"Working Together to Respond to Climate Change"
Annex I Expert Group Seminar in Conjunction with the OECD Global Forum on Sustainable Development

Zimbabwe

Country Case Study on Domestic Policy Frameworks for Adaptation in the Water Sector

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1. Introduction

Zimbabwe is located in a region where the impacts of climate change are likely to be felt very strongly in the water sector. Southern Africa's water sector is already being affected by unsustainable water and land use practices, over pumping, pollution, flooding, watershed degradation, wetland loss, proliferation of aquatic weeds, sedimentation, and climate variability. In the recent past, these problems have been exacerbated by unclear policies and strategies, weak legislation and institutional arrangements, and to some extent political interference. In addition, water was treated as a social good and was severely under-priced and thus the basic incentive for demand management was absent. Nobody was bothered to improve the management of existing supplies, plug leaks in reticulation systems or engage in the reuse or recycling of water. The Government of Zimbabwe acknowledged the existence of these problems and towards the end of the 1990s enunciated new water policies and strategies, approved new acts, and promulgated regulations for the water sector which were largely guided by the integrated water resources management concept as adopted by the Southern African Development Community (SADC). For Zimbabwe the need for new policies, actions and structures was spurred by the experiences and lessons of the droughts of the 1990s but not necessarily by the projected effects of climate change. This brief reviews Zimbabwe's institutions, policies, and actions for the water sector and the extent to which they provide a strong basis for the country's adaptation to climate change in this sector.

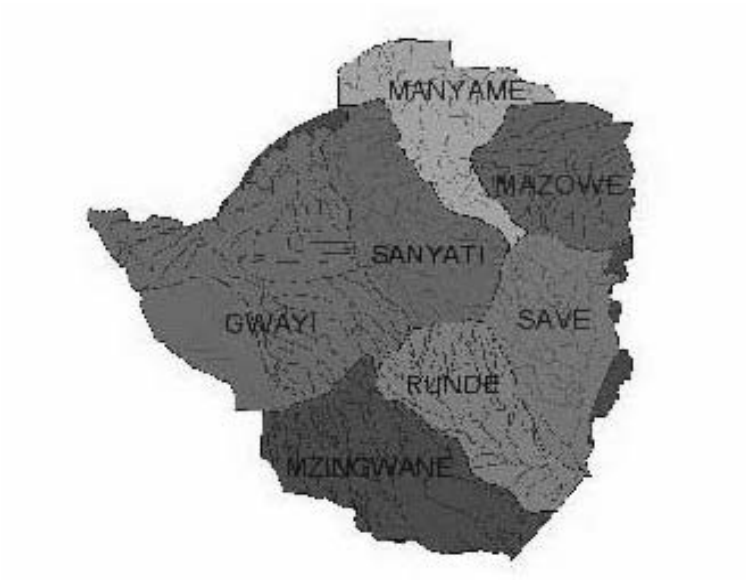
2. Overview of water resources and their main uses

Zimbabwe is an atypical sub-tropical country with one rainy season (November to March). The country's average rainfall is 657 mm/annum and varies spatially from the eastern highlands (1,000 mm) to low lying areas such as valleys (400 mm) in the southern part of the country[1]. Net annual pen evaporation ranges from 1,400 mm in the high rainfall areas to 2,200 mm in the low lying areas. Zimbabwe's rainfall pattern can be best described as erratic, unreliable, and insufficient and only 37 percent of the country receives adequate rainfall for agriculture. Trends over the years have shown that a majority of Zimbabwe's wet seasons are often punctuated by mid season droughts which affect crops resulting in poor harvests.

There are seven internal river basins whose watersheds yield 11.26 km^3 of freshwater per year[2]. In addition, the country also has 1 to 2 km^3 of ground water per year located in four aquifers viz., Lomagundi dolomite, Nyamandhlovu forest sandstone, Kalahari sands, and Save alluvial deposits. Thus, the country has 12.26 km^3 of water available per year. Much of the surface water (circa 45%) is stored in the government dams and the other 55% in some 5, 700 dams found in former large-scale commercial farming areas, mines, and plantation estates. While the figures cannot be readily confirmed there are also a number of small dams constructed by NGOs and rural communities.

[1] Often referred to as the lowveld
[2] Save, Runde, Mzingwane, Gwayi, Sanyati, Manyame, and Mazowe.

Map 1: Zimbabwe's Major Catchments



Of the total of water the estimated exploitable yield is 8.5 km^3 of water per year of which 56% is already committed leaving 3.7 km^3/year for irrigation and other sectors. Close to 550,000 hectares of land in Zimbabwe is irrigable but of this amount of land only 33.6% (200,000 ha) has been developed. The amount of land under irrigation includes functional and non-functional irrigation systems, as well as informal irrigation schemes. The failure to irrigate the other 350,000 ha is largely due to the prevalence of a mismatch between the location of irrigable land and water. While the mismatches are noted, there is considerable unutilised water in government dams and Department of Irrigation estimates that up to 15,600 ha could be irrigated if the water in 23 government dams was fully utilised (DOI, 2003). Further, an FAO (1990) study shows that an additional 200,000 to 250,000 hectares of land that is currently irrigable can be brought under irrigation.

Underground water is tapped mainly through boreholes and records show that there are over 16,000 boreholes scattered across the country but other experts believe that they could very well be in excess of 50,000. The total annual abstraction of ground water for the rural communities is estimated at 35 x 10^6 m^3 while that for the agricultural sector is estimated at 350 x 10^6 m^3. Groundwater is also being drawn for several Growth Points and Rural Service Centres (e.g., Nyamandhlovu, Gokwe), Urban Centres (e.g., Bulawayo), and Rural Institutions (e.g., schools, health). Overall, groundwater presently contributes not more than 10% to the total water use in Zimbabwe.

Increasing water demand due to the expanding urban and rural populations and the industrial, mining and agricultural sectors requires proper assessment, planning, development and management of water resources in Zimbabwe to avoid over-exploitation and degradation of its quality. At the moment water management leaves a lot to be desired as dams are not reaching their expected life expectancy due to siltation, poor drainage from irrigation schemes, leakages in urban areas, loss of capacity of ground water recharge due to soil compaction and algal capping – all

combine to paint a bleak picture on the future of physical water. Climate change will invariably affect water withdrawals especially against the predicted decreasing precipitation trend (1mm to almost 15 mm per decade) and the 2°C and 3°C increase in temperature which will also mean higher crop evaporative demand.

2. Institutional Arrangements

Institutions provide frameworks for policy and legislative action. The ability of a given institution and/or organization to fulfil its mandate depends not only on power relationships, source of mandate and political "rightness or acceptability" but also on the capacities of the individuals representing consortia of stakeholders. In the past Zimbabwe's water sector was dominated by the Department of Water Development, large commercial farmers, urban councils, and the Zambezi River Authority, and mining companies. Centred on River Boards, entities such as commercial farmers were awarded water rights, under the Water Act (1976). This regulatory framework left out most rural communities in terms of participation in decision making as the District Development Fund (DDF) and Rural District Councils (RDC) made decisions as to where to drill boreholes. The DDF, a centralised institutions with its own structures and represented by units at district level was for along time the infrastructure provider for rural communities (water included) and was the key institution under the water and sanitation programmes[3]. Never known for its ability to consult the local communities, this very top-down institution was disbanded and the district level units and equipment incorporated into the RDCs. Rural District Councils are provided for under Zimbabwean legislation as the equivalent of urban councils and are responsible for all development in the rural areas. This is an institution with a long history of limited capital support, limited capacity, poor financial base, and liable to make decisions on the basis of politics rather than pragmatism. While well positioned to involve rural communities the provision of services such as water is often affected by the lack of capital and political interference. In the end the decision to provide water is not necessarily based on the specific needs of specific communities and often times NGOs have stepped in to cover the neglected areas. .

Zimbabwe is very vulnerable to drought, with the economic impact of major droughts extending well beyond the immediate impact of reduced agricultural production. The droughts of the 1990s exposed the weaknesses of the Water Act of 1976 and heralded a new thinking on how to deal with water in Zimbabwe. Briefly, the droughts of the 1990s and in particular the 1991/92 drought resulted in virtually no harvests throughout the country and the Grain Marketing Board (GMB) domestic maize intake during the year was limited to 13,000 tonnes which translated then to a two-day food consumption. Well over one million head of cattle died of starvation during the year and the country's water reserves were so depleted that there was inadequate water for drinking, let alone irrigation. Apart from the immediate food shortages, the drought had a significant impact on the overall performance of the agriculturally based economy. The sugar and ancillary factories closed down with consequent loss of jobs. Indeed, agro-based industries e.g., meat processing, clothing manufacture, oil expressers, stock-feed manufacture, et cetera met with the same fate. Thus, the drought had wide ranging economic impacts in the industrial and agricultural sectors of the country and it is not surprising that the economic impacts of reduced hydropower generation from Lake Kariba alone led to an estimated losses of US$102 million in GDP, US$36 million in export earnings, and 3,000 job (Benson and Clay 1998).

[3] Trained pump minders for boreholes

The broader picture on the impact of drought in Zimbabwe shows a "snowballing effect". For example, while the major cause of the food shortage in the 1991/92 season was low rainfall the impacts were exacerbated by the progressive but less severe droughts of the previous two years which saw the country deplete its grain stock piles from three years back. Included in this analysis are issues related to pricing policy, storage and lack of clear strategic reserve policies. Further, the resettlement of peasants on commercial farms was initiated in 1982 has even to date not yielded positive results. The new land occupiers were and are still achieving the desired agricultural production objectives.

Important lessons arose out of this drought(s) and most importantly, the need for drought preparedness measures and drought recovery strategies are important aspects of alternative food policies in drought prone Zimbabwe came to the fore. The tenet of such a strategy was centred on the GMB which was tasked to come up with strategies for maintaining a minimum reserve stock. The proposed reserve stock would serve as a trigger for imports if stocks fall below the minimum reserve stock. This became critical in that the national statistics on retentions by smallholder farmers were proved wrong as the majority of rural households ran out of food stocks well before the droughts actually hit them. In addition, it became very clear that the rural farmers while interested in growing maize such the varieties being grown were vulnerable to drought and yet drought tolerant small grain cereals e.g., sorghum and millet were no longer being grown as subsistence food crops. Furthermore, the need to build stocks of fodder banks which would save livestock during drought years. Also noted was that conventional tillage techniques were largely not suitable for drought conditions instead soil and water conservation with a potential for improving field crop production while providing the other benefits were seriously considered. Farm level conservation promoting minimum tillage as an alternative to existing cultural practices was encouraged.

The Water Act of 1976 did not only allow for the issuance of water rights but also treated water as a free good and even those paying for water e.g., commercial farmers found it as very cheap. Water rights were a disenfranchising arrangement which flouted equity issues within the country. The droughts of the 1990s clearly showed the nation that the looming water shortages required a more integrated approach and to address this aspect effectively a whole new act was required through which GOZ could overhauled the institutional and structural arrangements for the country's water sector. The act's intention is to make established councils representative of all water users in the area covered, through the incorporation of people from the communal and areas, which had previously not been involved in any water management issues.

The new institutional framework for Zimbabwe's water sector as transformed is now dominated by the Zimbabwe National Water Authority, Catchments and sub-Catchment Councils. While these have compelling positions with respect to water management in Zimbabwe there are several government institutions, parastatal agencies, and non-governmental organizations that are involved water management in general and irrigation in particular (Table 1).

Table 1: Zimbabwe Water Sector: Institutions and Roles

Institution	Role in water sector

Ministry of Agriculture and Rural Development	Overall development and implementation of the government's policy on agriculture and irrigation
Department of Research and Extension Services	A functional arm under the Ministry of Agriculture and Rural development which provides extension services to irrigators, soil surveys and irrigation development.
Agricultural and Rural Development Authority	Quasi-government agency responsible for the operation of government-owned irrigated estates and farms.
Department of Irrigation	As specialist department under the Ministry of Agriculture and Rural Development responsible for irrigation planning, identification of schemes, designing, construction, operation and management of existing and new schemes.
The Ministry of Water Development	Custodian of water rights and develops policies on water development
Department of Water Development	A specialist department under the Ministry of water Development with the main task of formulation of national policies and standards for planning, management and development of the nation's water resources.
Zimbabwe National Water Authority	Water planning quasi-government agency advising Catchment Councils and Sub-catchment Councils. A key role in the management of the water permit system and the operationalization of water pricing systems, planning, coordination, management of water resources and the delivery of water
Catchment Councils – Linked to ZINWA	Prepare outline plans, determine applications and grant permits for water withdrawals and use, regulate and supervise exercise of water rights and supervise performance of sub-catchment councils. Day-to-day water management is carried out by sub-catchment councils.
District Development Fund (now subsumed under the country's 53 Rural District Councils)	Tillage services to irrigators, maintains infrastructure e.g., boreholes and small dams. Plans and constructs small irrigation schemes
Ministry of Local Government, Public Works and National Housing	Working through the Rural District Councils to mobilize the local community, farmer selection and irrigation plot allocation in smallholder irrigation development.
Environment Development Agency under the Ministry of Environment and Tourism	Environmental impact assessments for new irrigation schemes and dams, pollution abatement, environmentally healthy catchments, water quality

The suite of institutions presented in Table 1 and their various roles are not necessarily complimentary. The centralising institution is the Zimbabwe National Water Authority (ZINWA) which is a parastatal under the Ministry of Water Development. Its policies are generated by the Department of Water Development in the same ministry. Other service departments e.g., Department of Agriculture of Research and Extension Services, Department of Irrigation under the Ministry of Agriculture and Rural Development view themselves as specialist units providing advise to ZINWA albeit on the demand side. They do have their own mandates to fulfil and ZINWA can only influence the way in which these agencies use water through pricing but not necessarily by making calls for conservation. Only the Environmental Development Agency (EMA) does have some say on the supply side of water vis-à-vis the environmental status of catchments. To this end EMA should work closely with the Catchment Councils especially that the work of EMA is not constrained by political and administrative boundaries.

Zimbabwe has seven prominent catchments each under a Catchment Council (CC) under the Water Act of 1998. The Catchment Councils are made up of representatives of all the stakeholders residing in the catchment area and report directly to a Catchment Manager under ZINWA. The CC is expected to generate revenue from the sale of water within its catchment. In reality the delineation of the catchment areas clearly showed that these areas were rather large and thus sub-catchments councils (SCC) were considered as a lower level management unit. Sub-catchment Councils report to Catchment Councils thus the centrality of CCs and SCCs to the management of water need not be overstated as the following functions demonstrate:

1. Prepare plans for the optimum development and utilization of the water resources in their areas
2. Draw-up an inventory of water resources of their catchments
3. Specify the major water uses within the river system
4. Recommend the apportionment of water to different sectors of the economy
5. Recommend maximum permissible levels of pollution
6. Develop water development proposals in line with the inventory of resources

These functions are fundamental to the success of the management framework of water in Zimbabwe and presuppose that councillors have a grasp of issues on hand. To begin with these "elected people" who may not be technically sound and cannot carry out any of the functions stated above and surrogating the work to ZINWA and the Minister responsible for the Acts. In addition, there an a number of members who come in by virtue of derived power(nominees from rural district councils, ex-officio members e.g., chiefs) who are only there to safeguard the positions of their institutions and only come to swell the numbers but do not necessarily need to be well versed in the nuts and bolts of water management. Furthermore, the boundaries of sub-catchment areas (ecological river catchment boundaries) and even the main catchments themselves do not coincide with district and provincial boundaries making coordinated planning a Herculean task. Largely, this has set the scene for paralyses decision making and bickering leaving ZINWA to make the major decisions.

Using the 39,000km^2 Mazowe Catchment as example, a typical sub-catchment council will oversee an area as large as 5,000km^2 which also still too large for the SCC to be effective and as a result, water user boards, which bring together water users in a particular section of a river, have been created to carry out the functions of the SCC. Beyond this point other water management units that regulate water use are democratically elected local water point committee which ensure that boreholes, deep and shallow wells are functioning effectively. Members have been trained District Development Fund and in the case of boreholes trained pump minders will be on hand to ensure that the equipment functions well. These water point management committees have no legal standing and were prior to the subsuming of DDF's functions under the RDC were serviced by District Maintenance Teams, with pump minders responsible for a number of community water points and, at each point, would exist a caretaker. The move has been towards community based support strictures that are serviced by the Rural District Councils and/or NGOs that will have provided the facility.

In the irrigation sub-sector, three broad management types are active viz., government-managed, farmer-managed, and jointly-managed schemes. Government-managed schemes are developed and maintained by the government. Farmer-managed schemes are developed by the government but owned and managed by the farmers with no external assistance. In the case of jointly-managed

schemes, the farmers and the government share the financial responsibility for operation and maintenance. In terms of scheme numbers, it is estimated that about 50 percent of the schemes are farmer-managed, about 32 percent government-managed and 18 percent jointly-managed. The government manages a bigger area given that most farmer-managed schemes tend to be small. At the level of farmers in smallholder irrigation schemes, Irrigation Management Committees (IMCs) have been established to help encourage farmer management. The government's policy since 1980 has been to promote farmer-managed schemes where possible. The IMCs have no legal standing and their effectiveness varies from scheme to scheme.

The water sector has of late faced flood related disasters and the response by the government has been to set up a disaster management framework under the Civil Protection Organization which is responsible for management of flood emergencies. There is a working party comprising of the flowing government departments: health, foreign affairs, water, mining, state security, and information. Other organizations related to floods may be co-opted as and when required. The working party is subdivided into three subcommittees. Under this framework key agencies have specific roles:

- Zimbabwe National Water Authority (ZINWA) and The Meteorological Department form the early warning unit and are responsible for the weather and flood forecasts
- Zimbabwe Defense Force (ZDF) and Zimbabwe Republic Police (ZRP), Civil Aviation and Ambulance services are there to search rescue and relocate victims of floods as well as provide security during flood crisis.
- Health Services is there to attend to the injured
- Social Welfare looks at the needs of flood victims as well as provides social/ psychological support to the victims during and after the crisis. They also provide assistance in the form of clothes, food, and shelter.
- Local government will coordinate the activities by these different sectors in their areas of

While this is the nominal structure for responding to emergencies, emerging issues such as flooding are recent but require to be addressed. The plans in place highlight among other things the alert mechanisms / procedures, evacuation procedures, stock of resources available both material and human, contact details of focal human resources and should be reviewed regularly at least once a year. The plans are being used as and when emergencies occur and sectors also carry out regular simulation exercises to practically review the plans. Central to the plans are measures for alerting people to the dangers of floods as well as an information system for disseminating the same. The current approach has been to limit them to flood prone areas such as the Limpopo, Save and Zambezi and quite clearly this is not enough under the impending climate change scenarios. Increasingly, there is recognition that there is a need to increase local knowledge about the effects of floods which essentially is related to linkages with the local populations.

What is emerging in Zimbabwe is the fact that institutional capacity must be carefully built and particular functions assigned to the new institutions must be gradually done in order to give them time to develop sufficient capacity to hold the new responsibilities. Institutional strength is enhanced by clearly defining unambiguous responsibilities for the newly created institutions, providing training and guidance where necessary. Decentralization in Zimbabwe in as far is the water sector is concerned is centred on the creation of ZINWA, Catchment Councils and their linkages with the RDCs. Decentralization has become a reality in terms of structure but what is

unclear is the extent to which the central government has accepted to "let go". This is largely due to the limited capacity to generate revenue both at catchment Council level as well as the RDCs. The lack of capital as well as capacity has meant that decentralization has occurred in name only as in reality as these structures rely on handouts from central government for survival. In the water sector the loss of large scale water users such as commercial irrigators has put a huge dent in revenue streams and thus catchment councils are struggling to make ends meet.

While decentralization has its positive aspects, the danger that arises is that of having new institutions operating independent of existing local government and traditional authorities. Institutional evolution involves experiment. A chain of incremental learning is necessary, which defines objectives, identifies options, selects and implements approaches, monitors results, and adapts objectives and action on the basis of these results in a continuous and iterative process (Murphree, 2000). Zimbabwe must be mindful of this as the country gears its water sector institutions to deal with the threats and realities of climate change.

4. Legal Framework

The devastating effects of the 1991/92 drought gave some impetus for the reform of the water sector in Zimbabwe. The reforms which began in earnest in1993 culminated in the 1998 water and national water Authority Acts. These acts are complementary with the Water Act providing the legal bedrock for this sector. This act provides for:

a) All water (surface and underground) is owned by the state and all water use except primary requires state approval
b) Unit of management for water – catchment councils
c) Time bound water permits (subject to application and intended use) issued by the Catchment Councils as against water rights held in perpetuity
d) Priority date system replaced with proportional water allocation
e) Polluter pays principle recognised and water treated as an economic good
f) Water is allocated for environmental purposes and linked to drought preparedness and degradation of catchments
g) Setting up a national water authority

This is the principal piece of legislation for the water sector but it does not recognise some of the institutions discussed above e.g., water point committees.

The Water Act (1998) is complimented by the National Water Authority Act which provides for the setting up of the Zimbabwe National Water Authority one of whose key roles is to advise the Minister response for the act on the formulation of national policies and standards (water) pertaining to:

a. Resource planning, management and development
b. Quality and pollution control and environmental protection
c. Hydrology and hydrogeology
d. Dam safety and borehole drilling, and
e. Pricing

ZINWA is also expected to:

a. to assist and participate in or advise on any matter pertaining to the planning of the development, exploitation, protection and conservation of water resources

b. to exploit, conserve and manage the water resources of Zimbabwe
c. to promote an equitable, efficient and sustainable allocation and distribution of water resources
d. to encourage and assist local authorities in the discharge of their functions under the Rural District Councils Act [*Chapter 29:13*] and the Urban Councils Act [*Chapter 29:15*] with regard to the development and management of water resources in areas under their jurisdiction and in particular, the provision of potable water and the disposal of waste water
e. to superintend, catchment councils in the discharge of their functions under the Water Act, 1998
f. to encourage and assist catchment councils to plan and co-ordinate the development and management of water resources in areas under their jurisdiction
g. to operate and maintain any water works owned or managed by the Authority and to sell any water there from, to dispose of waste water, to construct boreholes and to provide design and construction services
h. to provide, at such fee as the Authority, all forms of assistance, including technical assistance, personnel, advisory and training, information and other services to the Government, local authorities and catchment councils in connection with the exploitation, development, management and distribution of water resources
i. to undertake research studies and develop a database on hydrological issues pertaining to or of interest to Zimbabwe and to publish the findings and any other data compiled by the Authority
j. to conduct hydrological and geographical surveys and to produce plans, maps or other information necessary in the planning, development and exploitation of water resources and to publish any such surveys, plans, maps or other information
k. to promote such mechanisms for the co-operative management of international water resources as the Minister may determine, and
l. to carry out any function that may be conferred or imposed on the Authority by or under this Act, the Water Act, 1998 or any other enactment

ZINWA's mandate is guided by the integrated water resources management approach as shall be shown under policies. To this end ZINWA works very closely with the country's seven river catchment councils to which it will devolve responsibility for managing river systems and enforcing laws and regulations at the local level.

The Environment Management Act (2002) is a statute which complements the Water Act of 1998 and has a very strong influence on the water sector. The Act provides a legal foundation for:

- the sustainable management of natural resources
- the prevention of pollution and environment degradation
- preparation of national and other environmental management plans
- custodianship of the country's environmental impact assessment policy

This act provides for total environmental management and recognises all the facets of the environment. The act which provides for an Environmental Management Agency which can advise, plan, and regulate on matters of environment. Thus, the agency is empowered through this act to regulate the management and utilisation of ecologically fragile ecosystems e.g., wetlands and will undertake works to protect the environment. The agency has law enforcement

capabilities which enable it to monitor and ensure compliance with act. The agency works very closely with the ZINWA over the especially in enforcing effluent and waste standards as stipulated in the Effluent and Waste Standards Statutory Instrument 274/2000 (ZINWA 2000). Linkages with the Catchment Councils are also recognised as well as with the Rural District and Urban Councils as land owners and potential polluters. For example, the agency is empowered under the act to force a land owner to clear a surface water body under their control that is infested with *Water hyacinth* or some such invasive aquatic weed.

There are a number of secondary pieces of legislation that also affect the Water Act and these include agriculture, irrigation, forestry, and land. With the exception of the Forestry Act all the other acts relate to water use and conservation. In addition, there are issues pertaining to access and equity to water such as rotational watering of crops and so on but their provisions have some what been superseded by the Water Act of 1998. There are some acts however that have an indirect influence on the water sector e.g., the proposed *Meteorological Services Bill (2003),* which sets the Meteorological Services Department's functions as the issuance of weather and climate forecasts, and advance warnings on weather conditions that are likely to endanger life and property and most are related to water. In the same vein the Emergency Preparedness and Disaster Management Act which emphasises localized decision making and preparedness and response to disasters in line with the country's decentralization policy. Through this act critical services are decentralized and the relevant equipment and training provided to ensure that most of the disaster related activities are done locally as opposed to the current centralized systems.

Decentralization started way back in 1988 but was then focused on district administration. With the RDCs in place it also meant that services were to be streamlined and to be provided at RDC level. Government line ministries would provide services through the RDC and so on. As already stated elsewhere in the paper decentralization has been hampered by the lack of revenue streams at RDC level which has meant that central government has continued to provide vital\support to these entities. The issue of revenues has been compromised by the government's equity imperatives which have also meant that agencies such as ZINWA are failing to extract the correct value of water form the new farmers now residing in the former commercial farms. There has to be willingness by central government for agencies to charge commercial rates otherwise there will be decentralisation without the devolution of power.

4. Water related policy plans and strategies

Water is a fundamental and nobody is to be denied water for purposes of survival and for a long time a majority of people used water without payment largely for drinking, washing, watering livestock and small gardens. In this period Zimbabwe treated water as a free good and those who used it for say irrigation paid nominal fee for the use of water. Institutions such as the Department of Water Development built dams for irrigation purposes whose water ended up in the hands of large scale farmers. The same farmers were also able to construct large dams on their properties and "owned" the water as well. This bias towards large entities such as the large farms and some urban areas was very clear. However, faced with increasing competition for water and irregularity in rainfall it became imperative for Zimbabwe to come up with new policy frameworks for the water sector. Much of the competition for water between different urban areas and between urban, industrial, and mining uses and agriculture was leading to the sub-optimal utilisation of water resources from a national perspective. Zimbabwe's the country moved rapidly to reform

the water sector was guided in part by a policy document, *Towards Integrated Water Resources Management: Water resources strategy for Zimbabwe* but an embodiment of these reforms are the water and national water authority acts of 1998. This policy enunciation made specific reference to the adoption of the integrated water Resources management (IWRM) strategy which was embodied in the Water Act (1998). The Integrated Water Resources Management Strategy provides a good platform for water demand management (WDM) implementation. The proposed interventions include market-based interventions (water pricing and effluent charges), technological interventions (loss reduction and recycling), special measures for irrigation, mandatory measures and raising public awareness.

While not as explicit the reforms also focused policy more on productive use of water the application of the user pays and polluter pays principle. The argument here was that management of water demand was viewed as ecologically, economically and socially sound. In this respect the Government of Zimbabwe set up ZINWA which now owns and manages all the dams that store more 5,000 megalitres of water. Funded primarily through the sale of water, the provision of clean water to cities, and the levying of water to large-scale users, ZINWA should not put emphasis on its economic survival only but also on ensuring that the water sector is well managed. This is critical as ZINWA has to produce master plans for the development of the country's waters while ensuring the protection of its environment.

There are a number of associated policy failures here. Firstly, the new Catchment Council and their stakeholders often lack the capacity draw money from water users or others e.g., the new farmers simply do not have the money. To make matters worse there are not standing mechanisms for deciding on the correct economic but socially acceptable value of water. In addition, some of the water users face serious management problems vis-à-vis collecting revenues from users (e.g., City of Mutare) and thus ZINWA and the Catchment Councils which are supposed to survive form these revenues face an uphill task. Secondly, the acquisition of land often with the old now defunct water right by a number of farmers has raised a number of issues vis-à-vis the proportional as well as efficient use of water. Under this arrangement there is nobody directly responsible for paying for the water and in fact the new farmers may nit be in a position to pay and thus the Catchment Councils and ZINWA fail to raise revenue.

A critical aspect of the supporting policy frameworks for the water sector is a focus on irrigation development for smallholders, especially in the context of the current government's land redistribution exercise where large-scale commercial farms are being acquired for the resettlement of smallholders. Wherever possible, the government is promoting farmer-managed irrigation schemes. Enabling legislation to support this development has been recently enacted in the form of the Water Act (1998), the Land Acquisition Act (2000) and the Environmental Management Act (2002). The Land Acquisition Act (2000) created a whole new group of irrigators (models A2) it also brought with it a contradiction in the manner in which water was to be accessed by the new farmers. This is due to the fact that there is a tacit desire by government to demonstrate that the new farmers are just as productive and their desire to work on the land should not be compromised by "expensive water". There has been no attempt to develop and inculcate a culture of paying for the commercial use of water among the new farmers. Thus, ZINWA is not getting its value for the water.

Another critical policy with a direct impact on water demand is the Zimbabwe's Agricultural Policy Framework (1995) which articulates the government's future direction on irrigation and water. The specific national policy objectives include:

- Growth in the irrigated area particularly in the smallholder sector with minimal negative impacts on the environment and human health;
- Equitable allocation and efficient use of scarce water resources;
- Establishment of a water pricing structure which is consistent with cost and social efficiency;
- Establishment of an effective institutional structure;
- Implementation of drought mitigating strategies.

The limiting factor in irrigation development in the country is water availability and lack of capital and as such the provision of water depends entirely on expensive storage works. However due to the past uncoordinated approach to irrigation development, many irrigation dams have been constructed without the corresponding irrigation infrastructure. The short-term plan is to utilize all the water in existing dams reserved for irrigation before embarking on new dam construction. The tradition has been to allocate irrigation water from dams based on a 10 percent risk factor. This is based on the "blend price" of setting prices for bulk water from government-owned dams which are calculated by adding the redemption of the historical capital costs of all Department of Water Development dams to the actual operating and maintenance costs and dividing by the sums of the yields (10% yield for agricultural water and 4% yield for urban, industrial and mining water). This is rather conservative and is unlike the rest of the world and in a country where inflation rates are spiralling and therefore diminishing the impact of historical capital costs, the government cannot even factor in the costs of new dams. Current thinking is that one way of increasing irrigated area at minimal cost could be to lower the reliability levels of water from existing dams by accepting a 20 percent risk factor rather than the traditional 10 percent. Due to the government's land reform, many new farmers with no prior experience of irrigation have been allocated plots on former commercial farmers' irrigated land. The future challenge for the country is to train these new farmers in irrigation so that they will be able to produce more efficiently and on a sustainable basis. In some cases there is need for massive re-planning of some of the allocated irrigation systems to convert them from single-user systems to multi-user systems.

5. Impacts of climate change

Zimbabwe is a sub-tropical country which experiences various frequent droughts such that before the devastating droughts of the 1990s the trend towards a late start to the rainy season, prolonged mid-season droughts, and shorter growing seasons had started to be openly noticed. These changes could fit well into the scenarios of climate change that have been suggested for Zimbabwe. Some models show that rainfall may actually increase in Zimbabwe but will not lead to increased runoff or lush vegetation due to high potential evapo-transpiration (IPCC 1997). Other models show Zimbabwe as shifting into the high-water-stress category, losing as much as 40 percent of its runoff. Recently, as noted by Magadza (1996) severe droughts that occurred in the country in the 1990s decreased the storage in Zimbabwe's reservoirs, leading to complete dryness in many cases.

Zimbabwe's economy is agro-based and any development hopes are pinned to a successful rainfall season. In the 1990s, the government was forced to divert funds to emergency and disaster

relief and this weakened the country's industrial reform programme. For a country so dependent on agriculture climate extremes have had adverse ripple effect on key economic sectors such as agriculture, energy development, industry, forestry, and health. In 2004, Zimbabwe's Gross Domestic Product (GDP) stood at US$8,300 million and the GDP per capita stood at US$647. It is noted that GDP has been declining since 1980 when the country gained independence. In 2004 the agriculture sector made a contribution of 17.4% to the GDP has been shrinking due to droughts and as well as the current land re-allocation processes the country is going through. Of Zimbabwe's 12.9 million close to 80% are dependent on agriculture and it is the largest employer. National agricultural production is based on rainfall, much of which is rain-fed and therefore is directly influenced by weather patterns. To date the 1991/2 drought stands as the worst. Linked to the El Nino/Southern Oscillation (ENSO) event, Zimbabwe's temperatures reached record heights. Rainfall levels fell to just 40% of normal, the water table dropped by 100-200 m, ground water (including traditional shallow wells and boreholes) dried up, and a number rivers, reservoirs, and their related ecosystems disappeared. In this period GDP declined by 5%.

Such changes which are experienced in every decade have an impact on the country's limited water resources are in great demand for both domestic and industrial use. In such times, people in remote rural areas travel long distances (circa 10-15 km) in search of water. Some schools, hospitals, and rural service centres are threatened with closure or may be closed due to water shortages. In some cases such institutions may have to operate under severe water use restrictions. Irrigation schemes be they government or private have been known to fail completely and require more than just one or two good rainy seasons to recover. Literature shows that following the 191/92 drought the 1992/93 season produced only 80% of normal rainfall and this was not sufficient to sustain river flow or to raise the water table to safe levels.

In a country where there are zones for grain production it has been noted that the southern normally around 20 S latitude has shifted northwards to 15 S, across the central districts of neighbouring Zambia. Similar shifts in agricultural and ecological zones have steadily been noted in Zimbabwe and will feature in the long-term discussions on climate change. The droughts of the 1990s and 1991/2 in particular reduced the national herd by up to 50% while the drought recovery programme, including the importation and distribution of grain, cost over Z$200 million (US$40 million). Since some 80% of Zimbabwe's 12.5 million inhabitants are farmers, with 30% of them being city-dwellers but also engaged in agro-industry, the economic damage and human suffering associated with droughts and climate change are enormous.

In terms of energy, close to 80% of the country's energy comes from the Lake Kariba dam and as such the energy sector is particularly vulnerable to water shortages and reduced flows. In the most well documented drought (1991/92 season) the lake level dropped to 40% of capacity; any further drop would have made generating electricity impossible. The result was frequent power cuts during 1992 and a serious challenge to Zimbabwe's economic structural adjustment programme. Productivity may have fallen by 30% or more. To maintain the programme, the Government was forced to import power at great expense from Democratic Republic of the Congo, Zambia, and South Africa.

In 2000 Zimbabwe and Mozambique experienced climate-related floods under Cyclone Eline which and did not only pose a serious threat to national economies but also to health and human

security. The lack of disaster preparedness was exposed and the international community summoned to assist to avert the accompanying human suffering. While development impetus was lost the Zimbabwe used this as basis for revamping the disaster management systems by coming up with a more comprehensive decentralised structure for emergency responses.

6. Preparedness to extreme weather events (and future climate change)

There can be no doubt that like the rest of southern Africa, Zimbabwe is strongly influenced by fluctuations in rainfall. An improvement in the water balance as a result of climate change would be a great benefit; increase water stress, on the other hand, would be a substantial development challenge. In this respect Zimbabwe has learned its own lessons from disasters in the past prompting the IPCC to note the country's desire to minimize sensitivity to climate change. To this end Zimbabwe is one of the few countries prior to the present political crisis which sought to diversify its economy and agricultural technology with a view to optimizing water usage through efficient irrigation and crop development (IPCC 2001).

The National policy for disaster management is that every citizen of this country should assist wherever possible to avert or limit the effects of disaster. Central government initiates hazard reduction measures through sector ministries with local administration taking the responsibility for implementing and maintaining its effectiveness. The system uses existing government, private and non-governmental organizations whose regular activities contain elements of prevention and community development. The organizations are adopted structurally, materially, and technically so that they can speedily shifted from their regular activities to undertaking protective, relief and rehabilitation measures in times of disasters in terms of intensity only without drifting from their operational principles. In essence the structures in place seek to provide for and ensure optimal emergency preparedness and disaster prevention at the individual, community, sectoral, local authority and national level through regulatory mechanisms and co-coordinated strategic planning for emergencies.

The desire to strengthen disaster management structures came immediately after Cyclone Eline induced floods to try and address the weaknesses identified in the management of flood events. Largely, some of the weaknesses included the fragmented approach to flood management, highly centralized decision making in flood management, and the lack of stakeholder involvement. Some of the victims of Cyclone Eline refused to be evacuated due suspicion and lack of knowledge of the effect of flooding. To compound matters further some of the rescue teams had little knowledge of the area and became a danger to the victims as well as themselves. The new decentralised structures reflect a major shift towards integrated floodwater management approach.

Strategies for preparedness and adaptation are known nationally, regionally, and globally. The win-win strategy is to address the issue of water and wetland management by making use of the opportunities to apply an ecosystem approach which incorporates measures such as new supply options, demand management, conservation and efficiency, pricing, and markets, appropriate national and state water laws, insurance instruments, disaster preparedness, and early warning systems. These aspects are captured in the IWRM approach adopted by Zimbabwe but the feasibility of such action is limited by series of obstacles which may hamper preparedness for disasters in a country like Zimbabwe. These are presented below:

1. Institutional arrangements

In any country the bedrock of a good disaster management system is a structure made up of strong, stable, well funded, resourced, and coordinated agencies. In Zimbabwe the institutions identified in the section above lack all of the above. All the institutions are under-equipped and have witnessed reduced flows of money from central government. Thus, the underlying principle that such institutions should respond to disasters through the use of existing resources makes a mockery of a very serious development. The critical issues that need to be addressed vis-à-vis the ability of the disaster management structure in Zimbabwe to carry out its mandate include:

- Reduced support for the central government
- Aged and outmoded equipment
- Limited capacity
- Disaster management not a priority

While these agencies are active at macro-level, the local e.g., village where the impacts of extreme weather events are likely to be felt very strongly remain locked out of they various planning processes. For example, village level institutions are not strong enough ton address issues of disaster management and cannot even organize and take the lead in the construction of flood protection measures. Viewed in this way the institutional arrangements for disaster management in Zimbabwe may be in place but the extent to which they can deal with the unfolding disasters.

2. Financial Markets

Vibrant markets where capital and credit are easily available are a good recipe for disaster preparedness. In such an arrangement the onus of responding to disasters is not just left to the government but also to the private sector and individuals. With a shrinking market, limited investment, and an economy in turmoil Zimbabwe cannot under the present circumstances expect the market to play a role in disaster preparedness.

3. Socio-cultural aspects

The dominance of single land use practises such as subsistence arable agriculture in vulnerable areas also fuel complications related to disaster management. For example, the cultivation of wetlands and stream banks in Zimbabwe driven by the search for fertile soils and moisture by local farmers may be difficult to change in the face of severe food shortages. Such practices are not geared towards disaster preparedness as they destroy the capacity of wetlands and flood plains to fulfil their ecological functions of water storage and gradual release of water. In Zimbabwe, wetlands, dambos and floodplains have been trampled and rendered imperious such that they often become waterways which under a flood event would be accentuate the impact of the flooding. Working with the farmers to accept new ways of doing conservation without any safeguards for household food security may not be easy.

Legislation both under the Water Act (1998) and the Environment Management Act (2000) forbid the cultivation of wetlands (aka dambos) and stream banks but due to the variability in rainfall and the presence of fertile soils in these zones subsistence farmers have continued to work in these restricted areas. There has been a claim that these are the areas where indigenous forms of

cropping have been taking place for a long time but the methods used as well as the increased demand for such lands have put these areas under severe strain and thus degradation. The introduction of the plough and its ability to churn the soil has destroyed the wetlands' ability to retain water and thus these areas are dying and with that a loss of their functions to regulate water flows into streams and rivers. There is no institution directly responsible for wetland protection except that it is an offence under the Environment Management Act (2000) and also appear as controlled areas under the RDC natural resources usage by-laws. The extent of enforcement is another issue altogether as these are the food producing zones in cases of drought failure. There has been a move to ensure that wetlands and dambos are sustainably managed which would require that management per given dambo. There is no question that the experiences of flooding under Cyclone Eline raised the profile of wetlands and their contribution to flood mitigation but the related actions are as yet to be seen.

4. Technological aspects

Disaster preparedness can not also be enhanced by the provision of technology or ensuring that it is available when needed and victims can have access to it. There are a number of technologies available that will bolstered disaster preparedness and will include contouring, pumps, and soil and water conservation. There is no shortage of technology in Zimbabwe at least in terms of knowing what is supposed to be done but there a number of factors limiting adoption viz.,

- Monopoly of technology
- Poor extension
- Cost of technology and poverty
- Training

The important role of catchment Councils in Zimbabwe should not be under played under disaster preparedness. These entities should map out their water resource base and such information should be shared under the auspices of ZINWA. The major issue here is that ZINWA and the Catchment Councils have not produced any tangible plans for their catchments as work has focused on getting the "institutions right". The production of plans is still in the pipeline. Thus, it is important to:

- to build sub-catchment level and catchment-level capacity to map existing water points and gather information about the use of existing sources; in addition, to study the impact of past drought experiences by consulting key informants, in order to build upon coping mechanisms previously adopted by communities and households. This is a task that catchment Councils are mandated to do.
- To ensure that emergency responses tackled issues, such as the water needs of essential assets (including holdings of livestock) within the community, at the same time developing a broader-based 'livelihoods' approach to water and sanitation that could bring specific benefits to the poorest; projects should encourage poor households to safeguard assets.

5. Information and education

Disaster preparedness can benefit a lot from a widespread use of existing information on disaster mitigation measures. There are known drought tolerant food grains, traditional food storage systems, high yielding short season crops and so on – which information must go to the farmers

but such information is not being shared. Government extension agents are failing to work with farmers to promote soil and water conservation practices e.g., agroforestry, zero tillage that incorporate traditional farmers' knowledge. The use of farmer to farmer extension to promote drought preparedness could be more effective. The complex, multi-species, low- to middle-intensity farming systems that characterize agricultural endeavours in the developing world may have greater adaptive capacity under conditions of global climate change than western monocultures and should be used to hedge farmers against droughts (Ramakrishnan, 1998).

7. Possible new (short-term and long-term) measures that can be taken to improve adaptive capacity to climate change

An adaptive style of management will need to be taken up by water users and managers if water management is to adapt to climate change. Defined as a systematic process for continually improving management policies and practices by learning from the outcome of operational programmes adaptive management is about people and resource use strategies (Maarveveld and Dangbégnon 1999). When applied to water resources, adaptive management must build on the acknowledgement that water resources and benefits that accrue from them are derived from complex natural (or semi-natural) ecosystems. As ecosystems are complex systems, their functioning and role in providing water resources is partly unknown. Dealing with such uncertainty therefore needs to be incorporated into management.

An adaptive management style to water resources applies a systems approach. It builds on trial and error, and establishes feedback loops to learn from experiences and adjust water management to fit people's and ecosystem's needs. It should be an inclusive style that builds new bridges between stakeholders and engages them actively in decision making (Jiggins and Röling 2002).
In many instances individuals, families, communities, and local governments lack the capacity to engage fully in adapting to new threats such as climate change. Adapting water management to climate change will thus require building the capacities of both institutions and people. In many countries, Zimbabwe included, there is a lack of awareness, information, knowledge, know-how and a network that can support them in incorporating climate change in their decision-making and water management.

One of the single most important draw back to adaptation is the lack of capacity. Ranging from people to the institutions and organizations they operate in the water sector where wider stakeholder involvement is required. The wide involvement of stakeholders is critical as the risks and uncertainties induced by climate change should not be left to experts alone. Water professionals' knowledge and expertise will need to be complemented with the views, opinions and knowledge of stakeholders. For Zimbabwe the stage is set for involving key stakeholders through the Catchment Councils and their ancillary structures. It has been noted however that the Catchment Councils ate not adequately capacitated to meet the demands of their own mandates. It is a question of the wrong people in the demand positions. Elected officials with little or no knowledge of water management related issues. Critical entities like the local water point committee have a say in how water is shared and management and yet a left out of the main training and related aspects of the water sector. Training is limited to pump minders and not so much to the more critical issues related to water management. Such capacity would include efficient water use, minimisation of losses and so on.

When considering the adaptive capacity at a national level one needs to distinguish between general and specific adaptive capacity. The former refers to societal characteristics that permit a response to new threats or challenges of almost any kind and in terms of climate change Zimbabwe learned from the droughts of the 1990s. The same is true for the level of skilled human resources, the effectiveness of organizations and institutions, and the prevailing levels of education and health, as well as for the presence and quality of infrastructure and the degree of equity and social cohesion in a society.

Zimbabwe's water managers often possess the experience and capacity to adapt to changing conditions. Droughts, floods, increasing water demands and changing water quality are just some of the aspects they have to deal with regularly. However, current institutional and technical capacities may preclude the type of adaptive strategies and measures needed to deal with climate change, particularly with increased variability and its associated risks and uncertainty.

In developing adaptive capacities it is important to overcome the great inequities that exist amongst and within societies, and to recognise that adaptive capacity is very unequally distributed both globally and within countries. Zimbabwe as a country with limited financial and human resources, poor infrastructure, unstable and weak institutions and inequitable access to resources are likely to has limited capacity to adapt. The country's rural communities will find themselves in this situation will be vulnerable to climate change, just as they are to other stresses. The institutions that represent them such as cooperatives, associations, clubs, community-based groups, and traditional forms of organization have significant potential to contribute to adapting to increased climate variability and climate change. Rural communities can be assisted to cope by strengthening their social capital through:

- Improvement of healthcare, schools, or communal water supplies will provide essential services and can be a meeting point for joint action.
- Establishment of production, manufacturing and trading cooperatives for collaborative action
- Community-managed village grain storage systems
- Credit groups

When applied to climate change adaptation, social learning fosters a strong interaction between scientists, water managers and other social actors to find innovative solutions. Zimbabwe has a history of community action especially in the water sector. Water sources varying from shallow hand dug wells, springs and boreholes have been managed at village level for quite a long time. The fortification of some of the water sources under Water and Sanitation Programmes led to the emergence of locally acceptable water point committees with training from DDF, RDCs and NGOs.

Monitoring and evaluation of activities, outputs and outcomes is at the core of adaptive management. A range of techniques are now widely available for monitoring and evaluation, and are increasingly known and used by managers of water resources projects and programmes. Regular measurements of indicators, including river discharge, rainfall and lake water levels, are at the heart of any monitoring programme. With the decline of metero-hydrological networks, however, accurate information on even the most basic indicators is generally becoming more and scarcer, especially in many developing countries. If this trend continues it will contribute to a further reduction in some countries' capacity to implement an adaptive management style.

Zimbabwe has a fairly comprehensive data gathering and monitoring network which brings together government, universities, research institutions and programmes. Meteorological information has been collected on a regular basis since the 1950sand daily rainfall data are collected from 120 stations, and reported by telephone to either the Harare or Bulawayo offices of Meteorological Services. Close to 1, 200 rainfall records are submitted monthly but there is close to a two-week delay in the compilation and capture of the data. Data are captured in the WMO CLIMCOM database and data are available at a fee. The meteorological service has a web page with current forecasts. In terms of water, information for Zimbabwe is available in the form of the SADC Water Resource Database on CD-ROM. Quantities of surface flows are monitored through a network of gauging stations and weirs which records dam levels and the amount of flow in rivers. Dam levels are recorded twice a week, and telephoned through to the central Hydrology Office in Harare where the amount of water in each dam is calculated and summed for each province. The change in water volume is monitored weekly for each of the important national dams. River water quality is monitored routinely by provincial pollution control officers. A network of sampling sites is visited at least every three months. Chemical analyses, which include common inorganic ions, are performed by the Water Quality Analysis Laboratory in Harare. The laboratory maintains computerized records of the samples and provides the pollution control officers with paper copies. In addition, information is also captured by the Department of Water Development on groundwater which includes water levels and quality, the nature of the geological formation and the results of pumping tests. Water levels are monitored on a monthly basis in order to optimize rates of abstraction by users.

With the process of decentralization and the advent of ZINWA most of these monitoring roles fall under this entity and as already indicated elsewhere in the paper the major concern is the extent to which ZINWA and the Catchment Councils have capacity between them to carry out some of this work. Zimbabwe has the necessary monitoring structures for this sector but like all sectors has also experienced a huge brain drain in recent years.

Under an adaptive management style, rules are updated on a regular basis to fit new natural, social, economic, political and institutional realities and projections. An adaptive management style can be extremely costly and time consuming. Often the outcomes remain incomplete, as management is likely to require an ongoing series of further experiments. This open-endedness has the danger of seldom presenting conclusively cut-and-dried answers that politicians and decision makers can use as a basis for policy formulation (Roe, E. 1999). For Zimbabwe the ability to adapt entails the following:

- All actors, including scientists and water managers recognise that they have much to learn and that they should remain open and responsive to change.
- Require the strengthening of people's ability to learn together under the Catchment Councils.
- Need to use a range of scenarios to test the sensitivity and vulnerabilities of specific sectors or of the entire system.
- Using innovative and appropriate tools enable people to step out of their current mindset and behaviour patterns and begin engaging in adaptation to climate change.

Managing water and land conflicts, including those related to climate change, is thus not just

a matter of providing technical keys to unlock the right decision or allow consensus to be reached. It is rather a way to facilitate and coordinate a shared and managed decision-making process. In many instances it will require the acceptance of certain levels of decentralised decision-making and pluralism; the recognition of a range of views and knowledge about the resource base and its management. Thus, rather than trying to reach some "ultimate consensus", it respects the skills and limitations of each party and creates opportunities for step-by-step progress towards reconciliation and long-term engagement in joint action.

To sum up, in order to strengthen Zimbabwe's capacity to cope with climate change a significant effort should be made in the field of capacity building. The specific actions to be conducted include:

- Development / strengthening of human, technical and training capacities through the organization of national, catchment and sub-catchment works sessions for training national experts in the studies on vulnerability and coping with climate changes;
- Setting up national and catchment level permanent system for observing and monitoring the evolution of parameters enabling to assess the impacts of climate changes on water resources, agriculture, and animal husbandry. While these forms of data are available they are locked in various thematic or specialist government departments and may not necessarily conform to the boundaries of a given catchment.
- Setting up at national and catchment level a system for gauging and observing climatic and non-climatic parameters relating to the evolution of the most vulnerable ecosystems to climate changes, assessing current and future impacts of climate change on the resources of wetland ecosystems in particular, prediction coping actions and strategies;
- designing of an information system for support to decision-making in natural resource management based on climate changes; as well as setting up pilot projects for implementing strategies for coping with climate changes at the level of village communities. Information is available albeit within the various government departments. The flow tends to be upwards (within the ministry) but fairly not that used at RDC level where supposedly decisions are supposed to be made. The extent to which it is used by policy makers at various levels is subject to the extent of their empowerment. Information is available at RDC level but often decisions are deferred to the Ministry of Local Government and for ZINWA to the Ministry of Water Development. Once decisions have been made the dissemination of information is takes a variety of pathways which include media as well as ruling party structures in the rural areas. The implication of this is that the veracity of such information may at times never be questioned
- From the previous flood and drought experiences, it is fairly clear as to where the most vulnerable areas are in the country. Fro droughts, the areas to be affected are the Natural Regions IV and V which get less than 600mm of rainfall per year. Flooding has been restricted to the Zambezi, Save and Limpopo river systems.

8. Recommendations (development of administrative capacity (institutional and legal), mechanisms (risk management, information, inter-agency cooperation, stakeholder process)

In Zimbabwe the conventional approach to water resource management is characterised by the principle of "predict and provide" water supply is largely been seen as a question of augmenting supplies to keep up with demand. This is changing as the IWRM approach adopted by Zimbabwe provides for demand-side management. Demand-driven approaches include attempts to encourage

more efficient water use through water pricing and by treating water as a commodity. Reduction of wastage, through leakage control and improved irrigation efficiency, is also a part of demand management. Improved forecasting allows for more efficient management of supply structures and systems.

Viewed from this angle ZINWA must increase the use of demand management techniques and adaptive supply-side techniques (such as forecasting, and changes to operating rules) to meet water resource goals and objectives, dams and their construction become less important components of water management than they have been in the past. All the same ZINWA will still need to continue to evaluate how existing dams will fare under changed climatic conditions. The move from supply-side management towards adaptive management, which is necessary in order to manage present water resources most effectively, can be seen as the most appropriate adaptive response to climate change. For Zimbabwe the water management challenge therefore becomes one of developing institutional and management structures that can implement adaptive water management. In the sections below some broad recommendations are made:

a. In Zimbabwe water demand exceeds or threatens to outstrip sustainable levels of supply – a situation that is likely to be accentuated under climate change. Conventional strategies to further increase water supply can no longer meet growing future needs, and are unable to cope with the uncertainty arising from increased climate variability and climate change. Thus, for Zimbabwe there is a need to channel efforts towards reducing water demand and mobilise non-conventional water sources through appropriate policies, laws, incentives, and technical measures.

b. As the potential for increasing the conventional water supply is no longer feasible, a greater emphasis needs to be placed on reducing water demand. Water allocations need to be made to higher-value uses based on a greater flexibility to allocate between competing demands. The adjustment of policies and operational guidance will be critical to achieve this. Additional incentives such as tax breaks for drip irrigation or blocked water tariffs can assist in reducing demand. A wide range of technical measures and know-how are now available to reduce water demand from households, industry and agriculture.

c. Non-conventional water supplies also need to be mobilised to reduce the gap between demand and supply. The re-use of return flows and the use of wastewater can replace the conventional water supply for irrigation. Increasingly, techniques and know-how are available to tap non-conventional water supply sources in a sustainable manner.

d. Water resource management as mandated to ZINWA involves the strategic and tactical planning of future resources, over at least a decade, in order to maintain an appropriate balance between supply and demand. It includes an assessment of existing sources and how they are or could be managed, together with an assessment of the need for new sources or measures to curb demand.

Conventionally, dams are designed to continue to operate over a long design life, which is generally greater than 50 years. Dam heights are fixed, as is the capacity of the spillway. Changing dam height or increasing spillway capacity is not accommodated in dam design, and consequently any alterations to the dam can be extremely expensive. Climate change implies that such an approach is no longer appropriate. The hydrological characteristics of a source catchment

and the estimated risk of extreme floods may change over the design life, and cannot be assumed to be constant, as they have in the past. The clear implication is that dams need to be designed in such a way that they can be enhanced and updated relatively cheaply, as their performance is periodically reviewed.

f. ZINWA and the Catchment Councils should there make frequent and periodic reviews of the status of its dams and should encourage the use of flexible dam designs and design approaches that allow for upgrades.

g. ZINWA should work with its cooperating partners to carry out the following:

- provide incentives for conserving and protecting supplies
- Use opportunities to transfer water among competing uses, e.g., from agriculture
- Evaluation of changing the designs and operation of existing infrastructure for coping with the changes
- New technologies to reduce the intensity of water use, e.g., recycling technologies, WC flushing technology, shower designs, irrigation water delivery technologies, etc.
- Economic changes of how water is managed within and among river basins

h. While this will be carried out at the level of ZINWA the Department of Water Development should seek to carry out the following:

- Evaluate all levels of legal, technical, and economic approaches for managing water resources in the light of climate variability and change
- Exploration by water agencies and wetland managers of the vulnerability of both structural and non-structural water systems to plausible climate variability

To sum up the Government of Zimbabwe working through ZINWA should address the following as part of the plan for adaptation:

a. Policy planning

While the 1998 water and national authority acts provide sufficient basis for a water policy framework there is a need to go a step further and:-

- Improve land-use and water resources planning, including risk zoning and evaluation of the design, safety criteria and current status of infrastructure
- Reinforce and support flood and drought preparedness programmes through robust proactive early warning systems to minimise the impact of floods.
- Need to harmonize the water law, land use, development planning and disaster response
- Ensuring compliance with existing regulations, such as those relating to at-risk zones, building zones, upper watersheds, and floodplain, stream bank and wetland cultivation
- Developing insurance products to cover the impacts of climate-related disasters and risks.

b. Capacity building and awareness

- Share, under the auspices of ZINWA, information within and between Catchment Councils, the business sector and civil society on potential and observed climate change impacts and extreme events

- Improve the existing capacity to do forecasts so that stakeholders will have more faith in the forecasts. The forecasts need to be made simple so that the ordinary man understands the likely impact of such forecasts.
- Involve a broad spectrum of the population in management of floods, with particular emphasis on management at local level as this is a lot easier than the traditional centralized approach.
- Develop disaster preparedness and recovery systems, including forecasting, early warning and rapid response

c. Measures and direct interventions

- Modify existing infrastructure and operations to cope safely with and perform in more variable and extreme conditions
- Reinforce watershed management measures to regulate extreme event runoff, erosion, and sedimentation originating from higher intensity rainfall
- Institute structural and non-structural approaches to flood management to reduce the impact of floods and drought i.e., inhabitants of flood prone areas such as the Zambezi floodplain should be encouraged to construct dykes to keep the floods out but must also have a locally based warning system in place. This is will be presaged on sound awareness of the problem
- Deepen the country's understanding of the relationship between climate change and water resources particularly on the processes of the hydrological cycle in relation to the atmosphere, land use, and the biosphere. This can be carried out by:
    - Organizing symposia on this subject
    - Run awareness programmes for parliamentarians and lobby for the setting up of a parliamentary select committee on climate change
    - Media campaign on climate change