Chapter 4

Learning to live with drought and climate variability

EXAMPLES OF EXISTING PROGRAMMES AND PRACTICES

The programmes and practices discussed below have been or are currently being implemented and supported by governments of basin countries, international agencies, local institutions, communities and farmers. Some national programmes have fairly consistent objectives across the four countries. Others are specific to one country and may or may not apply to the Limpopo River Basin as a whole. There may be many programmes and practices with a bearing on some aspects of drought mitigation that have not been identified or reviewed within the scope of this analysis.

Programmes and practices are grouped according to broad themes that correspond to the information presented in previous chapters, i.e.:

- drought response programmes,
- soil and water conservation and management,
- crop production and diversification,
- livestock,
- agroforestry,
- other.

The underlying principle of most of the examples is drought mitigation or integrated resource management. However, many projects are diverse and multisectoral and do not necessarily belong to a single broad theme. The aim is to provide examples that represent a cross-section of major programmes and practices that might be of value in the identification of constraints, gaps and opportunities to be considered during later phases of programme formulation.

Drought response programmes

Various drought response programmes have been developed throughout the region, especially as a result of the droughts of the 1980s and 1990s. Many of these programmes were developed on an ad hoc basis to enable responding, primarily with relief efforts at the time, without linkages to national development activities. However, drought is becoming an important part of national and regional development planning and is being recognized as a chronic problem rather than a series of ad hoc emergencies. This is evidenced by the evolution of drought management policies and strategies.

Drought response interventions executed by most governments, NGOs and donors have taken three general forms:

- emergency drought relief;
- drought rehabilitation;
- drought mitigation.

Box 29 shows typical examples of each type of intervention. The three forms correspond primarily to the timing and duration of the response. Relief includes the actual emergency response.

BOX 29

Typical drought response programmes

Drought relief schemes have included:

- general food aid to most affected households;
- supplementary feeding programmes for:
  - children, especially under five years old,
  - pregnant and lactating mothers,
  - the elderly and disabled;
- emergency water supplies for people and animals;
- assistance in destocking livestock.

Drought rehabilitation schemes have included:

- seed-pack and fertilizer distribution;
- livestock restocking programmes;
- nutritional garden projects;
- subsidies and loans.

Drought mitigation schemes have included:

- dam construction;
- water harvesting;
- small irrigation schemes;
- food storage programmes.

Rehabilitation is reconstructing and repairing damages in the short to medium term. Mitigation focuses more on reducing the impacts of future events. Most of the drought response programmes have focused on immediate and short-term relief efforts.

Unlike cyclones and floods, a drought is a slow-onset disaster. This usually allows more time to implement a relief plan. Although perhaps not as spectacular as other disasters (e.g. dramatic scenes of raging rivers and rising waters), the effects of a drought can be more widespread and damaging, especially in these chronically drought-prone areas. To be most successful, the drought response system should ensure that emergency relief (especially food and water) is distributed quickly in order to avoid loss of life once an emergency measure is in place. This is to be followed by coordinated and integrated rehabilitation and mitigation activities to preserve livelihoods.

Botswana

Botswana's experience with drought response provides good examples of major issues to be considered in developing a drought response programme. The Drought Relief Programme in Botswana was able to achieve zero deaths attributable to drought-related malnutrition by coping with the 1982–86 droughts (Valentine, 1993). Main reasons cited for the success in Botswana were:

- targeting – the drought relief was targeted at the rural poor and other vulnerable groups to minimize income disparities during and after the drought;
- use of established infrastructure – established local and district-level supplementary feeding facilities and lines of communication and distribution were used;
- funds were available – there were surplus national funds available generated by the diamond resources of the country;
- willingness to learn from past experience;
- political will – good governance and drought relief seen as a high priority issue.

Drought relief labour intensive works programme

Following an evaluation of drought relief programmes carried out during the 1980s, the recommendations of the Government of Botswana fostered a major policy shift toward intersectoral programmes. The government also created an Inter-Ministerial Drought Committee (IMDC) in the early 1980s to help develop and coordinate various aspects of the drought response programmes. A major intersectoral programme was the Labour Intensive Public Works Project (LIPWP), developed to relieve drought-affected people, and to provide sustainable and viable projects to create employment. From 1992 to 1996, some 50 000 people were employed annually under the programme (of whom 70 percent were women). In this period, a total of about US$64 million was also spent, of which 40 percent directly on labour. Completed projects included houses, feeder roads, classrooms, daycare centres, health posts, clinics, offices, community halls and other community-based projects. The approximate annual employment of people under this drought relief employment programme is equivalent to 21 percent of Botswana's current formal economic sector employment and, therefore, provides significant employment benefit to the country.

However, the LIPWP has not been without its problems, and the Government of Botswana has acknowledged deficiencies in the programme. The "working age" group (15–64 years) was projected to increase by 42 percent between 1991 and 2001 (compared with a far lower increase of 12.4 percent in total population over the same time period). Saddled with this increasing "working" population, it will be difficult for the authorities in Botswana to withdraw completely from this public works employment programme.

Capacity building for disaster relief

The Government of Botswana started with the establishment of a national disaster relief capacity during National Development Plan 7 (GOB, 1991). This has taken place at local-authority level and the structure is now tried and tested to respond quickly to natural and human-induced disasters such as drought, floods, and livestock disease. In turn, some local authorities have formed area committees that utilize national-level funding for relief activities. The Government of Botswana intends to carry out training and simulation exercises with these structures in order to prepare effectively for the necessary disaster relief readiness.

Short-term livestock drought-related programmes

Through the IMDC, which was set up to monitor and evaluate drought situations, the government has developed short-term programmes or subsidies for livestock owners. These short-term

programmes, generally referred to as drought relief livestock projects, are assessed on an annual basis and instituted as necessary. They include:

- maintenance of breeding stock, where farmers are encouraged to sell during drought to maintain breeding and young animals;
- feed supplements for energy, protein and minerals are sold at 50 percent of the cost price during drought;
- disease prevention (e.g. botulism vaccines and vitamin A) is provided free in drought years.

South Africa

Before 1992, drought response by the Government of South African focused primarily on mitigating the impact of drought on the industrial and commercial agriculture sectors (AFRA, 1993). Little was done to reduce the impacts on the economically impoverished communities of the rural areas, and response was based primarily on relief rather than mitigation strategies. South Africa has addressed many of these shortcomings by developing new policies and institutions.

Before 1994, the commercial farming districts came under the jurisdiction of national drought relief schemes. Farmers in the communal areas of the old homeland regions were assisted by special drought relief schemes implemented by the respective governments. Such schemes usually centred on: human relief (food parcels, water drilling for distressed villagers and labour-intensive public works programmes); debt relief to farmer borrowers (mainly the write-off of short-term crop production loans); and a plethora of different livestock schemes over the years.

During the 1991/92 drought, the Water Supply Task Force provided emergency water supply by means of water tankers to 950 communities, repaired existing water infrastructure, installed some 800 emergency pipelines, drilled more than 5 000 new boreholes, protected springs, and installed packaged water treatment plants. The Nutritional Task Force coordinated transport and distribution of food, while public works programmes facilitated job creation to stabilize household income. Various state structures were involved at local and regional level in drought relief.

Serious problems emerged in the implementation of the drought relief activities. The problems included: inadequate funding, rigid geographical jurisdictions, poor coordination, lack of personnel, lack of drought relief experience, poorly publicized relief measures, lack of legitimacy, poor community relations, and rigid "top-down" approaches. Owing to the absence of a common national approach to relief, most state structures at local and regional level had to act ad hoc through the drought period. The absence of meaningful community representation on any of the drought relief structures meant lack of accountability and the communities were excluded from the process of drought relief (AFRA, 1993). Additional shortcomings of past drought relief programmes included:

- Inefficient delivery mechanisms made it easier to deliver aid to communities that had better access (e.g. communications, social and physical infrastructure) than to the really disadvantaged rural dwellers.
- Ineffective credit schemes prevented farmers from developing better farm management capacity or understanding a constructive credit culture. By writing off production credit, the main aid recipients were the government-controlled banks and development corporations, which were protected from risk, rather than the farmer borrower.
- Ineffective livestock schemes, such as feed provision, subsidizing purchased feeds, subsidizing and encouraging farmers to offload surplus stock, and even operating State feedlot schemes, failed to be equitable. Moreover, they encouraged livestock owners to expect government to bear the full risk.

Nutrition security and supplemental feeding programmes

The Department of Health implements three nutrition security programmes in all of South Africa's nine provinces (R. Ochse, personal communication, 1999). These are targeted at the rural poor and those living in poor crop production areas. The programmes focus on high-risk areas such as those prone to disasters. The first was known as the National Nutrition Development Programme (1991–92), subsequently renamed the National Nutrition and Social Development Programme (1994) and now called the Nutrition Development Projects. Between 1992 and 1996, the programme's objectives were to help people to become self-reliant by assisting them to establish nutrition-security-related projects. However, because of the drought, the programme became one of social relief, with different NGOs in the provinces being contracted to deliver food parcels

to the needy. After 1996, it was realized that food parcels created a spirit of dependency among beneficiaries, and hence it was decided to encourage people to start up their own nutrition development projects. Money is channelled through NGOs and community-based organizations to communities and individuals that submit business proposals for projects such as nutrition gardens, small farms, bakeries, and fish projects. The current focus by the Department of Health promotes nutrition and food security in the region, and will enable resource-poor families to better withstand the impacts of drought.

Supplementary feeding schemes

One of the several schemes focuses on nutritional feeding of children aged between zero and six years. This age group has been found to be most at risk in the event of disasters such as drought. The programme also assists pregnant and lactating mothers with food and training on nutritional aspects. Another programme, the Schools Feeding Scheme, has the objective of providing a daily meal to primary school children, who have been identified as being most at risk of malnutrition.

Lessons learned from the 1991/92 drought

In preparation of the SADC drought strategy described in Chapter 3, the main lessons learned from dealing with the 1991/92 drought and previous drought response programmes are summarized below (SADC, 1999):

- An effective early-warning system is invaluable for timely implementation of drought mitigating and relief measures, but must be accompanied by adequate infrastructure for implementation.
- The severity of drought cannot be judged only from the reduction in total annual rainfall; the interseasonal distribution is important, especially for crops.
- A rigorous definition of drought is needed in order to distinguish between impacts caused primarily by low rainfall and those exacerbated by poor land management.
- Drought conditions can be expected somewhere in the region in most years, but it is rare for all regions to be drought-stricken at the same time.
- Farm management practices should take into account the low and erratic rainfall to be expected.
- Drought subsidies should not become regular handouts, nor should they encourage poor management practices.
- Fodder subsidies have encouraged farmers to maintain higher stocking rates than appropriate, and have contributed to the bush encroachment problem in some commercial farming areas.
- The crop compensation subsidies tended to encourage commercial farmers to cultivate agronomically inappropriate crops and/or to practise cropping in unsuitable areas.
- Better targeting is needed for all drought relief subsidies.
- Drought relief boreholes tend to remain in use after a drought and become foci for unplanned settlements, hence they are no longer available for drought relief in the next drought.
- Food-for-work programmes are difficult to launch rapidly where there is no structure already in place.
- NGOs can play an extremely useful role in the administration of drought relief measures, especially in communal areas.

At a regional level, four major shortcomings of previous drought programmes have been identified (SADC, 1999):

- Lack of an unambiguous definition of drought, which left declarations of drought to be determined on an ad hoc basis rather than using scientific criteria. This led to a situation where political considerations dominated economic or social rationale.
- Lack of equity and efficiency in the distribution of the benefits, which led to a situation where a substantial proportion of drought relief funds found its way to non-deserving farmers and individuals. In addition, farmers have been encouraged to continue with unsustainable farming practices, e.g. keeping excessive numbers of cattle, and production of maize. This has resulted in damaging the natural resource base and supporting non-viable farming enterprises.
- Misappropriation of resources and substandard infrastructure as a result of hurriedly planned projects.
- The dependency syndrome created by government drought relief and recovery programmes and the distortion caused on local markets can threaten private trade.

Water and soil conservation and management programmes

Water is a critical determinant in coping with drought. With continued population growth and socio-economic development, water demands are expected to rise throughout the Limpopo River Basin and SADC region in general. For example, water demands are estimated to increase by 5–10 percent/year in Botswana (GOB–MFDP, 1997). As water resources in the basin are very limited, there is an urgent need for suitable demand and conservation management measures to sustain social and economic development. Soil conservation measures are also important in managing and conserving the water resources, as soil erosion is causing high silt loads and turbidity in the Limpopo River and its tributaries, affecting water treatment and the storage capacity of dams.

Water demand management in South Africa

Water demand management is defined as actions to influence water demand and usage in order to improve economic efficiency, equitable distribution, water storage and infrastructure development, environmental protection, and various other elements of sustainable water supply. Most of these measures are dependent on water supply infrastructure and are specific to each water sector. They may include:

- prepaid metering and effective billing systems;
- use efficiency and reduction of water waste;
- effective O&M;
- user education, awareness and training.

For farming households and rural communities, the main water use sectors are basic water supply and irrigation. For basic water supply, the following key measures are promoted:

- Provision of services at appropriate levels and fair pricing structures to promote customer satisfaction and reduce occurrence of illegal connections and associated water waste. This remains a significant problem in many communities in the basin and results in poor cost recovery and financial failure of schemes. Service delivery has to be accompanied by training, awareness campaigns and institutional support.
- Transfer of infrastructure ownership to communities and their local authorities to promote self-sufficiency and responsibility for maintenance.
- Training of operators in maintaining and operating the infrastructure for effective water use.
- Community awareness regarding the scarcity of water, the potential pollution of water, water use efficiency, possible reuse of water, water storage, etc.

For irrigation use, the following key measures are promoted:

- Appropriate irrigation scheduling techniques. Various techniques have been proposed to farmers with varying success. In some areas, such measures were considered unimportant as water tariffs were very low and water restrictions were imposed infrequently. As water becomes scarce and is shared by more users, irrigation scheduling is gaining importance and many commercial farmers are now applying these techniques with success.
- Effective operation of irrigation infrastructure to prevent water loss. Various measures are promoted to reduce water loss in distribution pipes and canals, irrigation application methods and their use during times of the day and night when evaporation is reduced.
- Effective maintenance of irrigation equipment to reduce wear and maintain efficiency.
- Soil water conservation and crop demand management methods.

To date, demand management has been largely reactive and not proactive. Appropriate techniques have been promoted at "farmers days" and through government publications. However, there is still much to do in order to achieve the desired effect on the ground. Increased water tariffs during times of drought have reduced water usage effectively and in many cases corrected the water use pattern permanently. While such financial measures may be very effective, they can have a far-reaching impact on the overall socio-economic character of communities and water use sectors. Therefore, DWAF is developing various sector water demand and tariff strategies to help guide implementation of such demand management measures.

Within the context of drought, it is essential to provide the basic water requirements to all people prior to allocations for other water use. Generally, basic water requirements for human life represent a small portion of the overall water use and can often be provided through active demand management of high-end users.

Isolated rural settlements, subsistence farming households, small-scale farmers, and those

communities with inadequate water infrastructure are most at risk of suffering extensive damages requiring emergency intervention by governments and international aid organizations. DWAF is implementing an extensive programme of providing basic water supply and sanitation services to rural communities in South Africa. It received its original impetus from the broader Reconstruction and Development Programme (RDP) which was the main vehicle for rectifying past inequalities in the first five years of full democratization.

Recent studies by the Directorate of Water Services Planning (GOSA–DWAF, 1999a–c) have assessed the water needs of all communities in South Africa and developed suitable development strategies for addressing all relevant criteria for sustainable, effective and equitable water supply services. Minimum criteria for the RDP include:

- a minimum quantity of 15–25 litres/capita per day;
- accessibility of water within 200 m from each dwelling (household);
- assurance of availability 98 percent of the time;
- minimum flow at access points of 10 litres/minute;
- potable water quality.

Table 31 shows the progress made in supplying basic water and sanitation infrastructure. Service delivery is spread relatively evenly across the country, including the basin areas of Limpopo, Gauteng, Mpumalanga and North West.

Most of the completed projects have yet to be transferred to local authorities for O&M. This phase of development is especially important to long-term sustainability, and it requires proper training, education, and awareness by users of issues such as water conservation, water quality, loss management and drought management.

Other water management issues

In addition to water demand management, some other important programmes have addressed a variety of issues.

Waste water disposal and pollution monitoring and control

This includes finding effective ways of managing and disposing of sewage sludge and hazardous wastes so that they do not contaminate water resources. Mitigation measures are required to prevent groundwater pollution from pit latrines and irrigation (i.e. fertilizer application). Reuse of water and reclamation from water waste can supplement present water use effectively. These types of measures are mainly applicable in high-density population areas where the cost of such actions can be shared.

Optimization of existing infrastructure

Optimization of infrastructure use is a further area of potential water saving. Operating rules of dams and bulk supply infrastructure need to be reviewed regularly. Monitoring systems, through effective metering, pressure management and inspections, are essential for a focused O&M programme, including groundwater pollution vulnerability maps and groundwater monitoring guidelines. In some South African schemes, water losses are 20–30 percent because of leaking, illegal connections, poor maintenance of infrastructure, and ineffective operation and billing systems.

Integrated water and soil resource management

All the basin countries are involved in various regional and national programmes related to the prevention of soil degradation, e.g. Earth Summit, and the UNCCD. These efforts call for national action plans and programmes to be developed,

TABLE 31
Access to basic water and sanitation infrastructure

Period	Water			Sanitation		
	Supply (basic level or higher)	No improvement In supply	Access to services	Supply (basic level or higher)	No improvement in supply	Access to services
	(million persons)		(%)	(million persons)		(%)
March 2003	40.2	6.4	86	29.2	17.3	63
March 2002	37.8	7.8	83	27.6	18.1	60
1994	23.9	15.9	60	17.4	20.4	49

Source: GOSA–DWAF (2003f).


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Plate 2
Water harvesting techniques for improving land productivity

which will require the responsible departments to liaise with international and regional institutions, national and provincial government departments, universities, NGOs, the private sector and land users. For example, South Africa has initiated a national action programme to combat desertification. This programme involves the DWAF, the Department of Agriculture, and the Department of Environmental Affairs and Tourism (DEAT). The National Botanical Institute assessed the current status of desertification (Hoffman and Todd, 1999) and the DEAT is drawing up a strategy document on the combating of desertification.

Resource conservation programmes and research
The LandCare programme (GOSA–DOA, 2000) is a community-based and government-supported land management programme that offers financial support and technical assistance to community groups in order to help them to deal with land degradation and productivity problems (Plate 2). Each country has research programmes dealing with improved methods of preventing the deterioration of soil as an agricultural resource. These include: soil conservation structures, techniques and systems; and the development and implementation of suitable techniques, earthen dams and subsurface drainage. Extension efforts are channelled towards testing and implementing these results in cooperation with farmers who could influence communities.

Other research initiatives
Research is also being conducted to stimulate rainfall through so-called cloud seeding. One of the pilot projects is taking place near Tzaneen, South Africa. Preliminary results indicate that an increase in rainfall of up to 60 percent can be achieved, depending on locality, seeding method and cloud type. Such measures may have some potential for drought relief and may be cost-effective in reducing the variability in rainfall (Steffens and Fletcher, 1995).

To summarize water management issues, the National Conservation Strategy of Botswana (GOB, 1990) highlights the increasing pressures on water resources in Botswana and sets overall development and conservation goals:

- better and sustainable natural resource uses;
- optimization of existing resource uses and resource sharing;
- education of and participation by the public in order to improve the environment (water awareness);
- demand management and suitable development of water resources and supply;
- conservation of all main ecosystems (including the aquatic environment);
- maintenance of renewable resources (i.e. water resources and systems);
- cost-effective restoration of degraded renewable resources;
- prevention of groundwater mining (i.e. when extraction is higher than the recharge resulting in depletion of available groundwater storage);
- reduction of evaporation losses from storage dams and soils;
- prevention and control of water pollution;
- development of integrated catchment management and conservation strategies in consultation with neighbouring countries.

Crop production and diversification programmes

In addition to drought response programmes and water and soil management, there is also general recognition that arable agriculture may not be sustainable in arid and semi-arid areas. Measures are needed to promote crop production systems that are sustainable and include risk reduction and enhance the ability to cope with periodic drought. Extensive work has been conducted in Zimbabwe along these lines and this is used here to illustrate important practices and issues.

In addition to various other programmes and related activities, Zimbabwe's Ministry of Lands, Agriculture and Rural Resettlement recently launched the Smallholder Dry Areas Resource

Management Programme (SDARMP) and the Southern-Eastern Dry Areas Project (SEDAP). The basic objective of SDARMP is to mobilize communities into organizational structures capable of identifying, planning and managing income generating projects. SDARMP intends to support communal area farmers in the most marginal and drought-prone areas of the country, which include Chiredzi and Mwenezi Districts within the Limpopo River Basin.

Technologies developed for dry areas in Zimbabwe

SDARMP and SEDAP will build on research and practices that have been developed for marginal rainfall environments, such as the Limpopo River Basin, aimed at stabilizing and increasing crop yields. These include:

- Improved planting material. Crop improvement efforts have focused largely on early maturity as a drought escape mechanism and on high yield. A number of high-yielding and early-maturing open and self-pollinated varieties of small grains, cowpeas and groundnuts are now available.
- Seedbed preparation. The ox-drawn mould-board plough is the most innovative land preparation technology ever introduced to replace the hand hoe in the smallholder-farming sector. In addition to reaching greater soil depths, it ensures considerable inversion of the soil and is faster than the hand hoe. Although readily available, this technology is linked closely to cattle ownership. Ox-drawn cultivators were introduced for secondary land preparation (weed control). However, as is the case with the mould-board plough, these are beyond the reach of many farmers, especially the non-cattle owners who rely on the hand hoe.
- Row planting and monocropping. Farmers are encouraged to row plant and monocrop instead of broadcasting their seed. This facilitates the mechanization of operations such as planting and weeding and enables farmers to better manipulate plant densities in the event of a drought.
- Soil fertility improvement. Reasonable crop yields cannot be obtained on the granitic sandy soils without regular applications of inorganic fertilizer, manure or lime. Based on extensive on-station and on-farm research, the application of NPK basal fertilizer and nitrogen top-dressing in combination with some 40 tonnes of cattle manure (once every four years) is recommended for the major cereal crops grown in the basin.
- Moisture conservation practices. A number of moisture conservation practices such as ridge, tied ridge and furrow planting have been designed, tested and promoted widely. These practices have resulted in increased crop yields owing to the harvesting and concentration of the available moisture in some years. The practices also tend to improve crop response to fertilizer although this has not been consistent on sandy soils.
- Conservation farming. This approach involves minimum disturbance of the soil surface by using an ox-drawn ripper tine to open the planting furrow. It has been recommended as a soil, water and draught-power conservation strategy (Plate 3). However, because of the open grazing regime in communal areas, little crop residue remains in the field as cattle eat it during the dry season. Furthermore, the roaming animals compact the soil thus rendering reduced tillage unattractive owing to poor water infiltration into the soil.

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Plate 3
Conservation farming

Botswana

In Botswana, the Arable Lands Development Programme (ALDEP) was adopted as a vehicle for improving the productive capacity of resource-poor farmers (GOB–IFAD, undated). The principal objective of the ALDEP was to assist small subsistence farmers to increase the production of basic foodgrains (sorghum and maize), legumes and sunflower in order to achieve self-sufficiency at household and national levels, raise rural revenues

and improve income distribution. The programme comprised the following components: (i) on-farm investment; (ii) seasonal inputs; (iii) strengthening of the extension service; (iv) strengthening of the credit service; (v) strengthening of the marketing, input supply and distribution system; (vi) project management and coordination; and (vii) monitoring and evaluation.

About 40 000 farming households were assisted with ALDEP packages between 1982 and 1995, and 45 percent of these were female-headed. Under the programme, farmers were encouraged to use improved farming practices such as row planting, water harvesting and soil moisture conservation techniques. In addition, 170 demonstration farms have been established to promote the adoption of appropriate technology by farmers. In terms of crop production, ALDEP farmers have higher yields than non-aided farmers, despite constraints placed on the ALDEP by a weak extension service and disruptions during times of drought.

South Africa

Alternative crops

There is a widespread movement towards alternative crops that are better adapted than the traditional maize to harsh climate conditions and low inorganic fertilizer input. The LandCare movement is a vehicle for bringing about change. It promotes integrated farming, with crop rotation and fodder legumes, for example, to replace the much-valued maize stover for the overwintering of cattle (stover remaining on the land is needed in conservation tillage). The movement puts a high premium on participatory learning and people orientation. The focus seems to remain on rendering maize production (maize as the main crop, with or without intercropping with dry beans, soybeans or lupins) sustainable, rather than promoting crops that are relatively unknown in South Africa, such as various millets and grain amaranth (H.J. Smith, personal communication, 2000). There is much room for interaction and technology exchange with other SADC countries.

Intercropping

Intercropping is still very common on smallholder farms as a risk reduction strategy against the failure of a particular crop and because of to land pressure, as families try to maximize use of the land they have (where rain is not strongly limiting, intercropping gives more crop per land area). The most common system is to intercrop cereals (e.g. maize) with legumes (e.g. beans). Another system uses pumpkins and watermelons. The intercrop is grown on a minor scale, just to ensure enough for home consumption. The farmers aim to produce in such a way that the cereal yield is not lowered compared with when the cereal is grown alone. Research has shown that apart from the complications of managing two crops on a piece of land, intercropping has the advantage of improving ground cover and hence prevents soil erosion which would otherwise be increased by wind in drought years. Legumes also increase soil friability and fertility. Intercropping will probably continue on smallholder farms, and therefore more research is required in this field.

Extension

Extension staff and representatives from research institutions and agricultural input companies (e.g. seed companies) train smallholder farmers to use certain agronomic strategies that result in improved yields, and thereby enhance their ability to mitigate the effects of drought and help ensure improved food security.

Officers of the LandCare movement have found that up to fourfold increases in crop yield can be achieved with very modest increases in monetary inputs. The concept that they illustrate to farmers is one of doing a number of basic production tasks a little better. These are, in decreasing order of importance: improved weed control (mostly by hand); improved planting techniques (planting density, planting depth, and placement of fertilizer); improved fertilization, by supplying the most basic fertilization needs; and improved pest control, in most cases combating stalk borer by hand insertion of a few granules at knee height (C.E. Steyn, personal communication, 2000).

Rural engineering

The ARC-Institute for Agricultural Engineering is currently implementing the rural engineering programme that forms part of their effort to assist resource-poor communities to farm more efficiently and improve their yields. The emphasis is on the development of infrastructure, equipment and machinery that is appropriate for use by smallholder farmers. The institute also offers practical training in the application of technologies. The agricultural engineering programmes are integrated with other disciplines. Appropriate technologies enhance the production efficiency of

farmers, thus ensuring food security and ability to cope with disasters such as drought.

Indigenous technologies

Farmers in southern Africa have developed a series of crop management strategies that enable them to cope better with their harsh production environments. The effect of the available technologies on crop yields tends to vary from year to year largely owing to rainfall fluctuations. They include:

- Crop diversification. Crop diversification is included in order to reduce risks and spread labour input requirements. Farmers plant up to five or six different crops within a given growing season and although these crops are largely monocropped some limited intercropping is still practised, especially with low densities of melon, pumpkins or cowpeas.
- Use of traditional crop varieties. Farmers still predominantly plant the late-maturing and low-yielding local varieties of small grain cereals, cowpeas and groundnuts. These varieties guarantee farmers some yield as they are adapted to the low rainfall and poor soils found in the basin.
- Staggered planting. Despite the fact that crop yields decrease with late planting, farmers stagger the planting of some key crops such as maize during the cropping season in order to reduce the risk of total crop failure in the event of a mid-season drought. Moreover, this enables farmers to stretch their other limited resources such as labour and animal draft power.
- Use of organic fertilizer sources. It is difficult to obtain reasonable crop yields from basin soils without adding organic or inorganic fertilizer. However, because of the high cost and the risks associated with its use in marginal rainfall environments, there is limited use of inorganic fertilizer in the basin, especially by the poorer farmers. Such farmers have resorted to the use of leaf litter and humus as the majority of them have no access to manure, as they do not own cattle. However, because of the widespread deforestation occurring in these areas, the amount of leaf litter available is rather limited. Consequently, crop yields and livelihoods of these farmers continue to be worse than those using inorganic fertilizer or those with access to cattle manure.
- Cultivation of bottomland areas. Farmers have traditionally produced crops such as rice and early maize in the vleis or wetland fringe areas as a food security measure. However, the increased number of people cultivating these fragile areas in an uncoordinated and haphazard manner is rendering the practice unsustainable.
- Use of natural pesticides. Farmers traditionally use plant species such as blackjack *(Bidens pilosa*), marigold (*Tagetes minuta*) and chowa (*Datura stramonium*) instead of inorganic chemicals to control termites, aphids, cutworms and other insects.

Animal production and health programmes

As indicated in Chapter 3, the best-adapted land use in most of the basin is animal husbandry, utilizing extensive grazing on the natural grasslands. Therefore, animal production is a critical issue in any long-term drought mitigation strategy for the Limpopo River Basin. In addition to relief programmes to alleviate livestock mortalities and loss of livelihoods for the farmers, animal production must be incorporated into the integrated resource management strategies in terms of mixed farming systems, impacts on soil and water conservation and management, and national and regional livestock disease control programmes. All the basin countries have livestock programmes in place, aiming at supporting and developing livestock production. These include:

- short-term drought relief programmes;
- drought subsidies and loans to farmers;
- watering point development for livestock;
- livestock production and improvement subsidies;
- disease control and prevention;
- fencing of grazing areas (communal) to aid livestock and range management;
- commercial cattle range development to facilitate livestock and range management;
- livestock marketing programmes to increase offtake for smallholder farmers;
- development of cattle feedlots to reduce grazing pressure and prevent further degradation of the resource base;
- disease control and prevention through erection of dipping tanks and cattle posts in communal areas;
- technical advice on livestock management and herd dynamics;

- irrigation water for integrated livestock-crop production systems;
- livestock water development programmes;
- development of land care programmes;
- use of crop residues as supplementary feeding;
- animal traction (e.g. the Southern African Network for Animal Traction promotes the use of animal traction to encourage better crop production and provide additional crop residues for feeding working animals and enhancing nutrient transfer).

The SADC–FANR cluster comprises a number of areas of cooperation, including livestock production and animal disease control. The FANR Livestock Production and Animal Disease Control Sector has implemented several programmes successfully in recent years. Programmes with relevance to the basin include the facilitation of the establishment of veterinary science faculties in various member states, including Zimbabwe and South Africa; the Botswana Vaccine Institute; and the Regional Tsetse and Trypanosomiasis Control Centre. The sector has also developed heart water vaccines through the regional heart water project with technical support from the University of Florida in the United States of America. SADC–FANR has identified the following challenges in current policies and strategies (SADC, 2003):

- regional cooperation on optimal sustainable rangeland utilization and animal feed flow, especially across borders;
- lack of infrastructure and information on marketing of livestock and livestock products;
- inadequate use of animal traction and organic manure to complement agricultural mechanization and expensive inorganic fertilizers;
- overstocking and overgrazing in local communities;
- unlawful use of pesticides in the region, especially non-biodegradable products;
- absence of concrete interventions to address the constraints facing women.

Forestry and agroforestry programmes

The scope for further plantation forestry development in the Limpopo River Basin is limited by the limited availability of water resources, and environmental concerns about the loss of habitats and biodiversity. Plantation forests use a relatively high amount of water compared with other land uses. Other negative effects include soil degradation, primarily soil acidification. Forest fires and related effects also pose a serious hazard (SADC, 1996b).

There is already strong competition for land and water between forestry and other users. The present strategies of commercial forest development aim to reduce these negative effects by improving sustainable management (Evans, 1999) and by increasing the multiple use of plantation forests through the more direct involvement of local communities in the production and use of plantation forest products. Other non-commercial factors will become more important in the further development of plantation forests, such as land rehabilitation and habitat protection.

Botswana

Forestry is not carried out on a large scale in Botswana, and is mainly of a social forestry type. Therefore, although some areas have been gazetted as forest areas (e.g. Chobe District), government intervention has been more in the area of facilitating initiatives such as backyard nursery programmes, woodlots, a national tree seed centre, and a few farm and village tree planting projects.

Otsyina and Walker (1990) provide an overview of agroforestry development in Botswana. Currently, there is no research done by the government or the university in forestry or agroforestry. However, research is conducted by NGOs, in particular by Veld Products Research and the Forestry Association of Botswana. The research focuses on identifying suitable species for dry conditions and indigenous fruit tree species. Potential interventions and agroforestry technologies applicable to Botswana have been proposed by the SADC (1996a), aiming to alleviate identified constraints such as soil degradation, fodder shortage and shortage of fuelwood and timber. Several activities have already been established in Botswana, such as the use of trees in dune sand stabilization. Recommendations concentrate on alleviating degraded situations around cattle posts and homesteads by planting of multipurpose trees. Other recommended applications include windbreaks, live fences, fodder banks and woodlots. A variety of tree species are recommended, with emphasis on indigenous species, in particular nitrogen-fixing *Acacia* spp., such as *A. karoo, A. erioloba, A. tortilis, A. senega/, A. nilotica, A. nigrescens* and other species such as *Sclerocarya birrea* and *Boscia albitrunca.*

Mozambique

Potential interventions and agroforestry technologies applicable to Mozambique have been proposed by the SADC (1996a), aiming to alleviate identified constraints (above). A variety of tree species is recommended, with emphasis on indigenous species, in particular nitrogen-fixing *Acacia* spp. and others such as *Albizia* spp., *Combretum* spp., *Zizyphus* spp., *Terminalia sericea*, and *Sclerocarya birrea*. Mozambique has the potential to develop agroforestry, and offers a wide range of applications (Lulandala, 1991). Agroforestry is considered a priority in research and implementation activities, with a focus on community forestry. Recommended applications include:

- planting trees on dunes along shores;
- planting trees in cropland, contour strips, and degraded areas;
- planting multipurpose trees and woodlots near villages;
- planting nitrogen-fixing trees in combination with leguminous plants in order to improve soil fertility;
- planting trees and shrubs with good fodder production.

South Africa

Limited community forestry and agroforestry programmes have been implemented in South Africa in the higher rainfall areas in the eastern regions of the basin). Potential interventions and agroforestry technologies applicable to South Africa have been proposed by SADC (1996a), aiming to alleviate identified constraints (above). Recommended activities include planting of multipurpose trees and fruit trees in specific locations, mixed and hedgerow intercropping, live fences, and woodlots (Plate 4). For each of the situations, specific tree species are recommended, with emphasis on indigenous species, in particular nitrogen-fixing *Acacia* spp.

Zimbabwe

There has been renewed interest in agroforestry research and development work in Zimbabwe since the early 1980s. This is in recognition of the key role that this land use system can play in food security enhancement and poverty alleviation. In 1989, an inventory exercise commissioned by the National Agroforestry Steering Committee captured some of these initiatives. A total of 14 research projects were implemented by three institutions (the Department of Research and Specialist Services, the Forestry Commission, and the University of Zimbabwe) in the high and low rainfall areas of the country. Twelve of the projects were station-based while two were on farmers' fields. In terms of emphasis, 36 percent of the projects focused on soil fertility improvement, 21 percent on fodder provision for livestock, and 43 percent on both soil fertility and fodder. A total of eight extension projects were initiated by the AGRITEX, the Forestry Commission, Environmental Development Action, GTZ/ARDA, the Nyanga Development Project, French Cooperation, the Bikita Peoples Council and the Glen Forest Training Centre. The projects covered both the high and low rainfall areas. Only one of the projects concentrated on soil fertility improvement, two on fodder provision, four on both soil fertility and fodder, and one on fuelwood supply.

Plate 4
Agroforestry: growing bambara nuts between young orchard trees

SADC-FANR forestry sector

The forestry sector of the SADC–FANR has developed programmes on training and education, improved resource management, improved knowledge of the resource base, focused research, resource utilization, marketing and environmental management. Most of these programmes have focused on data and information gathering, and institution building at the national level. There has been limited regional collaboration and cooperation in areas of common concern, such as

overexploitation, law enforcement and promotion of community-based programmes. Problems of sustainable forest output persist, as millions of rural households use fuelwood for energy. There is a paucity of regional interventions aimed at developing and promoting appropriate alternative energy sources.

Information regarding appropriate forest management systems for the various indigenous forest types is lacking in most SADC member states. This is partly attributed to past national policies that gave higher priority to the establishment, management and protection of exotic softwood and hardwood forest plantations than to the indigenous forests (SADC–FANR, 2003).

The SADC–FANR (2003) identifies the following challenges in its current policies and strategies:

- the need to create public awareness and for education to address agroforestry practices, afforestation, fire control and overgrazing;
- the need to improve forestry and sericulture practices in order to address deforestation, genetic erosion, forest pests, disease control, invasive alien species, management and conservation of shared forests and forest resources, and law enforcement;
- the need for a regional strategy to develop small- and medium-scale forest-based industries, as well as appropriate fuelwood and charcoal production systems, especially in rural areas;
- lack of information to facilitate trade in forest products and a strategy to develop standards, guidelines and other mechanisms for recording, preserving and equitably sharing benefits from the use of traditional forest related knowledge;
- lack of concrete interventions to address the constraints facing women.

Nature conservation and tourism

The two main forms of nature conservation are: nature and game preservation, and degradation control. Nature and game preservation is a very important land use in the Limpopo River Basin, and takes place in reserves, parks and wildlife management areas. The main differentiation is according to the management and interference with the ecosystem, which is very low in reserves, and higher in parks and wildlife management areas.

Degradation control is often linked to nature conservation areas, but may also occur independently, e.g. in communal areas. Degradation control and land rehabilitation may take place without or with low interference, e.g. with fencing only, or with high interference, e.g. through land use planning and rehabilitation schemes.

A significant part of the Limpopo River Basin is utilized for ecotourism and conservation. The northern half of the Kruger National Park falls within the basin. Nature reserves and private game farms in the South African part of the basin include: Letaba Ranch, Honnet Nature Reserve, Messina Experimental Farm and Nature Reserve, Blouberg Mountain, Lesheba Wilderness, Buzzard Mountain Retreat, Happy Rest Nature Reserve, Marekele National Park, Lapalala Wilderness, Touch Stone, Doorndraai Dam Nature Reserve, Hans Strijdom Dam Nature Reserve, Mabalingwe Nature Reserve, Potgietersrus Nature Reserve, Warmbaths Nature Reserve, Langjan Nature Reserve, and Blyde River Canyon Nature Reserve. As these are privately administered, the total area covered by them in the basin and their role in terms of job and wealth creation is difficult to ascertain.

Game ranching research

The Messina Experimental Station of the South African Department of Agriculture is running a long-term (about 15 years) research programme on game ranching (B. Bekker, personal communication, 2000). The programme is assessing two production systems: (i) game production as a single enterprise, and (ii) mixed game and cattle production. Research focuses on the economics of production, assessment of carrying capacity, stocking rates, habitat selection by species, and biological and ecological norms for the area. The programme also pays attention to training and demonstration of production techniques to game ranching farmers. If game ranching were to be promoted in the region, along the lines of Zimbabwe's CAMPFIRE programme (Box 21), the research station has accumulated a wealth of information that would be of value.

WHAT HAS BEEN LEARNED

Tables 32–34 highlight some of what has been learned from the information presented. They also indicate perceived gaps in the understanding of the situation.

TABLE 32
Pertinent issues emerging from Chapter 1

Issue	What has been learned	Knowledge gaps
Basin from global perspective	Drylands constitute the bulk of the basin	
	UNCCD obligations apply to ratifying governments	The requirements are demanding; Is substantial progress being made in terms of the various NAPs?
Meteorological drought	The most important natural disaster in southern Africa	How to isolate its effects from those caused by land use factors
	The most complex and least understood of all natural hazards	Predictability of rainfall variation patterns
Occurrence of drought	Basin highly vulnerable to drought; one or more "ordinary" drought events per year in basin; extreme drought events recorded for more than a century at 10–20 year intervals; rare for all countries to be drought-stricken at the same time; consecutive droughts may occur	Cycles and periodicity; predictability; early warning
Impact of drought	Most important natural disaster in economic, social and environmental terms: - macroeconomic: biggest type of economic shock SADC countries are likely to experience, particularly agriculturally dependent economies; - socio-economic: food and water insecurity, poverty, health; - environmental: damage to natural habitats. Effects of impacts linger long after the actual event.	Proactive mitigating measures
Magnitude of disaster drought events	Example of 1991/92 drought period: - Botswana: widespread crop failure and livestock mortalities; - Mozambique: more than 1.3 million people affected, especially the rural poor of the southern and central zones; - South Africa: estimated 50 000 jobs lost in the agriculture sector, with a further 20 000 in related sectors, affecting about 250 000 people; - Zimbabwe: worst drought in living memory; owing to water and electricity shortages, manufacturing output declined by 9.3 percent, with a 25-percent reduction in volume of manufacturing output and 6-percent decline in foreign currency receipts.	Appropriate risk management systems, taking cognizance of the need for preparedness – impact assessment – response – re-construction – prevention cycles

TABLE 33
Pertinent issues emerging from Chapter 2

Issue	What has been learned	Knowledge gaps
Climate		
Climate classification	Gradation from west to east: tropical dry savannah, grading to warm temperate rainy with dry winters and hot to cool summers, and to a tropical rainy climate (Mozambique coastal belt).	
Rainfall	MAR: 200–1500 mm; spatial distribution: low along main river course in central-western part; high along eastern escarpment; about half the basin < 500 mm.	Are there atmosphere-oceanic interactive systems besides the ENSO that affect the area?
	Rainfall season: October/November–March/April; not particularly highly concentrated; effective moisture season may either be short or longer but intermittent; midsummer drought a common phenomenon.	Land suitability of various niches (AEZ) for drought-tolerant crops and cultivars
	Variability: high between seasons and within the season.	Quantification of long-term variability
Evaporation	ET_o of summer season (October–March.): 600–1 000 mm; spatial distribution the opposite of rainfall distribution; R = 0.5–1.0 ET_o indicates marginally arable to arable conditions; about half the basin climatically suited to arable agriculture.	Is ET_o sufficiently reliably modelled (taking the limited number of temperature recording stations into account) particularly for application at local level?
Temperature	Maximum temperatures: 30–34 °C in summer and 22–26 °C in winter; minimum temperatures: 18–22 °C in summer and 5–10 °C in winter. Frost: high-lying areas (bulk of basin) receives frost; severe in southeast highveldt.	Modelled interpolation between remote stations with intervening terrain features
Climate change	Africa considered vulnerable to climate change; temperatures (night temperatures?) appear to rise slowly.	Corroboration from other climate recording and expertise centres

TABLE 33
Pertinent issues emerging from Chapter 2 (Continued)

Issue	What has been learned	Knowledge gaps
Physiography		
Geology	Hard and soft geology plays an important role in the genesis of physiographic units and soils, e.g. deep, sandy soils of gentle topography or clays associated with Quaternary surface deposits, particularly in Botswana (sandveldt) and Mozambique; Lithosols and sodic soils associated with hard basement complex granite.	Best practice land use technologies for various unique land types (climate–terrain–soil landscapes), e.g. plains with excessively drained sandy soils in arid and semi-arid areas
Geological erosion cycles	Deep, porous soils associated with rolling remnants of old land surfaces; shallow soils associated with young, incised erosion surfaces.	
Main physiographic regions	Three major physiographic regions: Cape–Transvaal highveldt, Zambia–Zimbabwe Plateau and Kalahari Basin; separated from the coastal plains by the Great Escarpment. Altitude and longitude codeterminants of rainfall zones.	
Soil resources		
Data availability	Ad hoc rather than systematic soil surveys; general scarcity of detailed or semi-detailed soil maps; soil data mostly not easily accessible; different systems of classification.	Availability of soil survey data at appropriate detailed scales; interpretations; correlation between classification systems in use
Importance	Soil properties related to water storage (texture, soil depth and internal drainage) are particularly critical in semi-arid environments experiencing drought conditions.	
Two main groups	Old soils formed on deeply weathered parent materials, influenced by early erosional surfaces: favourable physical properties when not excessively sandy; often leached and acid; include the Arenosols of sandy deposits; the presence of slowly draining material beneath a permeable rooting zone may add considerably to the profile water-holding capacity.	Locally fine-tuned fertilizer and lime requirements for appropriate levels of crop production. Soil loss prediction expertise
	Relatively young soils, formed on the more recent erosional surfaces: often shallow and steep.	
Problem soils	Restricted water-holding capacity: Three common restrictions are inadequate soil depth (restricting the plant water reservoir), high clay content (causing runoff and low water availability), and excessively low clay content (causing excessive drainage and restricting the plant water reservoir).	Best practice land use technologies to deal with adverse soil conditions. Merging of western technological insights with indigenous knowledge.
	Erodibility and crusting/surface sealing: Solonetz and Planosols generally have low structural stability, adverse macrostructure conditions in the subsoil and susceptibility to crusting of the surface horizon; aggravated by the presence of relatively easily dispersible clay minerals, clay size quartz and sodicity.	
	Textural contrast: Displayed by Solonetz, Planosols and some Luvisols; renders them problematic from a plant extractable water viewpoint. Some members (mostly Solonetz or Planosols) display an abrupt transition between the topsoil (or sandy layer beneath the topsoil) and the subsoil with respect to texture, structure and consistence. The material above the transition is usually of light texture, permeable and can be penetrated readily by water and roots. The material below the transition is usually clayey, dense, very slowly permeable and can be exploited by roots to a very limited extent. The subsoil is characterized by very low water-stability and is thus highly susceptible to water erosion, particularly deep gullying, when exposed. In other members (certain Luvisols), the textural contrast is less prominent.	
	Acid soils: Acid problem soils are the most frequently reported. Most acid soils are found in areas with relatively high rainfall, e.g. on the northern and southern fringes of the basin, in particular the South African highveldt areas occupied by Ferralsols and Acrisols. Acrisols and other inherently acid soils also occur locally in the more central parts of the basin, in southeast Botswana, in some of the central higher rainfall parts of Limpopo Province of South Africa, and in similar areas of Zimbabwe and Mozambique.	
	Organic matter and nutrient depletion: Intensively cultivated soils in the basin generally undergo serious decline in organic matter. This results in structural and biological degradation and contributes to acidification.	

TABLE 33
Pertinent issues emerging from Chapter 2 (Continued)

Issue	What has been learned	Knowledge gaps
Surface water resources		
The river system	Botswana: Four major tributaries join the Limpopo River from Botswana and feed into the upper reach of the river; total naturalized MAR (difficult to estimate): 605 million m^3/year; contributes 8 percent to total river flow; difficult to develop.	Is flow adequately monitored at appropriate catchment levels to support modelled data?
	Mozambique: Three major tributaries join the Limpopo River from Mozambique and feed into the lower reach of the river; total naturalized MAR: 795 million m^3/year; contributes 10 percent.	
	South Africa: About 20 tributaries join the Limpopo from the South African side and feed into all three reaches of the river (Upper, Middle and Lower); total naturalized MAR: 5 066 million m^3/year; contributes 67 percent.	
	Zimbabwe: Four major tributaries join the Limpopo River from Zimbabwe and feed into the middle reach of the river; total naturalized MAR: 1 157 million m^3/year; contributes 15 percent.	
Reliability	Highly variable and unreliable flow (CV of 130 percent); water supplies consequently unreliable.	
Surface water extraction	Botswana: About 21 percent of naturalized MAR being abstracted, almost all from Notwane tributary; water development made difficult by low and erratic flow, level terrain and high evaporation; some potential for development in Shashe; domestic water needs dominate water use; South Africa plans to transfer 124 million m^3 water per year from the Crocodile West and Marico water management area to Gaborone.	Riparian sands and sandy alluvia as natural storage reservoirs?
	Mozambique: entering Mozambique the main river has an average natural MAR of 4 000–4 800 million m^3/year, yet irrigation water scarcities are reported, due to abstractions upstream.	What are the problematics with respect to irrigation water? Figures appear to suggest opportunities, rather than constraints.
	South Africa: Available water about 2 627 million m^3/year of which 1 017 million m^3/year is surface water; the rest comes from imports, groundwater and return flows. About 20 percent of naturalized MAR being abstracted; commonly regarded as the maximum that can be economically developed; abstraction takes place from all tributaries; in some tributaries, water for the ecological reserve is undersupplied.	
	Zimbabwe: 1 211 million m^3/year committed.	Apparent discrepancies in figures.
Groundwater resources		
Importance	Rural communities far from surface water resources depend on groundwater resources for household use and livestock (in South Africa, more than half of rural communities); uneconomic to serve all rural communities from surface water resources.	
Availability and quality	Botswana: Very low recharge rates; low probability for high-yielding boreholes; overexploitation during drought periods; sand rivers provide good recharge and storage capacity for local extraction; relatively high salinity (TDS 1 000–1 500 mg/litre for most catchments); commonly excess concentrations of fluorides, nitrates.	Detailed information on the distribution of health-related dissolved solids (e.g. nitrates, fluorine)?
	Mozambique: Coastal dune area: medium recharge rates and good quality; alluvial valleys: good recharge, high salinity; old alluvial plains: no potential due to high salinity; deep aquifer (80–200 m): low salinity and low recharge.	
	South Africa: Most rural communities located on minor aquifer types with an average borehole yield of about 2 litres/s. Communities north of Soutpansberg are located on poor aquifer types yielding less than one litre per second. Crocodile (West) and Marico: groundwater represents about 40 percent of the water resources; dolomite aquifers in places; Limpopo: in the Sand subarea, groundwater is of overriding importance; contribution of groundwater to the total water among the highest of all water management areas; Elephants: groundwater constitutes nearly 20 percent of the water; dolomite aquifers in places; Luvuvhu and Letaba: in Shingwedzi subarea, more than half of the water available is abstracted from groundwater.	
	Zimbabwe: Not well endowed with groundwater; reasonable groundwater reserves found in two areas only; Limpopo riverbed sand aquifer: low quality owing to salinity, although the quantities are good.	Data on exact extent and quantity of groundwater.

TABLE 33
Pertinent issues emerging from Chapter 2 (Continued)

Issue	What has been learned	Knowledge gaps
Interbasin and intrabasin water transfers		
Botswana	Transfer of 124 million m³ water per year from the Crocodile West and Marico water management area to Gaborone being planned.	
South Africa	Crocodile (West) and Marico: 42 percent of current water supplied by transfers from the Upper Vaal water management area and beyond. Elephants: 22 percent of current water supplied by transfers, mainly from Vaal River system.	
Land cover and land use		
	Savannah grassland, and shrubland: 67.7 percent, Cropland (rainfed): 25.4 percent, Cropland (irrigated): 0.9 percent, Forest: 0.7 percent, Urban and industrial: 4.5 percent.	Detailed breakdown of land use; local-level crop statistics.
Land degradation and desertification		
Key issues	Escalating soil erosion, declining soil fertility, agrochemical pollution and desertification.	Clear distinction between causes (human vs natural); mechanisms and impact of land degradation; role of drought; extent of rangeland degradation, deforestation and bush encroachment.
Botswana	Mostly alleged strong rangeland degradation, including bush encroachment; localized wind and water erosion.	Systematic inventory; agreement on extent of rangeland degradation.
Mozambique	Mostly light degradation (wind erosion); low erosion hazard; soils susceptible to salinity and sodicity; salinization in the irrigated areas.	Monitoring systems; benchmark sites; clear baselines; systematic data collection processes; adoption of area-specific best practice land use technologies.
South Africa	Soil and vegetation degradation significantly greater in communal areas in comparison with commercial areas (by at least a factor of two).	
Zimbabwe	Overall strong degradation in communal areas in northern and western areas adjacent to Botswana, with severe sheet and gully erosion caused by deforestation and intensive cropping.	Agreement on extent and degree of stabilization; how to achieve success in curbing degradation.

TABLE 34
Pertinent issues emerging from Chapter 3

Issue	What has been learned	Knowledge gaps
Population characteristics		
Density	Botswana, Mozambique and Zimbabwe cluster between 12.5 and 16 persons/km^2; South Africa, 57.7 persons/km^2.	
Urban centres	Botswana: two main urban centres: Gaborone and Francistown; South Africa: several main urban centres; Witwatersrand economic hub situated immediately outside southern border of basin.	Basin-specific statistics
Rural population	Basin predominantly rural; about 8 million out of 14 million people (58 percent of basin population) live outside the urban centres.	
Human development and poverty		
Human development index	Botswana, South Africa and Zimbabwe: medium; significantly lower (20 percent) when adjusted for skewed income distributions; Mozambique: low.	Basin-specific statistics; recent trends; rate of progress; relation to Millennium Development Goals (UNDP)
Human poverty index	Mozambique: 51, Zimbabwe: 30, Botswana: 28, South Africa: 20.	
People not expected to survive to age 40 years (%)	Mozambique: 41, Zimbabwe: 41, Botswana: 37, South Africa: 20.	

TABLE 34
Pertinent issues emerging from Chapter 3 (Continued)

Issue	What has been learned	Knowledge gaps
Adult illiteracy rate (%)	Mozambique: 57 Botswana: 24, South Africa: 15, Zimbabwe: 13.	Basin-specific statistics; recent trends; rate of progress; relation to Millennium Development Goals (UNDP
Underweight children under age of 5 years (%)	Mozambique: 26, Botswana: 17, Zimbabwe: 15, South Africa: 9.	
Livelihoods and land tenure		
Persons in basin deriving their livelihood mainly from agricultural activities (%)	Botswana: 65, South Africa: ±35, Mozambique: no exact figures; very high. Zimbabwe: not given.	Systematic analysis of livelihoods and food insecure populations conducted across the four countries; basin-specific statistics; recent trends
Land tenure	Dual system: customary land tenure (common property regime) and statutory land tenure (private property regime); South Africa excepted, land is dominantly held under customary tenure; 70 percent of basin area in Botswana is communal lands.	Sustainable land use systems for customary land tenure situations; appropriate mix of indigenous knowledge and science
Farming systems		
Livestock production under communal management	Dominant system; economically important; about 70 percent of ruminant livestock kept under small-scale farming and communal grazing systems; communal management systems not conducive to controlled grazing; overstocking common during periods of drought.	Veldt-condition monitoring systems and data
	Large stock: mixed crops/livestock system under communal management characterized by ownership and management of cattle; kept primarily for draught power, socio-economic status and a means of saving on the hoof; mainly local breeds that are generally low producers, but well adapted to the harsh climate conditions of the basin; herd sizes are small; indications are that the number of households owning cattle has been slowly decreasing and small stock (mainly goats) increasing in response to demographic pressure; low input farming; animals mainly depend on extensive grazing with little or no supplementary feeding apart from provision of water; poor reproduction rate; high mortality rates during drought; low offtake rates. Botswana: In 1993, there were 114 000 traditional farms, holding more than 90 percent of all cattle; the basin accounted for 76 percent of the total traditional sector cattle; however, incidence of livestock ownership in traditional sector fairly low: in 1995, only 53 percent of agricultural households in the basin owned cattle; average herd 44.7 head. Mozambique: Cattle herd drastically reduced during the war (from 1.4 million in 1974 to 214 000 in 1993); since then the sector has been recovering; largely owned by the small-scale sector; large potential for stock farming; use of traction animals quite limited; only 22 000 trained animals used in 1996 (6 percent of the cattle population). South Africa: In Limpopo Province, only 18 percent of farming operations kept cattle in 2002. Zimbabwe: Livestock farming the most viable enterprise in dry basin areas; browse from the mopane-dominated savannah provides the bulk of livestock feed, as the dry conditions limit availability of grazing to a few months after the rains.	Veldt-condition monitoring systems and data; appropriate marketing systems; value adding to animal products; agritourism; integrated farming systems (game, grazers, browsers, and value adding)
	Small stock: kept by most farmers and includes goats, sheep and chicken mainly used for own consumption and as a source of household income. Botswana: In 1995, 84 percent of agricultural households in the basin owned goats; goat flocks averaged 30 head. Mozambique: Small stock particularly important to women and poorer households. South Africa: In 2002, 33 percent of farming operations in Limpopo Province kept goats.	Relation between small stock and land degradation; browsing capacities; browser/grazer relationships; area-specific best practice technologies

TABLE 34
Pertinent issues emerging from Chapter 3 (Continued)

Issue	What has been learned	Knowledge gaps
Commercial livestock production	Half of the area within the basin in Zimbabwe and South Africa is classified as commercial farmland; predominantly used for cattle ranching; high responsiveness to biophysical and socio-economic environment; quick to sell stock when drought is apparent; the latter a common response to drought; in Botswana, restricted mainly to freehold farms situated along the Limpopo River.	
Rainfed crop production under communal farming systems	Revolves around maize, sorghum, beans, groundnuts, vegetables and millet in places; mangoes, banana and avocado important household crops in high rainfall escarpment and lowveldt areas; typically a low-input, low-output system aimed at minimizing risks arising from climate variability and making the most efficient use of the limited natural resources; characterized by low use of purchased farm inputs (fertilizer and certified seed) and low management levels; cropped areas small owing to poor access to draught power; majority of farmers rely on hand hoeing, limiting the areas cultivated; late and poor land preparations a common feature partly owing to labour constraints, poor access to mechanization and the need for draught animals to gain condition before they can be used; yields are low (0.25 tonnes maize in Botswana, 0.8 tonnes in Zimbabwe and Mozambique; 0.25–1.0 tonnes in South Africa); low yields partly due to soil degradation, nutrient depletion owing to continuous cropping, low nitrogen and other farm inputs; culture of using organic sources of fertilizers mostly poorly developed; use of improved seed is limited; in general, heavily dependent on low-yielding local varieties.	Basin-specific statistics; area-specific best practice technologies
Rainfed commercial crop production	Mainly on South African highveldt; large plantings of mainly maize and sunflower; relatively high yields owing to better natural resources, farm inputs and management; yields variable, but total crop failure infrequent; stover used for stock feed, retarding progress with conservation tillage.	Appropriate conservation tillage practices
Irrigated crop production	Botswana: Potential area under irrigation 5 000 ha; 1 300 ha currently irrigated of which 660 ha are under vegetables; basin accounts for 69 percent of the commercial holdings practising arable agriculture (largely irrigated), reflecting the higher incidence of irrigation availability, better soils and higher rainfall in the basin areas compared with the rest of the country. Mozambique: Potential area under irrigation 148 000 ha; 40 000 ha currently irrigated; originated as government schemes; little attention paid during war years to financial and technical sustainability; some schemes planned for rice production; large range of crops with maize, sugar cane, citrus and vegetables important; severe salinity and sodicity problems. South Africa: Potential for irrigation estimated at only 131 500 ha; 198 000 ha currently under irrigation; difference can be explained by "stretching" of water; mostly high-value crops produced (vegetables, citrus and subtropical fruit); mostly highly managed commercial enterprises; number of smallholder schemes, struggling to succeed. Zimbabwe: Potential area under irrigation 10 900 ha; 4 000 ha currently irrigated: 1 550 ha smallholder irrigation, 1 900 ha under large-scale commercial farming and 1 500 ha under the ARDA; crops not stated.	Monitoring systems and data on land degradation and water use
Forestry, agroforestry and conservation areas		
Commercial plantation forestry	Restricted to South African escarpment areas with more than 700 mm rain; economically important; based on exotic pine, eucalyptus and wattle species; requires high management levels; only 1.7 percent of total water resources in the basin area of South Africa used by afforestation.	
Community forestry and woodlands utilization	Natural woodlands quite extensive; main source of wood products, especially building materials and fuelwood for local communities; provide non-wood products (indigenous fruits, mushrooms, thatch grass, and material for medicinal use); economic/social importance of indigenous forest and wood products to local communities often underestimated as a source of income and for subsistence.	
Agroforestry	Natural agroforestry practices based on improved natural woodlands management have high potential in the basin; planted agroforestry not practised much in the basin owing to unfavourable climate, especially in the tree establishment phase; appears to have restricted potential in the semi-arid areas.	
Conservation areas	Several smaller and a few major conventional conservation parks (including much of the Kruger Park) are situated in the basin; plans are afoot for establishing transfrontier parks, of which the planned Gaza–Kruger–Gonarezhou Transfrontier Park would be largely within the basin.	While poverty persists in the region, how would poaching be curbed in multiple land use situations?

TABLE 34
Pertinent issues emerging from Chapter 3 (Continued)

Issue	What has been learned	Knowledge gaps
Drought strategies and policies		
General SADC policies	Acceptance that drought is a normal and recurrent phenomenon; to be integrated into programme management cycles aimed at mitigation and prevention; long-term prevention programmes needed rather than short-term mitigation measures; key elements: preparedness, rehabilitation, prevention and planning; responsibility for dealing with the impacts of drought policies to be shifted more onto the farmer or the user of the land; new strategies to ensure that drought relief assistance and programmes to support farmers are consistent with existing livelihood strategies and market development policies; compatibility between short and long-term development. Five strategic areas: - soil and water management; - rangeland and livestock management; - appropriateness of crop production patterns; - appropriate farming systems; - institutional arrangements and physical infrastructure. Objectives related to institutional arrangements: - to build human capacity for designing and implementing drought policies and programmes; regional support to national governments; - to promote contingency planning for drought; - to develop data banks on early warning, food security and market information; - to promote technology development and transfer; - to strengthen management of resources.	Acceptance and implementation
Botswana	Main thrust in policy is to include drought management in the normal planning and development process; in emergencies, government to use existing projects, programmes and budgets to respond to the situation, albeit in an expanded and accelerated way; short-term drought relief programmes and long-term drought mitigation strategies. Drought relief: essentially short-term operations and programmes, with action taken immediately after a drought. Drought mitigation programmes: building overall national resilience to drought through development strategies with special attention to the rural areas. Three main practical components: - human relief: human feeding strategies to include specific targeted populations in addition to existing and ongoing institutional programmes; - livestock relief: the provision of free vaccinations under certain drought-related conditions; an expanded livestock water development programme; the facilitation of supplies of livestock feeds and requisites; where feasible, incentives for increased livestock offtake; - arable assistance packages: free seeds; ploughing services; row-planting grants.	
Mozambique	No formal drought policy at the time of this report; formal policy guiding institutional arrangements for disaster management, including drought and the relationship with other national policies, were under review at the time.	

TABLE 34
Pertinent issues emerging from Chapter 3 (Continued)

Issue	What has been learned	Knowledge gaps
South Africa	New approach to disaster management adopted in a white paper on disaster management and ensuing Disaster Management Act of 2000; previous policies focused mainly on relief and recovery efforts; the act highlights the importance of preventing human, economic and property losses and avoiding environmental degradation; the act is administered by the Department of Provincial and Local Government; it prescribes the establishment of disaster management structures at national, provincial and municipal levels. Responsibility for developing a national drought management strategy to slot into the national disaster management plan assigned to the Department of Agriculture; a draft agricultural disaster management plan and a drought management strategy followed. Priority areas and programmes for addressing drought and drought management. Increasing awareness and preparedness by way of a national drought plan: - reducing risk to droughts through appropriate research plans; - mitigation plans; - recovery and development programmes – post drought; - implementation of education, training and information plans; - risk management with a strong emphasis on an insurance-based solution, which can be applicable to the agriculture sector as a whole.	How to progress from concepts to practice; workable drought management systems; effectiveness of drought management structures
Zimbabwe	National Policy on Drought Management (approved 1999): government capacities and structures to deal with drought preparedness, mitigation and response issues; emphasis on developing sustainable livelihoods of populations most at risk to drought-induced shocks; activities to be integrated with other developmental programmes and projects; to form an integral part of all district, provincial and national-level development policy and planning processes.	
Water policies/strategies		
General SADC policies	Water an important transboundary issue; SADC Water Sector Coordinating Unit (SADC–WSCU) established in 1996; coordination of activities: Ministry of Natural Resources, Government of Lesotho; ensuing actions involving SADC–WSCU: - Protocol on Shared Watercourse Systems (1998); - Regional Strategic Action Plan (RSAP) on integrated water resources development and management: five-year action plan (1999–2004); one of the actions is the formulation of a regional water sector policy and strategy.	
Multilateral organizational structures	Limpopo Basin Permanent Technical Committee (LBPTC) established 1986 by Botswana, Mozambique, South Africa and Zimbabwe; establishment of the Limpopo Basin Commission (LIMCOM) under consideration to elevate the status of the LBPTC to that of a permanent commission.	
Botswana	Water Apportionment Board administers the Water Act and the Borehole Act, requiring individuals or groups to apply for a right to use water for irrigation; any proposed irrigation project must be shown to be economically viable and sustainable; substantial shortfalls in water supplies, competition for water and high cost of water make it difficult for irrigation projects to be economically viable.	
Mozambique	Water Law of 1991 defines the institutional and legal framework for licensing and allocation of water concessions; National Water Council provides intersector coordination and strategic decision-making; National Water Policy (1995) highlights: - satisfaction of basic needs is a high priority; - operational water resources management to be decentralized to autonomous catchment authorities; - principal investments to be aimed at conserving the existing infrastructures and reducing water losses; - private sector participation.	How to maximize irrigation development and general water use efficiency in practice

TABLE 34
Pertinent issues emerging from Chapter 3 (Continued)

Issue	What has been learned	Knowledge gaps
South Africa	Water sector completely reformed following democratization in 1994, leading to National Water Act (1998) and National Water Resource Strategy (2002), with emphasis on: - meeting basic human water needs; - equitable access; - redressing past racial and gender discrimination; - aquatic ecosystems and biodiversity; - international obligations; - managing floods and droughts.	Effect of non-permanency of water allocations on irrigation farming investment and entrepreneurship
Zimbabwe	Water sector reforms since 1995: New Water Act (1988) and Zimbabwe National Water Authority (ZINWA), with emphasis on: - correction of skewed distribution; - environmental sustainability; - economic value of water to be reflected in pricing; - stakeholder involvement.	Study of current food shortages and their relation to land and water reform
Institutions and services		
SADC institutions	SADC–FANR: operational since 1998; focuses on food security strategies for the region; aiming at improvement of smallholders' competitiveness (rural development); increased efficiency of use of natural resources; increased agricultural and intraregional trade; improved access to food and nutrition; assisting national governments with strategy and policy formulation; networking; information and training. Operates through the following programmes: food security, regional coordination and cooperation, regional information system for food security; makes use of early-warning systems, remote sensing, GIS, marketing and environmental information systems.	How to integrate effectively with national efforts
	SADC Drought Monitoring Centre: focuses on monitoring climate extremes, especially drought; collaborates with major climate centres; provides training; issues advisories.	
National institutions	Botswana: Mostly state departments within the Ministry of Agriculture; about six parastatals, dealing with the livestock industry, marketing and training; commercial institutions include the National Development Bank, Botswana Development Corporation, cooperative societies, agricultural management associations, commercial banks, private cattle traders, and NGOs.	
	Mozambique: Several directorates, institutes and programmes within the Ministry of Agriculture and Rural Development and other ministries are supported by a number of international organizations, among which are a large UN system, USAID and the World Bank. Several international institutions provided assistance during recent flood events.	
	South Africa: Considerable transformation has taken place since 1994; a large spectrum of functions is delegated down to the provincial and municipal levels; all land came under the jurisdiction of municipalities; the Department of Land Affairs regulates inter alia issues of land reform; the most important change of all has been the abolition of all racial restrictions on land ownership. A large number of central and provincial government institutions, parastatals and training institutions serve the basin area directly or indirectly.	Regulations for and enforcement of the many new acts; how to effectively roll out services at municipal level; orchestration of service delivery, taking into account the institutional complexity
	Zimbabwe: Several departments, commissions, institutes and programmes within the Ministry of Lands, Agriculture and Rural Resettlement, the Ministry of Environment and Tourism, the Ministry of Energy and Water Resources and Development (as well as others) serve the basin area. A few international organizations provide support.	

OPTIONS AND STRATEGIES FOR SUSTAINABLE DEVELOPMENT

The following sections suggest six avenues of development as priority areas.

Livestock and range development

Animal husbandry is an essential economic activity in most African farming systems. In order to feed the growing human population, more land will need to be devoted to the cultivation of cash crops and, as land is a scarce resource, there will be a reduction in its availability for pasture and fodder. On the other hand, the increase in food and cash crops will make available more crop residues, many of which represent valuable animal feed resources. However, there is a need to increase the efficiency of resource utilization for sustained production.

A careful assessment and analysis of the production environment is required in order to formulate livestock development strategies that will lead to better use of local resources, contribute more effectively to food security, improve the living standards of poor people and ensure the sustainable development of livestock production. Sansoucy (1995) has identified the key factors of this overall strategy as being:

- political support for fair commodity prices and proposed strategies;
- better definition of the target recipients' needs;
- increased efficiency of use and management of natural resources;
- linking production and post-production components to effective services, infrastructure and marketing (Box 30);
- more appropriate policies for the use of common land and rangeland;
- improved capacity and commitment of national and international agricultural centres and NGOs to implement strategies that contribute to the development of livestock production in specific agro-ecosystems.

Sansoucy (1995) also observed that the availability and efficient use of local natural resources is the key to livestock production. A successful livestock development strategy requires the formulation of resource management plans that complement the wider economic, ecological and sociological objectives. Particular attention needs to be given to land use systems and to the natural resources required for improved livestock production. The strategy will also need to consider the social, cultural, political and institutional elements that affect the management of natural resources. On the policy side, issues relating to land use, common property, legislation, price policies, subsidies, levies, national priorities for livestock development and research capacity have to be addressed. Again, the implementation of action programmes requires both technical and institutional support and, equally important, government commitment.

One of the key challenges to livestock development is how to develop strategies that are long term, will ensure sustainable resource utilization, and at the same time ensure that the effects of drought are minimized. Before introducing technology to rehabilitate degraded land, it is imperative that institutional arrangements

BOX 30

Considerations relating to communal stock farming

Buying in fodder is seldom a realistic option in communal areas, where most stockowners are subsistence farmers and cannot afford to buy feed. In a situation of drought, fodder availability is commonly low. Subsidizing fodder appears to be an essential component of drought management.

Communal area farmers are generally reluctant to sell animals during a drought for a number of reasons, including:

- they are not commercially oriented and have different reasons for keeping livestock;
- most herds and flocks are small;
- they do not know how long the drought will last;
- by the time the drought is apparent, the animals have lost condition and their sale value has fallen;
- sale points tend to be few, with stock losing further condition before reaching the sale points.

There may also be the suspicion among communal area farmers that they are being coerced by government to de-stock. From a communal farmer perspective, livestock numbers are usually the best insurance against drought. With larger stockowners this form of insurance is often accompanied by herd splitting, either maintaining control (e.g. through herders) or distributing animals to poorer relatives to look after in return for the milk, draught and dung outputs.

be in place to monitor and ensure adherence and implementation. The following technology and policy options are relevant and need to be pursued.

- Develop water supplies. Before any development takes place, very careful consideration should be given to the possible impact on the distribution of wet and dry season grazing to settlement patterns and on the efficiency of feed utilization. King (1983) found that increasing watering frequency (e.g. from a two-day to a one-day regime) increases the metabolic rate and, hence, decreases the efficiency of the utilization of scarce feed resources.
- Breeding for increased adaptability in indigenous breeds, with selection schemes based on producers' herds. Traits of economic importance to drought resistance need to be conserved and developed.
- Introduce multispecies to encourage a better utilization of the vegetation. There is growing evidence that the combination of different species, including wildlife and livestock, has a positive effect on plant and biodiversity. Agricultural tourism needs to be studied.

Finally, it is important that government take a holistic approach to resource management by building capacity through increased analytical skills at farming level as well as school and university levels. Any sustainable livestock development strategy has to take full account of producer and consumer objectives. For many livestock producers in the SADC region, the first priority is household food security and family welfare. Less tangible future sustainability of resource use is often traded off against immediate food needs. On a national scale, social and economic objectives may be in conflict with environmental objectives or have different time scales. Therefore, it is conceptually useful to bring these different implications for environmental sustainability, social development and economic growth together in one "national wealth" indicator, i.e. holistic resource management.

Appropriate crops and production technologies for rainfed areas

In drought-prone areas, particularly where soils are shallow and poor in natural productivity, appropriate technological advances should be developed and trialled. These would aim at improving agricultural production during non-drought periods. Farmers should be encouraged to reduce the area grown to maize in highly drought-prone areas with poor soils until such time as there are acceptable cultivars with high drought tolerance. Instead, they should be encouraged to grow crops that are adapted to dry conditions through their ability to grow and mature in short growing seasons with low rainfall. The farming systems recommended to the farmers should be low-input systems to lessen the economic risk. Crop farming systems to be considered include appropriate forms of conservation tillage.

Revitalization of irrigation

Irrigation could be a strong stabilizing factor in the basin. There are two levels at which irrigated agriculture operates in the basin, each with a valuable contribution to make with respect to poverty reduction and household food security. These are: (i) highly managed, high-income fruit and vegetable crops, mainly for exporting or marketing in the urban centres; and (ii) small-scale irrigation schemes that produce vegetables and other food and fodder crops, mainly for local consumption. Both are needed and both are to be developed within the constraints of water availability.

Water use efficiency is to be the main developmental goal. This includes catchment management, water development, effective reticulation systems, and effective on-farm water management, including scheduling, weed and pest control, and seed quality.

As is the case with all of the other developmental issues, effective institutional support (including assistance from international institutes) would be the cornerstone of sustainable development.

Catchment management as a tool in drought mitigation

The catchment management approach, together with AEZ, is the most suitable method to address problems related to land degradation, unsustainable land use, effects of drought, etc. In particular, the spatial aspects of constraints and other issues in the Limpopo River Basin are best dealt with by these two approaches.

An FAO study highlights soil and water conservation issues in semi-arid areas (FAO, 1986). Another study (FAO, 1987) indicates several important aspects of integrated catchment management:

- concepts for policy and strategy development for improved catchment management;

- catchment management as a conceptual framework for diversified development planning;
- development of multiple-use options, such as agroforestry, forest production, and conservation measures. The first step is identification and assessment of current problems and constraints, such as resource problems and their effects (floods, drought, low production, erosion, etc.) and socio-economic problems (land tenure, land and labour shortage, lack of social organization, infrastructure, etc.);
- incentives for community involvement in integrated catchment planning and development. Incentives include direct incentives in cash and kind, and indirect incentives in fiscal support and provision of services, e.g. improving land tenure security, technical and social services, and community organization.

Reducing household vulnerability to drought

Potential impacts of drought, and specifically household vulnerability to drought, can be categorized into:

- type of drought impact and the type of household vulnerability;
- location of household and vulnerability types within national physical and institutional boundaries;
- relationship between national drought impacts and regional physical and institutional resources.

The type of drought impact is related closely to the type of farming practice and its extent. Different strategies are required for large commercial farmers, emerging farmers, small-scale farmers and subsistence-farm households. Household vulnerability is different for these farming types and they each require specific capacity building and suitable support programmes to reduce their drought vulnerability.

Different categories of farming and household types may share the same physical, climatological and institutional characteristics. They often share the same resources (water and land) and need to be developed and managed through integrated programmes (i.e. river catchment management), cooperative, institutional and community participation (i.e. disaster management centres) and intergovernmental monitoring and risk management programmes (i.e. the SADC).

BOX 31

Modern developments and concepts in conservation – transfrontier conservation areas

The conservation of natural resources and biodiversity has become a fundamental global concern and is recognized increasingly as a social–cultural issue. This may conflict with traditional concepts of conservation, as current conservation legislation in most countries does not recognize different levels of conservation protection, other than proclaimed nature reserves.

Following this holistic concept, conservation is also supposed to take place outside the officially protected areas. Conservation should become part of the overall sustainable management of forests and woodlands, which are primarily used for a variety of other purposes, including grazing, extraction and recreation.

There may be a wide range of applications and emphasis in conservation, depending on local conditions and uses. For example, formal recognition of conservation-worthy areas outside nature reserves may provide landowners and communities with an incentive to identify and register sites of special significance.

For the Limpopo River, catchment management is an international affair and requires intergovernmental monitoring, evaluation and early-warning systems. Information sharing and cooperative governance is essential to this drought management programme.

Exploring opportunities for wildlife development and tourism

Transfrontier conservation areas

Dongola/Limpopo Valley TFCA

This proposed transfrontier conservation area (TFCA) (see Box 31) encompasses a large tract of land around the tri-nation point of Botswana, South Africa and Zimbabwe, including public and private game reserves, private farms and communal land. This low rainfall area offers better prospects for game parks, game farming and tourism than most of the other present land uses. The area is particularly unsuited for dryland crop production. Scale enlargement is necessary to provide options for the game population, in particular elephants, to move from exhausted areas that have received

little rainfall and need recovery, to areas with better grazing and browsing.

TFCAs between Mozambique, South Africa and Zimbabwe

Recent regional initiatives such as the TFCAs and the Lebombo Spatial Development Initiative provide frameworks for enlarging the scope and concept of conservation. The World Bank has developed a multimillion-dollar proposal to revitalize rundown wildlife areas in Mozambique and link some of them with parks in South Africa and Zimbabwe (see Chapter 3).

The aim of these initiatives is to develop joint objectives, strategies and programmes in order to foster sustainable economic growth and to promote the sustainable use of natural resources, while at the same time managing for the conservation of transboundary ecosystems and associated biodiversity. This is to be achieved by identifying, planning and implementing projects (with full stakeholder participation, including local communities) that aim to improve transport, agriculture and ecotourism through focusing on specific development nodes. The term conservation area in this context does not refer to the traditional park type protected area, but incorporates different levels of protection within an overall area of management that allows for controlled habitation and the utilization of resources.

The Mozambique TFCAs comprise three major components. The central one is situated in the Limpopo River Valley, connecting the Banhine and Zinave (the latter in the Save River Basin) National Parks in Mozambique with the Kruger National Park in South Africa and the Gonarezhou National Park in Zimbabwe. Although wildlife populations in Mozambique have been devastated, animals in this area have migrated traditionally towards the Limpopo River. The state of the habitat is very good and there is potential for artificial and natural game restocking. The Kruger National Park is reaching saturation point, in particular with respect to elephants, which provides excellent opportunities for Gaza Province to absorb the excess of game.

The southern component (south of the Limpopo River Basin) is the Maputaland TFCA, connecting national parks and nature reserves in the coastal area of Mozambique and South Africa with the Lebombo hills and lowveldt of Swaziland, creating a unique combination of big-game parks, nature zones, wetlands and coastal zones. The northern TFCA component (north of the Limpopo River Basin) connects unique and well-preserved mountainous areas in Mozambique with the Chimanamani National Park in Zimbabwe. It is not clear in which way connections may be established between the three TFCA components.

Proposed biodiversity conservation and participatory development (BCPD) projects under the umbrella of the Global Environment Facility (GEF), and requested by the World Bank, is another very important initiative to conserve biodiversity and develop tourism. These projects will focus on establishing a sectorally integrated and sustainable system for the management of biodiversity and important catchments through a participatory development process in biodiversity and tourism corridors (BTCs). The corridors will connect protected and protection-worthy areas of globally significant biodiversity, while maintaining and enhancing the integrity and continuity of interlinking habitats. The BCPD projects will also support agrobiodiversity by promoting indigenous knowledge systems in the use of medicinal plants in the BTCs.

Cultural tourism

In Limpopo and Mpumalanga Provinces in South Africa, there is growing interest among tourists in traditional village life and experiencing African culture at grassroots level. These provinces have a variety of interesting traditional features to offer, such as handicrafts, pottery, basketry, paintings, and traditional food. Day visits to traditional villages are slowly becoming more popular, e.g. in Venda (Louis Trichardt - Thohoyandou area).

Tour operators are investigating the willingness of villagers to entertain visitors to see how they live. Some projects have started, e.g. in Giyani, where the community hosts occasional day visitors. The revenue is used in community projects, e.g. the reliable provision of clean water. There are operational problems, such as good communication, the provision of toilets and refreshments, and reliability of bookings (villagers have to be available on agreed dates). Village visits must also be sustainable – they will collapse without commitment.

ISSUES TO CONSIDER

The following points are put forward for consideration in the context of sustainable development.

Policy-related issues

Long-term economic progress depends heavily on developing a more productive dynamic and equitable agriculture sector, within a sustainable rural environment.

National governments must demonstrate greater commitment to addressing the problem of drought management by adequately funding research and development projects.

Existing policies, strategies and structures should be consolidated and rationalized, perhaps in a single document. What is needed is a clearer vision of the individual role of various government programmes and structures in mitigation, preparedness, emergency response, and drought rehabilitation.

Improved vertical and horizontal integration of policies and action plans and monitoring of projects is essential.

Community involvement

It is essential for policy-makers to realize that problems can never be solved at the national level if they are not tackled from the grassroots.

People-centred/farmer-centred approaches should be adopted. In this respect, it is important that the needs and aspirations of potential beneficiaries/communities be taken into consideration during the initial planning of any intervention strategy.

Inherent capabilities, intelligence, knowledge and responsibility of rural people will have to be taken into consideration and respected.

Given appropriate incentives and support, the rural communities are perceived to be willing to cooperate in initiatives aimed at using natural resources judiciously.

Ways should be sought for the community to be more involved in drought monitoring.

Community vulnerability assessment should be incorporated into the early-warning technical committee functions (this would prewarn authorities of community vulnerability and so help in targeting relief).

As environmental issues are related largely to communal land, every community should have natural resource management programmes and committees to steer them.

Institutional issues

Focused building and maintaining of institutional capacities will be an important consideration.

Problem-solving extension approaches are needed, considering the general socio-economic and natural resource conditions prevalent in the basin.

In order to address the needs of rural people, interdisciplinary, collaborative, problem-focused and participatory approaches would have to be developed.

The role of agriculture in the regional economy and society at all levels is recognized. Therefore, it is imperative that all agriculturally related research and development role players optimize their management processes and strategic approaches so as to maximize their impact on three of the important objectives (challenges) identified regionally: poverty reduction, wealth creation and household food security.

District/municipal drought committees should be strengthened (they should take responsibility for monitoring and reporting on drought impacts).

BOX 32

Systems approach

Research has done far better in increasing individual commodity yields in input-intensive single-enterprise agriculture than in improving the productivity of complex systems. Furthermore, the use of modern science has tended to focus on commodity yields rather than long-term sustainability. Researchers generally favour the approach where researchers study a piece of the system according to their own interest and specialization, and the results are then combined to create a picture. At best, it is a slow and often inefficient approach to problem solving. At worst, the pieces of the jigsaw puzzle fail to produce a meaningful picture.

What is required is a systems and interdisciplinary approach to the sustainable improvement of complex systems. This problem-focused approach requires a multidisciplinary team searching for greater understanding of the interaction between human needs and motives, the needs of animals, and the constraints imposed by the institutional, economical, infrastructural and natural environment. Teams must be encouraged to find innovative, cost-effective and simple solutions to problems and to grasp opportunities.

Technology and training

Challenges facing small/resource-poor farmers will probably become more severe in future, accompanied and often caused by environmental degradation, owing to water scarcity and droughts.

Measures for reducing poverty and food insecurity need to be explored and developed at all levels. These include appropriate and locally acceptable technologies for improved crop and animal production.

There is an inadequate understanding of the dynamics and socio-economic complexities of integrated crop-livestock farming systems.

Environmental education and appropriate development projects with large local content and participation, adequately supported by appropriate public policies, are essential. Every development programme should have a separate component for disadvantaged rural groups, especially women.

Environmental education should be given prominence in formal education, especially at primary and secondary levels.

Sustainable resource management calls for action on the broad and complex front of rural development. It is not merely a matter of agricultural production but rather comprises widespread sustainable rural growth and development (Box 32).