benefits

The hand pump installation, while basically the same technology which is successfully employed in the improvement of hand dug wells, is not a very successful intervention in this context, because farmers cut the fence to allow the cattle to drink directly from the pond. This is because of the added labour requirement to pump water for the cattle – one can imagine the significance of the daily burden to pump water for 100 LSU.

Factors contributing to success/failure

The improved storage capacity of the watering ponds is important, because it enables improved storage and utilization of rainfall run-off. However, the increased labour requirement of the hand pumps means that the pumps and watering troughs are not utilized as intended, and animals continue to drink directly from the ponds, with the following results:

- ?? the excavated ponds are damaged by trampling, resulting in silting;

?? the water is contaminated for human use; and

?? animals occasionally get stuck in the mud, especially when the ponds are nearly empty (not relevant in large parts of the country which are very sandy).

The hand pump intakes from the pond are constructed with gravel/sand filtration bedding, thus even though the hand pumps may not be utilized for animal watering as intended, herders are able to extract filtered water for human use through the hand pumps.

Funding and support

The funding and conditions for support are similar to those described for improvement of hand dug wells described above. In addition, farmer groups are required to be registered in accordance with the Agricultural Management Associations Act of 1979, and must have a Land Board permit for the site, and by implication the grazing rights for the area.

3.3 Small dams: Livestock watering and Multi-purpose dams

Description of technology

Approximately 120 small dams of average 160 000 m³ storage capacity have been constructed by Water Development Section since 1989. Of these, 15 dams supply water for irrigation, ranging in storage capacity from 35 000 to 2 800 000 m³, with an average of 500 000 m³. In total there are an estimated 500 dams in Botswana, mostly constructed since independence in 1966.

The dams currently constructed by government are mostly earth dams with a clay core and riprap protection.

Costs and benefits

These dams are for livestock watering in the first instance, and for multiple purposes like fishing and irrigation where practical and desirable. There are no specific changes in design to make the dams suitable for multiple purposes. The dam capacity is determined primarily by the available dam site and secondly by the estimated catchment yield.

The dams are constructed by three government construction teams with a combined capacity to construct 8 – 10 dams per year.

The cost of construction relates to the salaries and allowances of the construction teams (approximately 130 staff) and the operation and maintenance of construction equipment (approximately 40 major pieces of machinery).

The costs of small dams construction consists of the following:

Cost item	Approximate costs	
Government workers' salaries and allowances (3 construction teams)	P600 000	USD 105 000
Operation and maintenance of construction plant (equipment)	P1 000 000	USD 175 000

Total annual cost	P1 600 000	USD 280 000
Average cost per dam (at 3 dams per team)	P180 000	USD 31 600

It would cost approximately P10m (USD1.75m) to establish an additional Construction Team with staff and construction equipment.

Factors contributing to success/failure

Government constructs these dams under similar conditions to those described under the improvement of livestock watering ponds above.

Farmers have to tender in writing to utilize the dams. Prospective irrigation farmers are interviewed to ascertain their knowledge and understanding of the enterprise they are proposing to embark on. This includes a rigorous assessment of their understanding and planning for available markets for produce.

Funding and support

The Ministry of Agriculture published comprehensive ‘Guidelines for Investigation, Design, Construction and Management of Irrigation Schemes’ in 1998, and implements the ‘Agricultural Water Development Policy Implementation Guidelines’, revised in 1998. A ‘Hydrological procedure for small dams’ and various other design and planning documents have been developed.

Support for dam construction is primarily aimed at farmer groups, but support to individual farmers is also possible, but limited to the surveying, design and pegging out of the dam. The farmer is supplied with a design report, layout plans and dam wall design plans and must take care of construction himself, either by using own labour or by employing a contractor.

Farmer training on small dam utilization and maintenance is supplied by trained local extension staff.

As suitable dam sites are getting scarcer, government focus is currently shifting to maintenance and rehabilitation of the small dams. In terms of the National Development Plan 9 (NDP9), only Development Funds may be utilized for new dam construction. Water Development Section’s recurrent budget must be utilized for maintenance and rehabilitation, which occasionally includes the increasing of dam wall height, if justifiable by hydrological calculations.

There is however still tremendous popular demand for small dams, both for new construction and rehabilitation of older dams, such that it is a regular feature of political meetings. When an irrigation opportunity for 200 farmers was recently advertised, there were 500 applications, and in a separate case, 160 applications for 18 plots.

In addition to the work done by the Water Development Section in the Ministry of Agriculture, the Department of Water Affairs has allocated funds for the construction of small to medium sized dams and RWH initiatives in their National Development Plan 9, the implementation of which is anticipated to start in April 2006.

4. Review of Agricultural Water Programs under the Initiative to End Hunger in Africa (IEHA)

The Initiative to End Hunger in Africa (IEHA) is not implemented in Botswana.

5. Summary of key Actors in Micro Irrigation and RWH

The following organizations are active in the development and support of Agricultural Water Technologies in Botswana:

Government: ?? Ministry of Agriculture ?? Department of Water Affairs
Non-governmental: ?? BORHUA (Botswana Rainwater Harvesting and Utilization Association) ?? Permaculture Trust Botswana (allied to PELUM) ?? Somarelang Tikologo ?? Kalahari Conservation Society ?? Sanitas Farm
International: ?? SIDA, DANIDA and other donors ?? SADC ?? USAID

Please refer to the Annex 1 for a detailed list of contacts in Botswana.

In Botswana, the farmers themselves and government are the major actors in agricultural water development. There is great demand for government's services in this regard, such that it is a regular topic at political meetings. Support is rendered on application from the farmers.

The responsibilities for water supply are organised as follows (with some exceptions):

- ?? Lands areas – Ministry of Agriculture and rural communities/farmers' own responsibility
- ?? Rural villages with population 500-5000 – District Councils
- ?? Villages and towns with population > 5000 – Department of Water Affairs
- ?? Cities, large towns and strategically important towns (e.g. for tourism) – Water Utilities

The Department of Water Affairs often engages in water infrastructure development, which it then hands over for operation and maintenance to the relevant authority.

District Councils face a constant challenge in prioritizing funds, and cannot always meet the needs for maintenance of water infrastructure.

The Ministry of Agriculture has a stable, well-established capacity for agricultural water development, and is gearing up for an increased focus on maintenance and repair of aging dams. The continued demand for the services rendered by Ministry of Agriculture may well warrant a review of the current capacity for implementation.

Ministry of Agriculture Water Development Section currently has the following construction teams

for implementation of agricultural water development:

- ?? For the construction and maintenance of small dams:
3 construction teams, total 130 staff, 40 construction equipment items.
Combined capacity: 8-10 small to medium dams per annum
Cost of establishing an extra team: P10m
- ?? For the reconstruction of hand dug wells:
2 construction teams of 6-7 staff each
Combined capacity: 12-15 wells per annum
Cost of establishing an extra team: P168 000

There is currently tremendous interest in rainwater harvesting (RWH), through the awareness raising activities of BORHUA (Botswana Rain Harvesting and Utilisation Association) and its members. Department of Water Affairs are engaged in several pilot testing initiatives, with a special emphasis on schools water supply. The current drought, combined with awareness following DWA's RWH pilot testing results, plus very high water tariffs, is giving major impetus to RWH thinking in various quarters, including the following:

- ?? DWA has assigned budget for 2006/07 which would include RWH development initiatives
- ?? DWA has engaged consultants to do an environmental impact assessment (EIA) on the construction of small dams to harvest rainwater. DWA has assigned a substantial budget for small to medium dams, which DWA will build and hand over to the relevant authority, which would be mostly the Ministry of Agriculture.
- ?? The new draft Regulations for the Supply of Drinking Water in Botswana and National Policy of Water Conservation includes provision for the establishment and operationalisation of RWH tanks in institutions especially schools.
- ?? The reviewed Botswana Water Master Plan will pay significant attention to RWH, which will be operationalised in the National Water Conservation Policy & Strategy
- ?? Botswana has participated actively in the development of the SADC Water Policy, which was released in August 2005, which seeks ways of ensuring that RWH will be implemented in SADC. The related Strategy is currently under development.
- ?? The implementation of rainwater harvesting tanks through the ALDEP (Arable Lands Development Programme) has been reviewed and adapted for improved implementation. One of the major lessons learnt, is the need for technical assistance in RWH layout planning and construction to maximize captured run-off.
- ?? Some individuals had been experimenting with RWH in various forms for many years. Two examples are:
 - Mr Fred van der Geest who has for the past 13 years relied on captured rainwater only to run his household outside Gaborone. He has no borehole and no municipal water supply, but has created some 500m³ storage capacity on his property. At the end of the dry season and at the height of the drought in December 2005, he still had enough water stored for two months.
 - Mr Gus Nilsson of Sanitas farms have experimented for 30 years in Botswana with a specific minimum tillage technique he developed, called Permanent Strips. This

technique increases the water storage and root development capacity of the soil, while reducing the need for ploughing.

- ?? The Honourable President of Botswana is encouraging people to harvest and utilize rainwater.
- ?? Planning is underway of a RWH system for the DWA buildings in Gaborone to demonstrate potential for implementation and raise awareness
- ?? University of Botswana is investigating a similar system for the university buildings and is engaging in a rainwater contamination study in the urban context
- ?? Traditional leaders have expressed an interest in and support for rainwater harvesting. A need has been identified to study traditional approaches to rainwater harvesting in the rural areas.
- ?? The Ministry of Agriculture also has an Indigenous Vegetation Project which aims to enhance the carrying capacity of the veld through rainwater harvesting and other measures.

The Permaculture Trust Botswana is the organization that had arguably been most actively engaged at grassroots level with the promotion and implementation of rainwater harvesting in support of poverty alleviation in the rural areas. They are based in Serowe and work directly with households in the rural areas.

SADC Land and Water Management Unit is based in Gaborone and is currently engaged in a four-year EU-supported training programme on land and water management issues. Training providers from the region are engaged to design, organize and present training events on topics related to land and water management, with the objective of building capacity of research and extension practitioners. The results of a Mid-Term review are expected to be available soon.

The USAID Regional Center for Southern Africa is based in Gaborone. USAID is engaged in an important Initiative on Ending Hunger in Africa (IEHA), but this does not include Botswana.

6. Recommendations and Conclusions

Botswana has much to be very proud of. Their government has been responsive to the needs of its population since independence in 1966 and has done much to ensure that the benefits from its mineral riches were well managed to the advantage of the wider population. Botswana is known regionally and internationally as relatively corruption free and has excellent Standard & Poor investment ratings.

In this context it is not surprising that Botswana views as one of its challenges the development of policies that would avoid over-dependence of the population on government. The approaches to technology promotion described in section 3 above were clearly designed with this challenge in mind. It was not possible during this study to find information on how effectively this approach has achieved its goal of fostering independence, but the implementation and administrative systems developed by the Water Development Section seemed thorough and effective. Further, the demonstrated public demand for water infrastructure development is strong.

Recommendation: Should a review of the implementation activities of the Ministry of Agriculture's Water Development Section reveal that the desired impacts are being achieved, it is recommended that the implementation capacity for these activities be scaled up.

The Department of Water Affairs and BORHUA, through its highly committed staff, is playing a very strong advocacy role in the promotion of innovative approaches to water supply in Botswana, SADC and indeed Sub-Saharan Africa, especially w.r.t. rainwater harvesting. Botswana has already committed funds to implement more localized rainwater harvesting (in addition to medium to large dams) to improve its water security and efficient use of whatever rainfall it gets. DWA's strategy of advocacy and leaving implementation to all and sundry may be very effective, and indeed the results of their pilot testing efforts have already had significant impact on people's thinking. This could arguably be strengthened by an increased internal implementation capacity.

Recommendation: Review and plan Botswana's implementation capacity for rainwater harvesting and strengthen accordingly.

Botswana's National Development Plan 9 (NDP9) highlights the lack of information on poverty as it manifests at grassroots level, and the Honourable President, Festus Mogae refers to the income inequalities in Botswana. Traditional leaders have expressed interest in rainwater harvesting and holds information on traditional practices, including traditional cultural events such as the annual Environmental Cleansing Ceremony, through which rural communities clear away dead carcasses and other contaminants from the veld prior to the rainy season, to protect the quality of water resources. Traditional practices also took care of the poor and vulnerable without creating dependency and shame, by creating community-based opportunities to work for food.

Recommendation: Recognise traditional practices and mobilize communities and households towards improved local practices in water management and food security management, as part of a larger movement to give a voice to rural communities in the use and benefits of resources. Challenge rural communities to find the poor amongst themselves and plan together for their reintegration into society.

Botswana has, in terms of NDP9, decided to fully mechanise its agricultural production. This strategy should be analysed carefully in terms of potential deepening of farmer dependence, on both farmers' own cash reserves and government services. Significant experience exists in Botswana with minimum tillage and conservation agriculture approaches, which are effective in improving rainfall utilization to protect against crop failure and improve crop yields.

Recommendation: Where mechanization is implemented, it is recommended that the equipment needs for minimum tillage and conservation agriculture should form part of the foundation for mechanization planning, so as to enable the maximization of effective rainfall utilization for arable farming.

Annex 1: List of contacts

The following organizations and individuals are active in the development and support of Agricultural Water Technologies in Botswana:

Organisation	Contact person	Contact details	Website/Email	Technologies/ practices promoted; Programmes
MoA Water Development Section	Mr. D Matoto Mr K Wah Mr N Nape	Ministry of Agriculture P/Bag 003 Gaborone, Botswana (267) 395 0500	dmatoto@gov.bw kwah@gov.bw neonape72@yahoo.co.uk bnape@gov.bw	Waterpoint development, small dams construction, wells reconstruction
SADC	Ms M Nyirenda Dr Calvin Nhira Mr O Chapeyama	(267) 71240459 (267) 72106588	mnyirenda@sadc.int cnhira@sadc.int ochapeyama@yahoo.co.uk	Food, Agriculture and Natural Resources (FANR)
USAID Southern Africa	Mr J Brown Ms C Khupe	USAID RCSA Plot 14818 Lebatlane Road Gaborone (267) 363 1399	jebrown@usaid.gov ckhupe@usaid.gov	Initiative on Ending Hunger in Africa (IEHA) [regional, not Botswana focus]
Water Affairs Department	Ms B Mathangwane	(267) 72272230	BMathangwane@gov.bw	Water conservation; rainwater harvesting
BORHUA	Mr J Aliwa	(267) 390 7500	aliwa@botec.bw	Rainwater harvesting
Sanitas Farm	G Nilsson	PO Box 606 Gaborone Botswana (267) 71303698	gus@sanitas.co.bw	Conservation agriculture; permanent strip farming
TEAM	F Vandergeest	PO Box 20119 Gaborone Botswana (267) 390 2520	team@info.bw	Rainwater harvesting

Annex 2: List of documents

1. Report on RWH at Shoshong Senior Secondary School
2. Report on participatory investigation into RWH possibilities/needs at a community in Kgalakgadi
3. Concept for 'gat dam' fitted with perforated pipes and backfilled with sand to prevent contamination by livestock
4. Proposal for stormwater drainage study, University of Botswana and Department of Water Affairs
5. Draft 'Regulations for the supply of drinking water in Botswana', Department of Water Affairs
6. National Water Conservation Policy and Strategy
7. Botswana Water Master Plan
8. SADC Water Policy
9. Draft SADC Water Strategy
10. Report on ALDEP tanks
11. Document on Water Tariffs
12. Draft Report: Hydrological Procedures for the Design of Small Dams in Botswana
13. Supplement to Hydrological Procedures for the Design of Small Dams in Botswana – a Worked Example
14. Guidelines on Hydrology of Small Dams
15. Design and Construction of Small Dams in Botswana
16. SANITAS Leaflet: African Conservation Agriculture
17. Application Form: Application for Well Development (Hand Dug)
18. Agricultural Water Development Policy Implementation Guidelines 1993
19. Cost Sheet: Cost of a Well, Ministry of Agriculture, Botswana
20. Questionnaire with Oral Interview Questions, Dikabeya Irrigation Scheme, Ministry of Agriculture
21. Guidelines for Investigation, Design, Construction and Management of Irrigation Schemes
22. Integrating policy, disintegrating practice: water resources management in Botswana.
23. Technical Report: Trans Kalahari Corridor Implementation of a Common Transit System Introduction of an International Customs Guarantee
24. Rainwater Harvesting Information Resources Booklet for Southern Africa
25. Technical Report: Review of Vegetable Production and Marketing (Supply Chain Analysis)
26. Reference: Three years with an on-farm macro-catchment water harvesting system in Botswana
27. Reference: Economic assessment of water harvesting techniques: a demonstration of valuation methods.
28. UNICEF Document: Analysis of Child Focused Indicators