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SADC-HYCOS
(SADC HYDROLOGICAL CYCLE OBSERVING SYSTEM)

EVALUATION MISSION REPORT

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ABBREVIATIONS AND ACRONYMS

CEH	Centre for Ecology and Hydrology (formerly the Institute of Hydrology)

CIDA	Canadian International Development Agency
DCP	Data Collection Platform
DCS	Data Collection System
DRS	Direct Receiving Station
GTS	Global Telecommunication System
DWAF	Department of Water Affairs and Forestry of South Africa
EC	European Commission
EDCP	Enhanced Data Collection Platform
ELMS	Environment and Land Management Sector (SADC)
EU	European Union
EUMETSAT	European Meteorological Satellite Agency
FRIEND	Flow Regimes from International Experimental and Network Data
HYCOS	Hydrological Cycle Observing Systems
IHP	International Hydrological Programme
IRD	Institut de Recherche pour le Developpement
MDD	METEOSAT Data Distribution
MoU	Memorandum of Understanding
NHS	National Hydrological Service
NMS	National Meteorological Service
PR	Permanent Representative
PRC	Project Regional Centre
RC	Regional Centre
RDB	Regional Data Base
RSA	Republic of South Africa
SADC	Southern African Development Community
SADC-HYCOS	SADC Hydrological Cycle Observing Systems
SADC/WSCU	SADC Water Sector Coordinating Unit
TA	Technical Assistance
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHYCOS	World Hydrological Cycle Observing Systems
WIAG	WHYCOS International Advisory Group
WMO	World Meteorological Organization
WRTC	Water Resources Technical Committee
WSCU	Water Sector Coordination Unit

EXECUTIVE SUMMARY

The SADC countries, faced with various problems commonly experienced in the region, recognized the need for improvement of regional co-operation, in the fields of water resources information, flood and drought management, land management, watershed protection and management of international waters. It was realized that

the solutions to these problems are dependent on the existence of reliable water resources information systems both at national and regional levels covering not only the collection and analysis of data but also the exchange and dissemination of these data and related information. In partial response to this need, the SADC-HYCOS project was developed. The project has been implemented by a Pilot Regional Centre (PRC) hosted by the Department of Water Affairs and Forestry, Pretoria, South Africa, and Technical Assistance by the Centre for Ecology and Hydrology (CEH), Wallingford, UK (formerly known as the Institute of Hydrology). WMO played the supervisory role and provided technical and scientific support to the PRC and to the participating countries.

The overall objective of SADC-HYCOS was to develop and/or strengthen the national and regional capacity in the fields of water resources assessment, monitoring and management. This called for the provision of water resources data and information in the form needed for decision making on all aspects of integrated water resources development and management.

With the completion of Phase I of the SADC-HYCOS project, an evaluation has been carried out in order to identify successes and failures of the Project in relation to the expected results. The evaluation results would assist the donor and the stakeholders of the project to draw lessons to be used as input for improving the specifications and the design of future phases of the Project, as well as for preparing other HYCOS projects.

This Draft Report is the outcome of the consultants' work, which was carried out through interviewing 55 people, during travel in 8 out of the 10 SADC countries that participated in the project. Site visits made to some of the DCPs installed during project implementation, as well as the progress reports and other documents related to the project, provided further necessary information.

The achievements and shortcomings, as regards the **TECHNICAL ASPECTS OF THE PROJECT**, are recorded in Chapter 3. It is shown here that 43, out of the planned 50 DCPs, have been installed in the 10 countries. However, for various reasons, some of the installed DCPs are currently not operational. Data from field stations are transmitted by the DCPs to the Direct Receiving Station (DRS) at the PRC in Pretoria, through the METEOSAT satellite. The provision of the HYDATA software to each participating country has greatly improved the data management capabilities of the NHSs as well as enhanced the potential for **data exchange and dissemination**. The actual exchange of data amongst the countries is however low due to problems with the project website, whereby many countries have had difficulty downloading their data from the website. Another concern is that the data received from the DCPs is not being validated by the participating countries. Reasons given by the NHSs point to the problems experienced with the project website, and also due to delay in collecting data from the pre-existing or conventional stations which would have been used for checking and verifying the data from the DCPs. Consequently, the current RDB consists of raw data.

A regional electronic network established as one of the project objectives has greatly improved communication among the participating countries and with the Pilot Regional Centre (PRC). A **Regional Data Base (RDB)** consisting of data from the

HYCOS project and the Southern Africa FRIEND project has been developed. Initially, the countries have had difficulty accessing the RDB due to the slowness of the web page. The PRC has modified the web page to make it more user-friendly and things have improved. Each country was given a password which may be used for accessing all data on the RDB. However, some countries are still experiencing problems of accessing the web page and some are unable to gain access to data of some other countries. Since the exchange of data in real- or near real-time is one of the major goals of the HYCOS project, every effort must be made to ensure that all participating countries have access to the RDB through the web page.

The project was expected to deliver hydrometeorological products of national and regional interest but, unfortunately, this aspect of the project has been overlooked and the products were not delivered as expected.

Regarding training, each participating country had one or two of its staff trained in the installation and operation of DCPs, HYDATA software and use of the SADC-HYCOS web page. The interviews conducted by the evaluation team revealed that the training offered was inadequate. Countries wished for a longer training period for installation, operation and maintenance of DCPs as well as training for more than one person in DCP installation. They also needed more training in the maintenance of DCPs, the sensors and in programming of DCPs for data transmission. The general view is that the project has not been quite successful in building sufficient in-country capacity for maintenance and programming of DCPs.

Under **INSTITUTIONAL AND MANAGERIAL ASPECTS OF THE PROJECT** (Chapter 4) the various roles played by the participating countries, the PRC, the TA, WMO and SADC are reported. The technical capacity of the Pilot Regional Centre (PRC) has been analysed. The important aspect of sustainability of the project has been addressed in depth. Specifically, the consultants have assessed the capacity of the countries to allocate adequate budgetary and human resources necessary for operation and maintenance of DCPs, field data collection and maintenance of databases.

Chapter 5 elucidates **SALIENT ISSUES AND LESSONS LEARNT** based on the analysis of deficiencies in technical, institutional and managerial aspects of implementation of the project. Based on these issues as well as the assessment made in previous chapters, a number of **RECOMMENDATIONS** have been made in Chapter 6. It has been strongly recommended to consolidate Phase One of SADC-HYCOS and expand the project through implementation of a second phase. Consolidation should ensure an implementation of all the outstanding tasks including installation of outstanding DCPs and preparation of products. The need to build on the foundations of Phase I has been emphasized. Countries should make sure that funds are available for operation and maintenance of their DCPs. Regional data exchange and dissemination should be improved. All participating NHSs should start validating their data. Measures should be stepped up to fight vandalism, which has proved to be a significant problem in almost all the SADC countries.

Finally, Chapter 7 carries **PROPOSALS FOR CONTINUATION OF THE PROJECT,** including harmonization of the two available documents for Phase Two to come up with one project document.

1. INTRODUCTION

1.1 Background to the Mission

The Project Document of the SADC-HYCOS project stipulates that "An independent evaluation will take place in the second year of the project. It will require appointing a consultant for 1.5 month. The consultant will visit the PRC and some of the participating countries and WMO. He will prepare a draft report along the line of a framework established in agreement with SADC and EU. This report will be submitted to SADC and EU for comments. The consultant will then prepare the final evaluation report which shall include proposals for a possible continuation of the project."

During the fourth meeting of the WHYCOS International Advisory Group (WIAG) held in Geneva from 29 June to 1 July 2001, it was proposed that, considering the short remaining time available before the end of the first phase of the SADC-HYCOS project, the evaluation should be carried out by a team of two consultants who would divide the country visits. Subsequently, two water resources specialists from Sub-Saharan Africa were engaged to carry out the evaluation. They are Mr Datius G. Rutashobya from Tanzania (Team leader) and Mr Julius Wellens-Mensah from Ghana.

1.2 Background and History of the Implementation of SADC-HYCOS

There are fifteen international river basins in the SADC countries, out of which seven cover an area of over six million square kilometres. Of these, the Zambezi dominates the hydrology and water resources of the region and is being shared by eight countries. Apart from Lesotho, each SADC country shares at least two river basins, with a maximum of nine for Mozambique. The coordinated and integrated development of these basins, between or among the riparian countries, have been very limited. This, coupled with various common problems in the SADC region including, inter alia, disparities in the water per capita availability; frequent floods and droughts; growing demand for irrigation, hydropower and domestic and industrial water uses; limited access to safe drinking water and adequate sanitation facilities; conflicts of interest, both physically and environmentally, between the users or the usage of water resources; calls for tradeoffs between uses, more efficient utilization of water, and a recognition of ecological issues. This requires concerted actions at river basin, national, regional and international levels. It also requires an improvement of regional co-operation, notably in the fields of water resources information, drought management, management of international waters, and land management and watershed protection. All these initiatives are dependent on the existence of reliable water resources information systems both at national and regional levels covering not only the collection and analysis of data but also the exchange and dissemination of these data and related information.

The SADC member countries have committed themselves to integrate regional socio-economic development, which would primarily rely on food security, energy and water supply. Because of the great variation in water resources across SADC

countries, in both space and time, the success of any system for water management, which has to be considered as a key factor for the success of this regional policy, depends directly on the establishment and operation of an effective system for monitoring and assessing the resources.

In the light of the above, the SADC Heads of State Summit approved the concept of a SADC-HYCOS in January 1994, which became part of the SADC ELMS (Environment and Land Management Sector) programme. The draft project document was prepared by the SADC ELMS Co-ordination Unit and the WMO Secretariat, with the support of the European Commission(EC), in July 1996. This document was approved by the SADC Water Resources Technical Committee (WRTC) in late 1996. The project was presented by SADC to the European Commission who agreed to allocate 1,964,600 Euros for its implementation.

Administrative problems related to the awarding of the supply and service contracts, as well as for establishing the Imprest Fund at the PRC, delayed the start of the project. Institutionally, The project was launched at the SADC-HYCOS Initial Technical Meeting which took place from 20 to 23 April 1998, in Pretoria, RSA. The project actually started in June 1998, with the signature by SADC, EU and TA of the Technical Assistance Contract. It was due for completion in June 2000. However, completion was later extended to August 2001.

SADC-HYCOS has been developed as a regional component of the global system WHYCOS (World Hydrological Cycle Observing System), promoted by the World Meteorological Organization (WMO) with the support of the World Bank and other international agencies. It has been implemented by a Pilot Regional Centre (PRC) hosted by the Department of Water Affairs and Forestry, Pretoria, South Africa.

1.3 Objectives of the SADC-HYCOS Project

The general objective of SADC-HYCOS is to contribute to regional socio-economic development through the provision of management tools necessary for sustainable and economical water resources development and management. It has as its objective, the provision of water resources data and information in the form needed for decision making on all aspects of integrated water resources development and management.

In order to attain the overall objective the project has three main purposes:

- Provide SADC with one of the necessary operational tool (information system) for the sustainable improvement of regional integrated water resources assessment, monitoring and management for a peaceful and sustainable development of the region;

- Assist the participating countries in developing their own national capacity in these fields to allow them to fully participate in and benefit from the Project;

- Collaborate with other national, regional and international projects and programmes, towards the modernization, rationalization and improvement of the

efficiency, cost-effectiveness and sustainability of the water resources and related fields information systems in the continental part of the SADC region and at the international level.

The specific objectives of the project are:

- Installation of a network of 50 DCPs for the collection and data transmission through the Meteosat data collection system at 3-hourly intervals;

- Support to National Hydrological Services (NHSs) in enhancing the management of the national databases by providing software and training;

- Setting-up a regional database of current data from the DCP network and historical data and information provided by the NHSs and the UNESCO-IHP Southern Africa FRIEND-project.

- Enhancement of regional co-operation among the NHSs, and between the NHSs and the PRC.

1.4 Objective of the Evaluation Mission

The objective of the evaluation of SADC-HYCOS is to produce a clear and comprehensive report, identifying successes and failures of the Project in relation to the expected results. The evaluation report will compile strengths and weaknesses in the Project achievements, point out the reasons for these successes and failures, and relate them with technical, financial, institutional or other reasons. This would allow the donor and the stakeholders of SADC-HYCOS to draw lessons from the Project, which will be used as input for improving the specifications and the design of future phases of the Project, as well as for preparing other HYCOS projects.

1.5 Modus Operandi

The consultants executed their task using three different sources of information:

- **Documents**

Various documents provided information on the implementation of the SADC-HYCOS Project. These included the project document; periodical reports submitted by the Technical Assistance to the Project and by the PRC; periodical evaluation and supervision reports of the Project prepared by the WMO Secretariat; reports of meetings of the SADC Water Resources Technical Committee; and a number of other documents as they appear in Annexture E. These documents were compiled and provided to the consultants by the WMO Secretariat and the SADC Water Sector Coordination Unit (SADC/WSCU).

- **Interviews**

The core activity of the mission was the interviews conducted at the PRC, the SADC/WSCU and some of the participating countries. The two consultants first visited and made interviews with the PRC personnel at the Department of Water Affairs and Forestry in Pretoria, South Africa. They then visited Maseru, Lesotho where interviews were made with the staff of the SADC/WSCU and the Department of Water Affairs of Lesotho. Interviews were also made in the countries of Botswana, Mozambique, Namibia, Swaziland, Zambia and Zimbabwe whereby, in view of the short time available to carry out the mission, the visits were divided between the consultants. Prior to the mission, the Team leader had conducted interviews in Tanzania. Annexture D shows the list of persons interviewed.

While it has to be acknowledged that not every SADC country that participated in the project could be visited, and that not every individual stakeholder could be interviewed, it is fair to assume that the broad-based interviews and discussions gave a significant and reliable sample for the diagnostic approach to the evaluation of the Project.

- **Site visits**

In all the countries that were visited the consultants made sure that at least one DCP was visited in order to ascertain its installation and establish the current status of the station.

1.6 Acknowledgement

The evaluation team thanks the staff of SADC Water Sector Coordination Unit for all the assistance rendered to the team. Special thanks go to the Water Sector Coordinator Mr Phera Ramoeli for accepting to meet and brief the team at his home despite his medical condition, and Mr E. Mokuoane who tirelessly provided the necessary material and documentation. The team owes may thanks to staff of WMO's Department of Hydrology and Water Resources for compiling and providing reference material, as well as PRC staff for providing information, office space and other facilities to the evaluation team. In this regard, special thanks go to Mr Stefan van Biljon, Director of DWAF's Hydrology Division and PRC coordinator.

2. EXPECTED PROJECT RESULTS

The expected project results were:

(i) A basic network of 50 Data Collection Platforms (DCPs) located at benchmark hydrological stations equipped with automatic sensors for the measurement and transmission in real-time, through the METEOSAT satellite, of water quantity and quality and meteorological parameters, in 10 of the mainland countries of

SADC. These countries are Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe.

These 50 upgraded stations would each be equipped with six sensors: two for water level (upstream and downstream), a rain gauge, water conductivity, and air and water temperature.

In addition, 10 of these stations, one in each country, would be called enhanced DCP stations (EDCP), and would have an additional five sensors: water turbidity, plus humidity, wind speed and direction, and solar radiation so as to enable calculation of potential evaporation using the Penman formula.

Although South Africa was not eligible for financial support from the Project for acquiring DCPs, this country has made a significant contribution to the project by including 57 METEOSAT DCPs of its own national network, operated by the Department of Water Affairs and Forestry (DWAF);

(ii) Improvement and/or implementation of the data exchange and dissemination systems for the various information fluxes related to the project, using means like the Global Telecommunication System (GTS) of WMO, the METEOSAT DCS, MDD stations installed at Meteorological Services and for deferred time CD– ROM;

(iii) An electronic network interconnecting the relevant national data bases and information systems and allowing the national agencies to easily and cost-effectively exchange information;

(iv) An operational regional database aimed at providing consistent, good quality, updated and timely available data from the basic network. It is foreseen that the Southern African FRIEND data base and the Zambezi River Basin Database under Phase I of ZACPRO 6 will constitute the historical archive of the PRC and that the data from the SADC-HYCOS' DCPs will supplement this archive with a regular flow of data;

(v) Products of national and regional interest from the SADC-HYCOS real time operational database in conjunction with the historical regional database being developed by the UNESCO FRIEND–Southern Africa project and ZACPRO 6;

(vi) Attachment programmes, training and on the job experience for hydrologists and technicians from the SADC countries in the fields of DCP installation and operation and maintenance, satellite transmission, electronic networks, data base management, data processing, data quality checking, water quality monitoring, etc.;

(vii) A Regional Centre (RC) developed from the Pilot Regional Centre (PRC) established at an existing institution in the region to implement the project.

3. TECHNICAL ASPECTS OF THE PROJECT

3.1 Installation of a real-time data collection and transmission system

3.1.1 Angola

Angola is one of the two participating countries not visited by the evaluation team. It had been approved that 6 DCPs be installed in the country. However, reports indicate that, after considering the real situation in the country, the project Steering Committee decided during its last meeting held in Johannesburg, that only 2 of the planned 6 DCPs should be left in Angola to be installed in safe sites. The remaining

4 would be used as spares within the project area where they would be highly needed, with the resolution of giving an appropriate number of DCPs to Angola during Phase Two. The two DCPs were installed on Bengo River at Cabiri Station and Cunene River at Xangongo.

Assessment
The evaluation team feels that it may have been unrealistic to plan for the installation of 6 DCPs in the field in Angola, given the security situation. The decision of the Steering Committee of sending the 4 DCPs back to the PRC was never implemented. Angolan National Directorate of Water (DNA) expressed interest in installing 3 further DCPs instead of sending them back to Pretoria. Since the military situation has recently improved, the evaluation team proposes a review of the situation with the view to retaining, and subsequently installing, the outstanding DCPs in Angola.

3.1.2 Botswana

The national hydrological services of Botswana are provided through the Hydrology and Water Resources Division (HWRD) under the Department of Water Affairs. The HWRD consists of 11 hydrologists and water resources engineers, a chemist a botanist and 28 technicians. The above personnel were involved in the installation of 4 DCPs (See Table 1), of which one is an enhanced DCP (EDCP). Two DCPs have 11 sensors, one has 6 and one has 3 sensors. The Okavango at Mohembo DCP was installed as an additional station, having been one of the five DCP sets held by the PRC as spares. It was installed at a key station to replace a pre-existing DCP that had failed.

Three of the DCPs have been operating well, except for occasional hiccups, like sensors being covered in mud. Also, rain gauges have, lately, been giving wrong recordings. The fourth DCP, which was recently installed, initially had problems like the other three but is now working well. As part of the mission to Botswana, the Gaborone Dam station on Notwane river was visited. All the installed sensors were operating.

Apart from the 4 DCPs there are 12 more in the Okavango delta, but these are not part of the SADC-HYCOS project.

Assessment
The siting of DCPs, in some cases, does not benefit flood warning. If they had been located upstream of the flood prone areas then, apart from fulfilling the specific project objectives, they would have provided data and information for warning of impending flood events downstream. Further, some of the DCPs were installed in low-lying parts of the river banks and their elevations were not high enough to avoid inundation. Determination of the elevation of a DCP should have involved an analysis of the discharge time series over a long period of time. Consideration should have been made of the highest flood recorded on a particular river channel. As a measure of safeguarding the installations the HWRD staff plan to raise the towers to ensure that the level of the DCPs are well above the highest flood marks.

3.1.3 Lesotho

The Hydrology Division, which is under the Department of Water Affairs, was responsible for the SADC-HYCOS project in Lesotho. Personnel of the Division consist of one Principal Hydrologist, one Senior Hydrologist and two Hydrologists. Others are 2 Principal Technical Officers, 3 Senior Technical Officers, 8 Technical Officers and 4 Hydrological Assistants. All hydrologists plus three technicians participated fully in the implementation of the project.

4 DCPs have been installed (See Table 1). The Malibamatsu at Katse Dam station was requested jointly by the Governments of Lesotho and South Africa and funded directly by DWAF to assist with operation of the Lesotho Highlands Water Project.

Presently, not all variables are being measured. The variables measured are water level, rainfall, air temperature and water temperature. For the enhanced DCP at Masianokeng, the variables measured are water level, wind speed/direction, rainfall, air temperature, water temperature and solar radiation. The inability to measure all variables are due to insufficient cable lengths supplied with the equipment to connect the DCPs to probes/sensors and the rocky and hilly nature of the terrain. The hilly nature of the terrain required longer cables (more than the 30 metres supplied), whilst the rocky nature exposed the probes for conductivity and turbidity measurements to likely damage.

A visit by the mission was made to Masianokeng station on S/Phuthiatsana river. This station has had its solar panel stolen but has since been replaced.

An annual budget to the tune of 4 million Rand is usually set aside by the Department for the project but this is small compared to the total requirements. It is feared that, in case of vandalism, it might be difficult to replace a station. However, there are no problems of operation and maintenance of the DCPs because the Division has reliable transport and the available funds for this purpose have so far proved to be adequate.

Assessment
Procurement of appropriate lengths of cables to connect the probes to the DCPs would make it possible to measure variables that are currently missing.

The limited budget set aside to cater for replacement of equipment at the stations, or to replace a station that has suffered vandalism, cast a doubt as to the sustainability of the project. This is particularly so because vandalism of stations is rampant in Lesotho. It is important to institute measures to curb vandalism and also increase the budget for station replacement.

3.1.4 Malawi

Although the evaluation team's itinerary for country visits did not include Malawi, it was deemed necessary to include a brief report about the country. The SADC-HYCOS project component for Malawi was implemented under the Hydrology Section in the Ministry of Water Development. Among other personnel, the Section comprises 10 hydrologists and 10 technicians, of which 3 hydrologists and 4

technicians participated in the project. The hydrological network has about 300 stations.

As Table 1 shows, the 6 DCPs in Malawi were installed between September 1998 and November 1999. The station on Lake Malawi at Monkey Bay has been transmitting at a very low rate because its antenna is protruding through a large tree which, according to the Hydrology Section, cannot be felled down as it is within the area of the fisheries department. Stations Lake Malawi at Chilumba and Songwe river at Mwandenga were vandalised in the past but their instruments and equipment have been replaced.

Budgetary allocations to run the field stations in Malawi are very low, in the order of US$ 2,000 only annually. This makes operation and maintenance of stations difficult to achieve. This situation is compounded by the problem of lack of personnel required to repair damaged stations. Of the two technicians trained in the maintenance of stations one has since resigned from the hydrological services. The remaining one has had insufficient training to undertake repair work.

Figure 1: DCP installation on Shire River at Liwonde (Malawi)

3.1.5 Mozambique

Mozambique experienced a long standing problem of getting their equipment out of customs. After resolving this problem PRC staff assisted Mozambique national staff in installing 3 out of the planned 6 DCPs (see Table 1). These are Maputo river at Madubulu, Limpopo river at Combomune, and Save river at Vila Franca de Save. All the stations have had problems of data transmission at different periods of time. The station at Vila Franca de Save is planned to be re-located as the present location is not good. The 3 remaining stations, namely, Zambezi river at Tete, Zambezi river at Marromeu, and Pungoe river at Bue Maria (Fronteira) have not been installed because they are earmarked for location in central Mozambique which was affected by floods and river levels have been too high. In addition, PRC have expressed doubts over the suitability of civil works at these three sites, suggesting that the instruments are likely to be affected by flood waters fairly regularly. A contractor has already been identified to undertake civil works and it is expected that installation of the DCPs will start soon.

Assessment

Data transmission in real- or near-real time in Mozambique is very essential in view of the devastating floods that have been experienced recently. Since some of the staff who underwent training under the project are presently not available (away on studies), there is need for PRC staff to intervene and make sure that the three stations continue to transmit the data. PRC should also be involved in the installation of the remaining three stations, once the civil works have been properly done and accessibility of their earmarked locations becomes possible. If the locations remain persistently inaccessible then alternative ones should be identified, ensuring that they satisfy all the intended goals. On the job training should be provided to other NHS staff in order to replace those that are currently not unavailable.

3.1.6 Namibia

The hydrological network of Namibia is operated by the Hydrology Division of the Department of Water Affairs. The actual monitoring of hydrological stations is undertaken by the Surface Water Data Management Sub-Division. The network consists of 83 river flow recording stations, out of which 5 are HYCOS stations.

Out of the 5 DCPs allocated to Namibia (see Table 1), 4 were installed with the assistance of TA. Installation of the fifth one has been delayed due to bridge construction works going on at the site. One station had to be relocated due to vandalisation of the original station; the new station is however not yet rated. Currently only one station is recording and transmitting data. The other three stations have either the solar panel vandalised, cables damaged by mice or too close to the Angolan border, which is in a state of war and therefore not safe.

It was not possible to visit any of the DCP stations due to the great distances involved in travelling from Windhoek to these stations and the limited time available for the mission.

Assessment

The main constraint facing Namibia is the shortage of staff to carry out field work activities. At a point in time, the NHS had only one hydrologist, with no technicians on the project. In solving this problem the NHS has now engaged 2 hydrologists and some technicians, who are being trained on the job to enhance the field capability of the Department. With improvement in staffing levels and support from the PRC to replace the vandalized or damaged stations, all 5 DCP stations can be made to collect and transmit data again. Since the visit by the evaluation mission, the station close to the Angolan border has been installed with the assistance of the PRC.

3.1.7 South Africa

The hydrological network of South Africa is operated by the Division of Hydrology of the Department of Water Affairs and Forestry (DWAF) through regional offices. The Hydrology Head Office currently has 36 hydrologists, 13 technicians and 7 engineers. The function of monitoring of the hydrological network is supported by hydrology staff in 8 regional offices where there are hydrologists, technicians and support staff as well as construction teams for building and maintaining the gauging infrastructure. Only one technician from a regional office lent support to the SADC-HYCOS project thus far. The rest of the

support was provided from head office. In future it is planned that greater support should come from the regional offices.

Currently, 1130 gauging stations are operated and 250 major reservoirs are utilised as gauging stations. Head office budget allocation is currently 21 million Rand while 50 million Rand is for the Regional offices. Major problems of operation and maintenance are vandalism and theft at transmitting stations, siltation and damage of stations as a result of floods. Another problem is that financial resources are insufficient to establish new gauging stations as requested from within the DWAF and its clients.

As part of the evaluation the team visited 3 HYCOS stations. These are Kalkheuwel, Nooitgedacht and Atlanta all on the Crocodile River.

3.1.8 Swaziland

Swaziland has a designed network of 45 hydrological stations, out of which 36 are functioning. The rivers in the country are all shared with other countries. The hydrological network is operated by the Hydrological Unit of the Water Resources Branch.

All four DCPs allocated to Swaziland (see Table 1) have been installed with assistance from the PRC. Three of the stations have standard DCP equipment, while one station, Croydon Bridge, is equipped with enhanced DCP instrumentation. Out of the 4 installed stations, 3 are functioning and transmitting data to the PRC. One station is not functioning due to vandalisation of the equipment at the station. In all two stations were vandalised, but one has been restored. It was learnt that Mozambique has promised to release 1 DCP to Swaziland to improve monitoring of rivers flowing into Mozambique. The promised DCP is yet to be delivered.

To date, not all required sensors have been installed at the stations. These sensors include the remote water level, conductivity, turbidity and water temperature. The reasons given for not installing these sensors are inadequate cable lengths and the need to install some sensors in a running river rather than in stilling wells.

As part of the mission to Swaziland, the Croydon Bridge station on the Black Umbuluzi River was visited. It is an enhanced DCP station equipped with sensors to collect data on water level, air temperature, rainfall, wind speed and direction, radiation and humidity. Currently, there are no sensors installed for turbidity, conductivity, water temperature and downstream water level. Due to vandalism, the solar panel has been replaced by direct connection to the national electric grid with an AC/DC converter. The converter is however faulty, so the station is currently powered by a DC accumulator battery, which has to be replaced every 2 weeks. The wind cups for wind speed measurements have been broken off by local boys taking aim with catapults at them. Currently, the station is recording but not transmitting probably due to an antenna problem. The logger cartridges are however being downloaded regularly.

3.1.9 Tanzania

The Tanzania component of the SADC-HYCOS project was implemented by the Hydrology Section, under the Department of Water Resources. The Section consists of a Principal Hydrologist, 25 Senior Hydrologists and 2 Hydrologists. In addition, there are 6 Principal Technicians and 119 Technicians of different levels working at the Head Office and in the regional offices. Out of these personnel, 5 hydrologists and 6 technicians participated in the project.

All 5 DCPs allocated to Tanzania (see Table 1) have been installed with assistance from TA. Four of the stations have standard DCP equipment, while one station, Ruvu river at Morogoro Rd Bridge, is equipped with enhanced DCP instrumentation.

Civil works for some stations were not properly done and towers not properly installed. However, stations were functioning well. As part of the evaluation mission the Ruvu at Morogoro Rd Bridge station was visited. The water level sensors at the station were not working because of siltation. This was also the case at Wami/Mandera station.

The average annual budgetary allocation for conducting the hydrological services is US$ 200,000 which is a small fraction of the actual requirements. The Hydrology Section has a big shortage of transport to visit the field stations. For this reason, operation and maintenance of stations is not done adequately.

Assessment
The limited budget allocated to the Hydrology Section is a big dilemma to hydrological services. It takes a long time before changing the cartridges at the DCP stations. Some of the data, e.g. water level data, was not being transmitted due to the malfunctioning of sensors and the Section was not in position to replace them. Consequently, flows could not be determined which is a big shortcoming. This casts some doubt as to the sustainability of the functioning of DCPs. Some of the old stations had not been visited for more than a year and their conditions could not be ascertained. Following the evaluation mission the civil works have been redone and are now in acceptable condition. Also, water level sensors have been replaced during a visit by the PRC staff.

3.1.10 Zambia

Zambia has a hydrological network of 287 stations. Out of this number 6 are DCP stations installed under the HYCOS Project. The hydrological network is operated by the Water Resources Division of the Department of Water Affairs. Other Divisions under the Department are the Water Development Board and the Water Supply Division.

All 6 DCP stations allocated to Zambia (see Table 1) have been installed. One of the stations is an EDCP. The DCPs were programmed by TA staff. All 6 DCPs are recording and transmitting data to the PRC. Only 1 station was vandalised, but has since been restored and is functioning again.

One DCP station, Luangwa Bridge on River Luangwa was visited. All equipment installed at the station are intact and are recording, as well as, transmitting data. The DCP instrumentation are mounted inside and on top of a concrete structure with

a steel door. The station is protected by a security guard, for whom the Department will soon provide a dwelling hut at the station.

Figure 2: DCP installation on Zambezi River at Nana's Farm (Zambia)

3.1.11 Zimbabwe

The hydrological network of Zimbabwe is made up of over 600 stations out of which about 400 are currently functioning. The National Hydrological Services are operated by the Hydrology Branch of the Department of Water Development. The SADC-HYCOS project is however implemented under the Zimbabwe National Water Authority. Personnel in the Department and Water Authority include 10 hydrologists, 40 engineers and 70 technicians.

All 5 DCPs (see Table 1) have been installed. During the time of the evaluation mission, only two were functional, namely, Mzingwane river at Doddieburn and Save river at Save Gorge. Nuanetsi at Malapati Bridge station was washed away by floods but has since been restored except for the battery which is not functional. The Nyakapupu station on Manyami river (see figure 3) had its solar panel stolen only two weeks earlier.

A visit was made to Mazowe River at Old Mazowe Bridge station. The station was not recording due to the problem with the battery which was not charging for the previous two weeks. A guard is permanently available at the station to ensure the security of the equipment.

Assessment

The annual budgetary allocation for running the national hydrological services in Zimbabwe is in the tune of US 100,000.00. According to the project personnel this amount is too little to cater for all the stations, including the DCPs. The country is also facing a serious problem of vandalism of the field stations. Other problems include a lack of spares and human resources.

Figure 3: DCP installation on Manyami River at Nyakapupu

3.1.12 General evaluation

43 out of 50 DCPs have been installed and if this give an average achievement of 86%. The technical difficulties for achieving this may have generally been underestimated, especially regarding the time necessary for accomplishing the work. The evaluation team happens to know similar projects undertaken in other regions where the recorded achievements have been much lower. Hence, the team regards the performance for this particular aspect of the project as not bad, even though everything is not 100% satisfactory.

Table 1: Status of DCP installation and performance

COUNTRY	RIVER NAME	STATION NAME	DCP TYPE	WMO ID	START DATE	DRS STATUS 29 Oct 2001
Angola	Bengo	Cabiri	EDCP	66163	12 Feb 01	98%
	Cunene	Xangongo	DCP	66485	15 Feb 01	0%
Botswana	Okavango	Mohembo	EDCP	68025	18 Dec 98	98%
	Limpopo	Buffel's Drift	DCP	68150	31 May 99	95%
	Notwane	Gaborone Dam	DCP	68238	31 Mar 00	97%
	Limpopo	Seleka farm	DCP	68044	29 Mar 01	98%
Lesotho	Malimabatso	Kao	DCP	68451	19 Apr 01	97%
	Senqu	Mokhotlong	DCP	68453	11 Mar 99	97%
	Makhaleng	Qaba	DCP	68455	08 Mar 00	98%
	S/Phuthiatsana	Masianokeng	EDCP	68457	02 Oct 99	81%
Malawi	Shire	Liwonde	DCP	67694	28 Sep 98	97%
	Lake Malawi	Monkey Bay	DCP	67431	15 Nov 99	16%
	Lake Malawi	Chilumba	DCP	67492	11 Nov 99	93%
	Songwe	Mwandenga	DCP	67422	06 Nov 99	97%
	Ruo	Sandama	ADCP	67794	01 Oct 98	98%
	Lake Malawi	Nkhata Bay	EDCP	67698	12 Nov 99	97%
Mozambique	Save	Villa Franca de Save	DCP	67305	15 Oct 00	98%
	Limpopo	Combomune	EDCP	67328	06 Mar 01	97%
	Maputo	Madubula 1	DCP	67350	15 Sep 00	95%
Namibia	Zambezi	Katima Mulilo	DCP	68017	20 Mar 99	0%
	Kwando	Kongola	DCP	68022	21 Mar 99	O%
	Fish	Ai-Ais	DCP	68023	06 Jan 00	91%
	Okavango	Rundu	EDCP	68309	18 Mar 99	0%
Swaziland	Great Usuthu	Siphofaneni	DCP	68390	30 Nov 99	95%

	Great Usuthu	Bhunya	DCP	68393	16 Mar 99	0%
	Black Umbeluzi	Croydon Bridge	EDCP	68397	11 Dec 98	98%
	Ngwavuma	Lubuli	DCP	68398	01 Dec 99	91%
Tanzania	Ruvu	Morogoro Rd Bridge	EDCP	63840	17 Nov 98	90%
	Wami	Mandera	DCP	63867	17 Nov 98	95%
	Ruhuhu	Masigira	DCP	63868	22 Oct 00	90%
	Pangani	Korogwe	DCP	63884	14 Nov 98	88%
	Great Ruaha	Msembe	DCP	63949	20 Oct 00	95%
Zambia	Zambezi	Smith's Bridge	DCP	67635	21 Jan 01	98%
	Zambezi	Nana's Farm	EADCP	67636	14 Nov 99	76%
	Kafue	Kafue Hook Bridge	DCP	67649	18 Jan 01	95%
	Kafue	Smith's Bridge	DCP	67635	21 Jan 01	98%
	Kabompo	Watopa Pontoon	DCP	67670		98%
	Luangwa	Luangwa Bridge	DCP	67742	10 Nov 99	97%
Zimbabwe	Manyami	Nyakapupu	EDCP	67772	08 Sep 99	0%
	Nuanetsi	Malapati Bridge	DCP	67993	10 Aug 99	0%
	Mazowe	Old Mazowe Bridge	DCP	67766	08 Aug 99	0%
	Mzingwane	Doddieburn	DCP	67988	27 May 99	98%
	Save	Save Gorge	DCP	67996	28 Nov 99	100%

Figure 4: SADC-HYCOS DCP installations

3.2 Improvement and/or Development of Data Exchange and Dissemination Systems

Assessment

Each participating country has been provided with a copy of the CEH's HYDATA software for storage of their national data and of data from other stations of interest. This software enables users to download data from the RDB web site and also to store data from the data loggers which have been provided at each station. The provision of HYDATA hydrological software under the project has provided 10 countries with a uniform data management system (Namibia uses HYDSYS software, developed in Australia, for the management of its hydrological data). This has greatly improved the data management capabilities of the National Hydrological Services as well as enhanced the potential for data exchange.

Although the framework for data exchange has been established, actual exchange of data amongst the countries is low. Requests for data have been limited to flood warning from downstream countries, notably from Mozambique. There is however a general willingness to exchange data once the request is made. The low level of data exchange amongst countries may be attributed to a limited direct access to the regional data base and project web site, with many countries having difficulty downloading their data from the web site.

3.3 Development/Improvement of a Regional Electronic Network

The project has been able to establish an effective regional electronic network that allows all the participating countries in the pilot phase to communicate easily by e-mail and internet with each other. This was made possible by providing e-mail and internet communication through service providers to the NHSs of the participating countries and, in some cases, providing personal computers and accessories to some of the countries e.g. Swaziland, Zambia and Zimbabwe. The regional electronic network has greatly improved communication among the participating countries and with the Pilot Regional Centre (PRC).

3.4 Development and Implementation of a Regional Data Base (RDB)

The original idea of developing a regional database using a GTS system was discarded. The regional database was developed by IRD (formerly ORSTOM) acting as a sub-contractor for the TA (CEH). The data transmission from the field is via METEOSAT through Darmstadt in Germany to the RDB at the PRC in Pretoria. The RDB is based on Microsoft SQL, with filtering of messages by CREX codes developed by WMO. The RDB consists of data from the HYCOS project and the Southern Africa FRIEND project.

Closely linked to development of the RDB is the development of the web page for posting and accessing the data. The views of the participating countries regarding the effectiveness of the web page were varied. Four countries (Botswana, Namibia, Swaziland and Tanzania) out of the eight interviewed were still dissatisfied with accessibility to the web page. Whilst some complained about not gaining access to data of countries other than their own countries, others complained about total failure to gain access to the web page. The other four countries (Lesotho, South Africa, Zambia and Zimbabwe) reported initial difficulties with access to the web page. They are now however satisfied with accessibility and are now able to download data of other countries from the web page with ease.

The PRC agreed that there were initial difficulties with gaining access to the web page. The main difficulty was that the page was not user-friendly and required too many clicks to navigate through. Realizing this difficulty, the PRC modified the web page to simplify navigation through the page. This modification greatly improved accessibility to the web page and data held in the RDB. The evaluation team witnessed a demonstration of connecting to and downloading data from the web page at the PRC in Pretoria.

Assessment

The continued inability of some participating countries to access the RDB through the web page is of great concern. The exchange of data in real-time or near real-time is at the heart of the HYCOS project and therefore every effort must be made to ensure that this very important component of the project is achieved. It has been noted that there is some confusion among the participating countries about the RDB and the web page. The RDB as verified by the evaluation team is established. The web page through which the countries access data in the RDB did present some difficulties initially, which did not allow the countries to gain access to data in the RDB. This created the impression that the RDB was not in place. Another misunderstanding was the password to be used to gain access to data of other countries. Some countries were expecting to be given special passwords to enable them gain unlimited access to all data on the RDB. The PRC however explained that the same password for accessing their data might be used for accessing all data on the RDB. In the view of the evaluation team, it is very important to clarify all misunderstandings and confusion about the RDB, the web page and access to data on the RDB.

3.5 Preparation of Products of National and Regional Interest

The project was expected to deliver hydrometeorological products of national and regional interest. The products were expected to give 'added value' to basic raw data from the HYCOS RDB and the historical regional database developed by the UNESCO Southern Africa FRIEND project. The products were categorised as Core Products, to be developed by the TA and Menu Products to be developed according to agreed priorities between the TA and the participating countries.

The Core Products comprise:

- WISE HYDRO (Web Integrated Server Enhanced Hydrometric Data Release and Observation) System for Southern Africa
- Publication of a register of the SADC-HYCOS gauging station and DCP network
- Validated historic river flow records established on the RDB from the SADC-HYCOS and the FRIEND projects
- Calculation of Penman Evaporation using the hydrometeorological data collected at the Enhanced DCP sites
- Publication of station yearbooks and hydrological bulletins
- Regional hydrological drought severity assessment through software and technical outputs from the DFID funded ARIDA project

Of the above listed products only the first two were realised.

The Menu Products were expected to include:

- Documentation describing any potential hydrological products that accrue during the first two years of the project
- Hydrological analysis modules to calculate flow regime measures such as low flow frequency, flow duration and recession curves
- Supplementing the functionality of the WISE HYDRO using FRIEND data

Significantly, none of the above tasks were achieved.

Assessment

The hydrometeorological products promised by the project were not delivered as expected. The evaluation team did not have the opportunity to interview the TA to shed light on this aspect of the project. The progress reports available to the team did not ascribe any convincing reasons for non-delivery of the products.

Through e-mail communication, the TA gave an explanation that participating countries were provided with some 'stand-alone' software that comprised two products. The first one is the HYDATA database and data processing software which enables participating countries to produce flow duration curves, low flow frequency curves and do simple inter-station comparisons using double-mass curve

plots. The second software product was called ARIDA (Assessment of the Regional Impact of Droughts in Africa). This software was produced in part through an associated UNESCO project, Southern African FRIEND. The final training of NHS staff on the software was not undertaken until November last year, some months after SADC-HYCOS had ended. This late training course had to be funded by FRIEND as HYCOS had ended, although it was always intended that the software be 'driven' by the real-time data collected through SADC-HYCOS. The training workshop could not be held earlier due to delays in getting the software Beta-tested by Malawi and Botswana and through delays in actually completing the software. However, the software is now up and running, feeding of the real-time HYCOS data via the local HYDATA databases.

3.6 Training

The training courses proposed within the project were:

1. Training at the factory of the DCP suppliers in France for 2 staff from PRC, 4 from TA and 1 part-time from WMO
2. Two-week training workshop at PRC by the DCP equipment supplier supported by PRC and TA staff for 1 person from each country
3. Two-week training workshop at PRC on HYDATA database software by TA for 1 person from each country
4. One or two week workshop at PRC on electronic networks and use of GTS by TA (ORSTOM) for 1 person from each country
5. Two-week training workshop at PRC on WISE-HYDRO software system by TA (ORSTOM) for 1 person from each country
6. Two-week workshop at PRC on development and use of hydrometeorological products by TA for 1 person from each country
7. One month attachment at PRC by one staff member per country by PRC to allow training on all aspects of DCP data reception, quality control, data distribution to SADC-HYCOS partners and other users plus overall operation of the system
8. General 'on-the-job' training of additional field staff by TA and PRC during field installation of DCP equipment
9. Five individual training or technical visits of one month each to either Wallingford, U.K., or to Montpellier or Guidel in France.

The overseas training visits were intended to offer training to promising individuals identified during initial training courses on specific aspects of the project. They were expected to act as resource persons for the region on specific skills and, in turn, train other people.

Of the above, training activities 1,2,3 & 8 were accomplished. Training activity 7 was also carried out for two weeks instead of one month as originally planned. Training activity 4 became irrelevant since GTS was not used for data transmission. The remaining three activities were not carried out at all.

Assessment
The participating countries interviewed confirmed that they received training in the installation and operation of DCPs, HYDATA software and use of the SADC-HYCOS

web page. They are however of the view that the training component of the project offered during the project was inadequate. They wished for a longer training period for installation, operation and maintenance of DCPs as well as training for more than one person in DCP installation. They reiterated the need for more training in the maintenance of DCPs, the sensors and in programming of DCPs for data transmission. The provision of a diagnostic or trouble-shooting checklist for maintenance of DCPs was considered very desirable by all the countries interviewed. It is the general view of the countries that the project has not built sufficient in-country capacity for maintenance and programming of DCPs.

The evaluation team see the failure of the project to build in-country capacity for maintenance and programming of DCPs as a serious omission which could adversely affect the sustainability of the project. This needs to be addressed in the next phase of the project to reduce reliance on the PRC and also secure the smooth operation of the data collecting and transmitting system well after the project has ended.

4. INSTITUTIONAL AND MANAGERIAL ASPECTS OF THE PROJECT

As decided by SADC member countries, the SADC-HYCOS project was implemented by the Pilot Regional Centre (PRC) hosted by DWAF, Pretoria, South Africa, which was selected by the SADC member countries. The PRC implemented the project with the support of Technical Assistance (TA) funded by the project and with the technical and scientific support of WMO as the supervising agency. SADC, being the Contracting Authority, facilitated the smooth implementation and the review and evaluation of the project, notably through its Water Resources Technical Committee. The National Hydrological Services of the participating countries also had a key role to play.

An assessment of the roles played by the participating countries, SADC, WMO and TA has been based on the specific tasks assigned to them as shown in Annexture C.

4.1 Role played by the participating countries

4.1.1 General

The successful implementation of the SADC-HYCOS project had to rely on the active participation of national hydrological services. In general terms, all the eleven countries participated in the project implementation to a satisfactory degree, even though the individual levels of performance differ. It can be said that the good will and the strong political commitment by the SADC Member countries at the highest Government levels contributed very much to the recorded successes. The designated national agencies responsible for hydrological services, namely, the Hydrology Division, Hydrology Unit or Hydrology Section, provided the required national staff who carried out the project activities on a day-to-day basis. They also provided various means including vehicles for the field missions undertaken by the PRC and the TA.

4.1.2 Participation in the installation of national segments of SADC-HYCOS

Personnel of the NHSs carried out field installation of DCPs with assistance from members of the PRC (Lesotho, Botswana, partly Malawi, South Mozambique, Swaziland and Zimbabwe) or TA (Angola, partly Malawi, Northern Mozambique, Namibia, Tanzania and Zambia). The participating countries provided funding for the civil works, which were carried out by NHSs before installation of the DCPs.

Assessment:
There were delays in carrying out the required civil works before installation of DCPs, particularly in Angola, Lesotho, Mozambique and Namibia. The reaction was

not very fast in some countries and there were delays in allocating the necessary funds for carrying out the civil works. Angola and Mozambique initially had problems in securing such funds. Most of these civil works took much longer than expected, even though they involved limited actions such as digging narrow trenches or building small shelters for instruments. The result was a delay in the DCP installations in many countries. It has to be pointed out here that one reason for the extension of the project was the slow rate of the DCP installation.

4.1.3 Undertaking normal hydrological field operations

Normal hydrological field operations are undertaken by all participating countries but, in most of them, not as regularly as necessary. While countries like RSA and Zimbabwe make regular field station visits, others including Angola, Mozambique and Tanzania carry out this activity on an ad hoc basis depending on availability of the required funds.

Assessment:
Regular survey of river channel cross-sections is very important in order to monitor any changes in the stability of river banks and take necessary measures. This should go hand in hand with regular review of stage-discharge rating curves, which is not the case in almost all participating countries. The failure to adhere to these practices means that the data recorded and transmitted from the field stations may be of questionable quality. The resulting national and regional databases would therefore be unreliable.

4.1.4 Undertaking field maintenance activities

Assessment:
For reasons mentioned under 4.1.3 above, most of the countries have not been undertaking routine maintenance of their field stations. Nevertheless, when problems regarding the functioning of the DCPs are identified through satellite monitoring or otherwise, the action commonly taken is to consult the PRC or TA seeking their intervention. Further, countries have not been able to carry out maintenance work on their own, partly because the trained people did not acquire sufficient expertise to undertake maintenance work. Since there will always be a need to carry out maintenance work, training in this particular aspect is necessary.

4.1.5 Validation of data collected through the DCPs network

Each country was required to validate the data downloaded from the project web site. This exercise involves comparing the data with that collected from other means including staff gauges, automatic water level recorders and data loggers.

Assessment
Unfortunately, data validation is presently not being done. According to the NHSs this is partly because of the problems experienced with the project web site, and also due to delay in collecting data from the conventional chart recording or gauge plate stations which would have been used for checking and verifying the data from the DCPs.

The reasons assigned by the NHSs are not convincing since collecting hydrological data from stations is a basic operational hydrology activity of NHSs. It appears the NHSs have not attached much importance to validation of the data. It is therefore recommended that the NHSs undertake this activity without delay in order to give credibility to data in the Regional Database. The RDB, which is the physical cornerstone and the heart of the data exchange and dissemination system, is supposed to consist of validated data collected through the SADC-HYCOS network, but is currently made up of raw data.

It has to be noted that use of data from this database involves some risk, since its validity has not been ascertained yet. Much as some of this data may be valid in its present state, this has to be verified through comparison with data obtained through other means. It is well understood that hydrological data from the RDB would be used in the design of various water resources projects. It would therefore be risky to invest huge amounts of funds in infrastructure on the basis of non-validated data.

4.1.6 Facilitation of utilisation by the project of existing national facilities

Assessment
All countries made their existing facilities readily available to the project. The facilities included office space, vehicles and plants. Also, computers and accessories, telephone, fax, e-mail and Internet installations were made available to be used for data exchange and dissemination.

4.1.7 Participation in the workshops, attachment programmes, etc. organized by the project

Assessment
The countries were ready and willing to have their personnel participate in the forums, attachment programmes and other events organised as part of the project. They were actually concerned that no workshops or attachment programmes had been organized as was expected.

4.1.8 Dissemination of data to national, regional and global users

One of the project purposes was to collaborate with other national, regional and international projects and programmes in the water resources and related fields information systems in the SADC and at the international level. One means was to disseminate the data according to the agreements established by SADC.

Assessment
It has been realised that, so far, there have been very few requests for data either from within or outside the SADC Members. In assessing this situation, the evaluation team considers that it might be too early to conclude that there are no, or few, users of the data and information as the RDB has been in existence for only a short time. Also, the existence of the RDB in Pretoria has not been widely publicised among potential users of the data. Chapter 6 carries a recommendation to this effect. The absence of attractive hydrological products, which might have attracted the clients to the project web site, might be another reason for this situation. It is

expected that, with time, and with availability of products of national or regional interest, data will be disseminated more than is presently happening.

4.1.9 Ensuring the security of the facilities

The security of facilities is a major concern of most of the countries, given the number of cases of theft and vandalism to the DCP equipment and instruments. Measures have been taken to ensure the security of the facilities. These include housing the instruments in concrete shelters with steel doors; electrification of security fences; solar panel mounting in concrete; stationing security guards at the stations, in some cases for 24 hours; installing burglar wires around the instruments; etc. Theft and vandalism has remained a problem in all countries, except Tanzania and Zambia, where such cases have not been recorded so far.

Assessment
Theft and vandalism are proving to be a big problem and casts a lot of doubt as to the sustainability of some of the national segments of the project. There have been cases where all the equipment on one DCP have been vandalised. Given the value and importance of the project it is essential that NHSs set aside sufficient funds for instituting security measures like the ones mentioned above.

4.1.10 National data bases

Besides the Regional Data Base maintained at the PRC, each country was required to establish its own national data base consisting of validated data from the national DCPs. Work to establish these data bases is continuing in the participating countries but, as explained already, the data is not validated. All the countries have had one or two of their people trained in data handling and they should be able to keep their data bases up to date. In the few cases where the trained personnel have left their national hydrological services, their colleagues who have been working with them should take over the databases.

4.2 Role played by the Pilot Regional Centre (PRC)

4.2.1 General

The Pilot Regional Centre (PRC) had a key role in the Project as shown by the long list of tasks (Annexture C). It was charged with implementation of the project (installation of DCPs in collaboration with participating countries), receiving and disseminating data in real time, creating a regional database and capacity building. The PRC had to serve as a focal point of a regional network grouping all the participating countries. It implemented the project under the supervision of WMO and with the support of Technical Assistance and of WMO.

Assessment

All the countries visited have rated the performance of the PRC in the implementation of the project high. According to Botswana, "they came every time they were asked.

Lesotho said, "the PRC did a good job. They were always available to assist in case a problem arose". There is even a feeling that they were spoon-feeding the project personnel so much so that the latter were too dependent on them.

Swaziland was satisfied with the role played by the PRC. Its only dissatisfaction was with the lack of sufficient training in the maintenance of DCPs and connection of DCP equipment for data transmission.

Although Namibia has not had many interactions with the PRC by way of installation and maintenance of DCPs, it rates the performance of the PRC as satisfactory. This assessment is based on training programmes conducted at the PRC, the PRC's efforts to improvement of the web page and its monitoring and reporting on the DCPs. Namibia has never called on the PRC for maintenance and repair of vandalised or damaged DCPs, because it was under the impression that such maintenance and repair work was the responsibility of Namibia and the TA. The PRC, however, on its own initiative, has assisted Namibia to install the outstanding DCP station and carry out maintenance of stations that are recording and transmitting data.

Zambia is convinced that the PRC has the right calibre of personnel with the requisite expertise and skills to adequately play the role of hosting the PRC. Zambia would however wish to have more training for technicians in the maintenance of DCPs, programming or connecting DCPs to transmit data and in electronic instrumentation in general.

Below are the tasks performed by the PRC

4.2.2 Preparation of final list of SADC-HYCOS DCPs installed

The PRC reviewed the list of the 96 stations proposed by the participating countries, on the basis of which it proposed and presented, at the SADC-HYCOS initial technical meeting held in Pretoria 20-23 April 1998, a list of 50 stations. This list was discussed, a number of changes made, and a second proposal was finally approved by the participating countries, in a spirit of regional co-operation and collaboration. This list was subsequently approved by the SADC Water Resources Technical Committee (SADC WRTC).

4.2.3 Preparation of a draft implementation plan for SADC-HCOS

The PRC, with assistance of the TA, drafted the implementation plan for SADC-HYCOS, which included the final list of stations as agreed at the initial technical meeting. This plan was submitted to the SADC WRTC for approval.

4.2.4 Arrangements for the inclusion of SADC-HYCOS DCPs in the METEOSAT DCS

METEOSAT being a meteorological satellite, data transmission from the DCP using METEOSAT is currently free for international projects, which come under the auspices of WMO. The PRC, in association with WMO, assisted the countries to fill out the EUMETSAT Admission Forms for each DCP that was included in the METEOSAT Data Collection System (DCS). The technical part of the form was filled by PRC and TA before being sent by WMO to the Permanent Representative (PR) of each participating country for agreement and signature.

4.2.5 Assistance to the National Hydrological Teams (NHT) in the installation, operation and maintenance of the DCPs

As indicated in 4.1.2 the PRC assisted the NHT in Lesotho, Botswana, Swaziland and Zimbabwe in the installation of DCPs. Later, by agreement with TA, PRC took over the installations in Malawi and Mozambique. Prior to this activity the NHT had been trained in the installation, operation and maintenance of DCPs at the PRC by the manufacturer of the DCPs and by TA. The PRC prepared and organized with the participating countries the missions for the TA.

Assessment

The PRC has been actively involved in the operation and maintenance of DCPs in the above-listed countries. Whenever faults were detected through the server at the PRC, the respective countries were quickly notified of the faults and instructions were given on how to rectify the problem. If the problem persisted then a technician would travel to the country concerned in order to fix the problem. Maintenance of this kind involved adjustments to the instruments at the DCP, replacement of a malfunctioning part or complete replacement of the DCP. PRC had to utilise Imprest Funds to purchase replacement parts lost through vandalism, the floods etc. On many occasions, the problem was detected by the NHS, in which case the PRC was called upon to go and fix the problem.

4.2.6 Maintenance and operation of the METEOSAT DRS

The server, which has been handling all the data from the SADC-HYCOS DCPs, was purchased and installed at the PRC. The METEOSAT Direct Receiving Station (DRS) has been maintained and operated by the PRC.

4.2.7 Dissemination in real-time or near real-time the raw data received from the DCPs to all participating countries

The raw data received from the DCPs was supposed to be disseminated in real-time or near real-time (same day) to all participating countries, using all possible existing means including the Global Telecommunication System (GTS) of WMO. Data transmitted through the GTS would be received by the national meteorological services (NMSs). Since NMSs and NHSs belong to different bodies in all the participating countries, agreements and investments for the transfer of data from NMSs to national agencies in charge of the national segments of SADC-HYCOS would have had to be established. This would have been cumbersome and time consuming. It was therefore decided to disseminate the data via satellite. The PRC established the SADC-HYCOS web site through which each participating country would be able to download the data.

Assessment
Operation of the web page did not start until September 2000 and, initially, had a terribly slow response, and with lots of clicks required accessing the required information. It was towards the end of the project that the web page started functioning well.

4.2.8 Daily monitoring of DCPs

Assessment
The DCPs were monitored daily by the PRC and the national agencies in charge of the SADC-HYCOS were notified immediately of any problems detected.

4.2.9 Development and implementation of reliable regional data dissemination and exchange systems

Assessment
The PRC participated in the development and implementation of regional data dissemination and exchange systems among the national hydrological bodies and between them and the PRC. Details of the execution of this task are given in 3.2 above.

4.2.10 Development and implementation of a regional operational data base

The PRC participated in the development and implementation of a regional database for the raw data collected from the SADC-HYCOS network. The details of the execution of this task are given in 3.4 above.

Assessment
The PRC appointed a data base administrator to ensure that the project database was operational all the time. This arrangement has greatly increased the reliability and accessibility of the RDB.

4.2.11 Exchange and dissemination of the data at the regional and international levels

The PRC had to organize, in agreement with the participating countries, the exchange and dissemination of the data collected by the SADC-HYCOS network at the regional level. Details of the execution of this task are given under 3.2 above. As regards the exchange of data at the international level, when a foreign country or agency requests for data of one of the participating countries, the PRC has first to request for the consent of the country concerned before data is issued to the requestor. An example was when the United States Geological Survey (USGS) requested for Mozambican data. The data was issued to the USGS after PRC obtained approval of Mozambique.

4.2.12 Development, management and implementation of the training programme

The PRC, with assistance of the TA, and in co-ordination with SADC and WMO, developed and implemented the training programme to support the implementation of the project. Details of the training programme are discussed under 3.6 above.

4.3 Role played by the Technical Assistance

4.3.1 Preamble

The work programme and itinerary of the evaluation mission did not include a visit to Technical Assistance at the Centre for Ecology and Hydrology (CEH), Wallingford, UK. Hence, there was no opportunity to interview the TA staff. Therefore, the evaluation of the TA has been based on the progress reports prepared by TA Consultants, information obtained during the visits to the PRC, SADC/WSCU and some of the participating countries, as well as other relevant documents collected in the course of the mission.

4.3.2 General

The Technical Assistance (TA) consultants were responsible for a range of tasks as summarised in Annexture C. The main role of TA was to assist the PRC to implement the SADC-HYCOS project. However, they had sole responsibility for two tasks:

- Development/improvement of a regional electronic network,
- Organization of the use of the existing segments of the Global Telecommunications System (GTS) for data exchange and dissemination.

In addition, the TA were primarily responsible for:

- Assisting the PRC and the participating countries with implementation of the Regional Data Base
- Support to the PRC in the organization of training activities

4.3.3 Assistance to PRC with the preparation of the implementation plan

Preparation of the implementation plan of the project was essentially done during the Initial Technical Meeting held in Pretoria from 20 t0 23 April 1998. TA attended the meeting and provided input in the discussion and amendment of the plan.

4.3.4 Assistance to the PRC and the countries for the implementation of the SADC-HYCOS network of DCPs

The TA, in collaboration with WMO, assisted the PRC to arrange with EUMETSAT to allow the DCPs to make use of the METEOSAT Data Collection System. Then, the TA consultants together with staff of PRC, supported the staff from SERPE-IESM of France, the equipment suppliers, in conducting a two-week training course in Pretoria from 29 June to 10 July on the DCP equipment.

Staff of CEH, Wallingford, assisted the NHSs of some of the participating countries in the implementation of the DCP network. Preliminary site visits were made to Malawi, Mozambique, Tanzania and Zambia. These TA staff then assisted the countries in the installation and commissioning of the following number of DCP equipment: 2 in Angola, 2 in Malawi, 4 in Namibia, 5 in Tanzania and 4 in Zambia. Details of the DCP installation in these countries have been discussed under 3.1.

4.3.5 Assistance to the PRC and the countries for the development and implementation of the Regional Data Base

Development and implementation of the Regional DataBase has been narrated under 3.4 above.

4.3.6 Development/improvement of a regional electronic network

Work carried out under this task has been recorded in 3.3.

4.3.7 Support to the PRC and the countries for the use of the RDB for the preparation of hydrometeorological products

Assessment
As recorded in 3.5 above, hydrometeorological products were not prepared as expected.

4.3.8 Support to the PRC for the organization of training activities

Assessment
The TA participated in developing, organizing and conducting the training programme. Details, including the areas on which training was provided, are reported in 3.6 above.

4.3.9 Organization for the use of existing segments of the Global Telecommunication System(GTS) for data exchange and dissemination

During a meeting in Pretoria in April 2000 attended by TA, PRC, SADC-WSCU and EU representatives, it was agreed that the GTS was unlikely to offer the project any real advantages. The matter was subsequently discussed during the second SADC-HYCOS Steering Committee Meeting held in Johannesburg in September 2000.

It was agreed that the Internet and email links would provide participants with the most effective means of exchanging data between their national offices and the PRC and between countries having common interests in data on international river basins. Consequently, it was agreed that there should be no attempt to utilize the GTS facilities within the project, and the sub-contract between TA and WMO for provision of this service was terminated by mutual agreement.

4.4 Role played by the World Meteorological Organization (WMO)

4.4.1 Preamble

The work programme and itinerary of the evaluation mission did not include a visit to the World Meteorological Organization (WMO). Therefore, the evaluation of WMO is based on the discussions on the project the evaluation team had with WMO staff before the mission started. Other sources of information included the six-monthly reports prepared by WMO; information obtained during the visits to the PRC, SADC/WSCU and some of the participating countries; as well as relevant documents provided by the WMO staff and others collected in the course of the evaluation mission.

4.4.2 General

The role of WMO was to supervise and facilitate the implementation of the SADC-HYCOS project and to provide a technical and scientific support to the PRC and to the participating countries. WMO with its World Weather Watch Programme (WWW) has a long experience in the exchange of environmental data at the global, regional and national levels, which could be used for the benefit of the implementation of programmes for exchange of data such as the one included in the SADC-HYCOS Project. The specific roles of WMO are listed in Annexture C.

WMO signed an agreement with EU, on 27 March 1997, for the "Monitoring and Supervision of SADC-HYCOS project".

4.4.3 Evaluation of tenders

Following SADC invitation to tender for both services (Technical Assistance) and supplies contracts (Tender No. 4193), WMO carried out the following activities:

1. A review and evaluation of the following offers received from SADC WSCU after opening of tenders which took place in Maseru, Kingdom of Lesotho on 25 February 1997.

   (i) Supplies: SERPE IESM and CIES TM (France), Space Technology Services (United Kingdom), SAINCO (Spain) and SEBA Hydrometrie (Germany). The offer by OTT Messtechnik GMBH from Germany, which had been rejected at the opening of the tenders in compliance with article XV of the Special Regulations, Part A of the invitation to tender; was not considered by WMO.
   (ii) Services: Bundesanstalt für Gewässerkunde (Germany), Aquater (Italy) and Institute of Hydrology (United Kingdom)

2. Preparation of an Evaluation Report.

3. Participation in the meeting of the Evaluation Committee convened by SADC WSCU in Pretoria, South Africa, on 4 and 5 April 1997.

4. Advising SADC WSCU for the awarding of the Technical Assistance contract, contacts and discussions with EU and the Pilot Regional Centre in Pretoria.

5. Participation in the second meeting of the Evaluation Committee convened by SADC WSCU in Maseru, Lesotho, on 25 July 1997 to re-evaluate the offer made by AQUATER.

6. At the request of the European Commission (EC) Delegation in Lesotho, WMO prepared:

(i) An Annex to the letter of contract which include the detailed list of equipment and services to be provided by SERPE- IESM, and the summary price in Loti (the currency of Lesotho).

(ii) An Explanatory Note for the File.

7. As a follow up to an independent re-evaluation of the tenders for the Technical Assistance (TA) which was requested by EC, the tender procedure was annulled. Therefore, WMO participated in the meeting for the direct negotiation of the TA contract between SADC and the Institute of Hydrology (IH) and ORSTOM, held on 26 and 27 March 1998 in Maseru, Lesotho.

4.4.4 Liaison with/visits to EUMETSAT and Contractors

After the awarding of the supplies contract to SERPE IESM (France) WMO, at the request of the SADC-WSCU, got in touch with the manufacturer for the preparation of the contract for the delivery of equipment. For that purpose WMO undertook the following activities: -

1. Mission to SERPE IESM premises in Guidel, France, on 4 and 5 September 1997. The details of the procurement were discussed and agreed upon with the manufacturer. The report of this mission was sent to SADC WSCU on 17 September 1997.
2. Preparation of a Memorandum of Understanding (MOU) that was attached to the Letter of Contract for the supply of equipment for the SADC-HYCOS project. The MOU was sent to SADC WSCU on 21 November 1997.

Other activities undertaken by WMO under this task:

- WMO undertook the supervision of the Factory Acceptance tests, which were conducted by SERPE-EISM, and representatives of the SADC-HYCOS Pilot regional Centre (PRC), in Guidel, France, from 18 to 26 May 1998.

- Following the agreement by the SADC Water Resources Technical Committee (WRTC) in May 1998 of the list of stations to be equipped, WMO carried out the following tasks:

(i) compilation of the EUMETSAT Admission Forms received from the countries for the 50 Data Collection Platforms (DCP) to be installed by the project; and

(ii) consultation with the relevant EUMETSAT Unit for the allocation of the appropriate addresses, channels and time slots for the DCPs.

4.4.5 Project monitoring

As the supervising agency for the project and technical and scientific advisor to SADC and the PRC, WMO: -

(i) Participated in the Initial Technical Meeting organized by the PRC in Pretoria, South Africa, from 20 to 23 April 1998;

(ii) Reviewed the activity reports prepared by the PRC and TA; and

(iii) Participated in the last Steering Committee meeting of the project, which was held in Johannesburg (21-22 September 2000).

4.4.6 WMO missions to PRC and the countries

The first mission was carried out from 25 February to 5 April 1997. More missions were carried out during the dates 15 to 26 February 1999, and 25 April to 9 May 1999. During the latter visit an Evaluation report on the status of the implementation of the SADC-HYCOS project was prepared and later submitted at the SADC Water Resources Technical Committee which met in Luanda, Angola on 10 May 1999. Another mission was carried out from 15 to 26 February 2000 to the PRC, which included field visits to Lesotho, Swaziland and RSA with officers of the respective NHSs. A planned visit to Zimbabwe was rendered impossible due to the floods.

In the follow up to the floods, which in February-March 2000 affected the Central and Eastern parts of the SADC region (RSA, Zimbabwe, Swaziland and especially Mozambique), WMO participated in the technical workshop on the Mozambique Floods (Maputo, 7-11 August 2000) and in the International Conference on Mozambique Floods (Maputo, 23-30 October 2000). During these two events WMO promoted the role played by some HYCOS stations and by the overall project in the flood forecasting. WMO was in charge of the organization of one of the technical sessions of the International Conference and ensured that a presentation was made, by the PRC coordinator, on the SADC-HYCOS project achievements.

In conjunction with one of the missions to Mozambique, a technical review of the PRC was carried out from 12 to 16 August 2000.

4.4.7 Preparation of six-monthly and final reports

Six-monthly reports were prepared; the latest dated 31 march 2000. The evaluation mission could not come across any WMO report prepared after that date. WMO has not yet submitted the draft final and final reports. The evaluation team has learnt that preparation of the reports is awaiting the terminal report of the TA, which has not been submitted yet.

4.4.8 WMO inputs to the evaluation process

WMO prepared the ToR of the evaluation mission in consultation with SADC/WSCU and after an iterative process with EC-Brussels. Also, WMO compiled some of the reference material for the evaluators.

4.5 Role played by SADC

4.5.1 Preamble

Until 1996, water resources issues within the SADC member states were co-ordinated by the Environment and Land Management Sector (ELMS). In August 1996 a new sector dedicated to the water resources management of the region, the Water Sector, was created. It is under this sector that the implementation of the SADC-HYCOS project has been monitored and co-ordinated. The Water Sector Co-ordination Unit (WSCU) was established in the Ministry of Natural Resources of the Kingdom of Lesotho.

The SADC WRTC reviews projects and related issues, makes recommendations to the SADC Council of Ministers for action, which makes further recommendations to the SADC Summit of Heads of State or Government for those issues which require regional agreements or Government commitments.

SADC was the Contracting Authority of the project. It facilitated the smooth implementation and the review and evaluation of the project.

4.5.2 The project document

The project document, which had been prepared by WMO, was reviewed and ultimately accepted by SADC through its WRTC.

4.5.3 Selection of the host institution for the PRC

A precondition to the start of the project was the selection by the SADC member countries of the host institution for the Pilot Regional Centre, which would play a vital role in the implementation of the project. At a special meeting held in Pretoria, South Africa on 1st and 2nd February 1996, and on the basis of the recommendations prepared by a mission fielded by EU and SADC to the candidate host institutions, the SADC-ELMS Water Resources Technical Committee (WRTC) identified the Department of Water Affairs and Forestry (DWAF) of South Africa as the most suitable institution to host the PRC. Following that, the SADC Committee of Ministers of Food, Agriculture and Natural Resources decided, in Maseru, Lesotho, in June 1996 that the PRC would be located within the DWAF to facilitate effective and efficient implementation of the project.

4.5.4 Reaching agreements with co-operating partners

SADC discussed and reached agreements with co-operating partners on the financial and technical assistance for the implementation of the project. A Memorandum of Understanding (MoU) for the establishment of a Pilot Regional Centre for the SADC-HYCOS was signed between the SADC Water Sector and DWAF. Another MoU for the Technical Assistance Consultancy was signed between the SADC Water Sector Co-ordination Unit and the Institute of Hydrology and ORSTOM.

4.5.5 Approval of SADC-HYCOS stations

The final agreed list of gauging stations for the locations of the 50 DCPs to be installed by the SADC-HYCOS project was approved by the SADC WRTC at the meeting held in Zambia from 4 to 8 May 1998. The 50 stations were selected from a list proposed by the participating countries.

4.5.6 Facilitation of delivery of project equipment

The SADC WSCU laid the groundwork for delivery of equipment from the suppliers to the individual participating countries. The WSCU also intervened whenever problems arose, like the case of Mozambique where clearing of project equipment from the customs took a long time.

4.5.7 Facilitation of country visits by the TA

The SADC WSCU made arrangements for visits by staff of the Institute of Hydrology and ORSTOM to the participating countries in order to assist in the installation of DCPs and training in the use of HYDATA software.

4.5.8 Chairing of project review meetings

Meetings held to review the progress of project implementation were chaired by SADC.

4.5.9 Monitoring and co-ordination of the project's implementation

The SADC Water Sector through its WSCU in Maseru, undertook the overall responsibility of monitoring and co-ordination of the project's implementation. It approved for payment the work done by different parties involved in the project.

4.5.10 Review and evaluation of the project

Through the WRTC and WSCU, SADC reviewed the progress of project implementation and made the required interventions whenever necessary. Terms of Reference for evaluation of the project were prepared in consultation with WMO and under the auspices of SADC. The WSCU facilitated the evaluation process by providing the evaluation team with the required material as well as logistical support, which included arrangements for, travels and meetings in the countries visited.

4.5.11 Preparation of progress reports

Relevant project progress reports were prepared by the WSCU.

4.6 Technical Capacity of the Pilot Regional Centre (PRC)

The Department of Water Affairs and Forestry of South Africa was selected to host the PRC for the project. The primary role and responsibility of the PRC, as outlined in the SADC-HYCOS project document is liaison, co-ordination and initiation, through activities in monitoring, networking, training and assistance for the

successful implementation of the project. The main tasks of the PRC are detailed in Annexture C.

To be able to carry out the tasks assigned to the PRC the DWAF allocated the following staff to the project:

- Mr. Stefan van Biljon, Director of Hydrology - PRC Co-ordinator
- Mr. Felix Wulff, Deputy Director - HYCOS Programme Manager
- Mr. Hannes Calitz, Senior Industrial Technician
- Mr. Gerhard Booysen, Consultant (Information Technology)
- Mr. Graeme Mostert, Auxiliary Services Officer.

Assessment
Prior to the HYCOS project, the PRC has had considerable experience with installation and operation of DCPs and telemetry. It is currently contributing about 57 stations from its own resources to the SADC-HYCOS project.

The calibre of staff committed to the project is high and have generally discharged their obligation satisfactorily. The PRC has discharged its functions creditably, as well as, carried out successfully its main tasks as defined in the project document and as described under 4.2 above. From responses received from all the participating countries interviewed concerning the performance of the PRC, all the countries gave the PRC a high performance rating and expressed support for the PRC to continue with the task in the second phase of the project.

From the performance of the PRC in the pilot phase of the project and the general expression of satisfaction by the participating countries interviewed, the evaluation team concludes that the technical capacity of the PRC is adequate and satisfactory and is also well placed to continue to exercise the role of a regional centre in a future phase of the project.

4.7 Sustainability of the Project

The issue of sustainability of the project, once the external support will come to an end, is very important. Sustainability will, to a large extent, depend on the continued operation and maintenance of the DCPs, collection of field data, maintenance of the regional database and web page, availability of sufficient financial resources and logistics and continued availability of human resources within the NHSs of the participating countries. In addition, the sustained interest and commitment of the participating counties will be a very important element towards sustainability of the project. This commitment could be secured by demonstrable benefits that the countries could obtain from the project. Some of these benefits include timely availability and accessibility to data for flood and drought forecasting and warning and water resources management; hydrometeorological products of relevance to the countries and at regional level, training opportunities for staff of NHSs and improved performance of the NHSs to meet the needs of their countries.

4.7.1 Operation and Maintenance of DCPs

With the exception of Tanzania and Zambia, the rest of the countries interviewed during the evaluation reported that DCPs have been vandalised at more than one

site. The acts of vandalism are mainly removal/stealing of solar panels and batteries from the DCP housing. Originally, these acts of vandalism had not been expected. The participating countries and the PRC have, since experiencing vandalism, gone to great lengths to safeguard the DCP equipment as described under 4.1.10. Besides those measures local communities have been involved through creation of awareness to be watchdogs for the DCP installations. Besides securing the equipment, the availability of spares to repair vandalized or damaged equipment and, in some cases, replacement of DCPs have so far been effectively ensured by the PRC. The participating countries are apprehensive of the cost and difficulty in procuring spares and DCPs from Europe if the stock being held by the PRC should run out. They are of the view that a supplier within the SADC region might offer a more cost-effective option and would like the PRC with its expertise to investigate this possibility.

Assessment
Though it is acknowledged that the PRC is providing very useful support for maintenance and repair of DCPs, the evaluation team considers that the building of in-country capacity for maintenance and repair of DCPs will contribute immensely to sustainability of the project. Towards this, it will be useful for the PRC and the supplier of DCPs to make available to the countries a diagnostic or trouble-shooting manual on maintenance and repair of DCPs as a first step to building the in-country expertise. It is also worth considering committing some of the unutilised funds earmarked for training activities to further training in maintenance and repair of DCPs.

4.7.2 Field Data Collection

Assessment
One major pre-requisite for continued field data collection and therefore sustainability of the project is the continued access to the WMO METEOSAT satellite. From the project document, the involvement of WMO in the project as supervisor and provider of technical and scientific support, combined with ownership of the WHYCOS concept by WMO, it can be safely concluded that the METEOSAT satellite will continue to be available to the project. Beyond the technological infrastructure such as DCPs and satellite for collecting and transmitting the data, the contribution of the countries in monitoring field equipment, downloading data from the stations, quality control of data collected from the field and updating rating curves are essential elements to ensuring field data collection. There is strong evidence in 7 out of the 8 countries interviewed that these activities are going on and a commitment that they will continue. The only exception is Namibia, which is seriously handicapped by lack of personnel. It was noticed that each country had only one reader for downloading data from the loggers without any back up. A back-up reader for each country will ensure uninterrupted transfer of data from the field for archiving.

4.7.3 Regional Database and Web Page

One of the main objectives of the HYCOS project is the sharing of hydrological data and information on real time or near real time basis. The vehicle for delivering such data within the SADC-HYCOS project is the combination of the regional database (RDB) and the web page. The RDB and the web page have been successfully established under the SADC-HYCOS project. However, one important aspect of the RDB has not been realised. The validation of data, which is expected to give credibility to data on the RDB, is not being done, for reasons given under 4.1.5. Significantly, even those countries, which are able to download the data without any difficulty, are also not validating the data. It is clear from the above that sufficient importance has not been attached to validation of data for the RDB.

Assessment
The evaluation team sees this as a serious omission in the maintenance of the RDB. To build confidence in the RDB, the validation of the data by the participating countries must be carried out regularly. It may be necessary to task the web page master at the PRC to take the staff of NHSs through the procedure on location in their countries. This will have the added advantage of correcting any problems with the configuration of their computers and/or advising on their data quality control procedures. Development and adoption of a standardised procedure for validation of data, including frequency of validation, will be useful and is strongly recommended. It is also recommended that the NHSs immediately validate data currently in the RDB, since this requires minimum effort to achieve.

4.7.4 Development of Hydrometeorological Products

Assessment
As pointed out under 3.5 the hydrometeorological products were not delivered by the TA as should have been expected. The essence of hydrological data is the use to which they are put. In this context, the development of hydrometeorological products of national and regional interest from data obtained from the project and other data sources in the sub-region such as the FRIEND and ARIDA projects should be considered as an important output capable of securing the commitment of the participating countries in the project. The benefits of such 'value added' products to the countries justify the allocation of resources, as well as, make a strong case for budgetary allocations for sustaining the project in future. The utilization of such products and data for flood and drought warning for public safety, water resources management and overall socio-economic development gives credence to using water as a tool for regional integration in the SADC Region. Thus the development and use of hydrometeorological products should be seen as a major outcome that can positively impact the sustainability of the project in future.

4.7.5 Budgetary Allocation

In response to a directive by the SADC Council of Ministers, the NHSs of all the participating countries visited are making provision in their budgets for the SADC-HYCOS project. The levels of actual budgetary allocations by governments, however, do not always meet the expectations of the NHSs. The shortfall in

budgetary allocations delayed the execution of civil works at gauging sites in some countries during the field installation phase of the project.

Assessment
Some countries have, but others do not have, adequate budgetary allocations to meet the cost of routine monitoring of river gauging stations and other logistics. Others have insufficient ground transportation. A bigger concern is that all the countries have reservations about receiving adequate budgetary allocations to meet the costs of spares for DCPs vandalised or damaged and complete replacement of DCPs, if the PRC runs out of stock of spares and DCPs. The NHSs of the participating countries should be proactive and start including costs of DCPs and their spares in their budgets and in projects that could benefit from the SADC-HYCOS project. With the present number of installed DCP stations in each country, the level of budgetary allocations for routine monitoring of stations is not considered a serious risk to sustenance of the project, so long as the budget of NHSs are not encumbered with the costs of DCPs and their spares.

4.7.6 Training

Assessment
It has been realised that the training received by the countries' personnel was commonly inadequate. Training and more importantly, development of in-country capacity within the participating countries are a key objective that needs to be achieved to sustain the project. It is therefore recommended that future training in follow-up activities or phases of the project should focus on providing in-country capacities to ensure sustainability of the project.

4.7.7 Human Resources

Assessment
With the exception of Namibia, which is facing serious shortage of manpower, the remaining 7 countries visited and the PRC have sufficiently trained personnel to sustain the pilot project. The threat of losing such staff to the private or other parastatal organisations exists. Some could also be lost temporarily by leaving for further training, re-assignment or career progression within their organisations. Namibia has already lost two of the three persons trained for the project; there is only one hydrologist trained for the project left. It has however recruited new staff who are being trained on the job. Namibia may therefore need some special attention and support from the PRC if the country is to remain an effective component of the SADC-HYCOS network.

Staff of the PRC has acquired considerable experience and is very highly motivated to ensure sustainability of the project. The PRC has given the assurance of the availability of its staff to continue with the project. To forestall the loss of essential personnel for the project, it will be necessary for countries to involve more of their personnel in the project, other than those specifically trained for the project and trained on the job. Such cross training should be encouraged. Some countries are doing this already.

4.7.8 Evaluation summary

On the whole, the present arrangement and level of achievement of the project can ensure the sustainability of the project. The continued access to the METEOSAT satellite and the preparedness of the PRC to continue with its role, which are critical to sustenance of the project are guaranteed. Certain aspects of the project, such as, in-country capacity to maintain and repair DCPs, acquisition or provision of back-up data logger readers, validation of data by the countries, ensuring availability of spares for vandalised or damaged DCPs and allocation of trained staff to the project need to be addressed. It is the view of the evaluation team that the countries and the PRC, with a little bit of support from the funding agencies and SADC are capable of addressing these shortcomings. Towards this end any unutilised resources from the original budget of the project may be committed to support the project and ensure its sustenance.

5. SALIENT ISSUES AND LESSONS LEARNT

The issues elaborated below are some of the prominent lessons learnt in the course of implementation of the project. Most of them are a result of the analysis of deficiencies noted from the technical, institutional and managerial aspects of project implementation. Some sustainability issues that need to be wary of have been pointed out. The evaluation team has also taken an in-depth look into some institutional arrangements and the weaknesses thereon.

5.1 Technical issues

(i) The SADC-HYCOS project has exposed the NHSs to new and modern technologies and given the staff the benefit of upgrading their skills thereby giving them job satisfaction. It has provided them with the opportunity to rehabilitate broken-down stations, receive data from inaccessible areas and access basin-wide data from shared basins. Some countries have experienced real time data transmission for the first time.

(ii) There were cases where stations failed to operate for trivial reasons. These include cables being damaged by rats (e.g. in Namibia); the solar panel being obscured by a tree, preventing battery re-changing (e.g. Malawi); and poor alignment of the antenna.

(iii) Site conditions and short sensor cable lengths prohibited installation of downstream water level and conductivity sensors at some sites.

(iv) The flow of information between the PRC and the participating countries didn't go as anticipated due to the late arrival, slowness and sluggishness of the web page.

(v) Due to the limited budget of NHSs the cost of the project proves to be high. Despite this, all the countries expressed their support for the project and its second phase.

(vi) Representatives of NHSs who received training on various aspects of project implementation did not train their colleagues back home, as was expected.

(vii) Most of the people who were trained at the PRC on the installation of stations had to wait a long time before undertaking the actual installations in their countries. Because of this delay, most of them had forgotten the skills taught to them in Pretoria.

(viii) The time taken to train representatives of NHSs in the different activities related to the project implementation was too short. As a result, many of the countries are unable to maintain their DCPs.

(ix) The planned one-month attachment programmes at the PRC for one person from each of the participating countries were not implemented. This activity was important, as it would have exposed the participants to continuous involvement with the RDB and the website.

5.2 Institutional and managerial issues

(i) Project take-off was delayed due to late appointment of TA and also due to EU's strict tendering procedures.

(ii) The expectations of the SADC/WSCU is that the SADC-HYCOS project, in addition to conforming to the concept and meeting the objectives of the original WHYCOS project as outlined in WMO documents, should also meet the overall development goals of SADC and the objectives of the Regional Strategic Action Plan of SADC. It is also the expectation of the WSCU that the project will address the concerns of the various countries in the region.

(iii) Many of the participating countries were not happy with the assistance given by TA. Some of the views of the countries visited are quoted below:-

"They were not always available when needed."
"They would promise but not deliver."
"Sometimes they failed to attend meetings when called."
"They were enthusiastic at the beginning but lost tempo as time progressed."
"They could have done more."

(iv) Some countries wondered whether there was a real need to have the services of the TA when the tasks of the TA were just to assist the PRC in the

implementation of the project. The evaluation team supports this view, as some of the activities of TA were actually taken up by the PRC.

(v) Some of the project funds have not been spent. This includes funds for field installations; training; airfares for TA, PRC and NHS staff; sub-contract for provision of GTS facilities; and for contingencies.

(vi) From interviews conducted, the evaluation team gathered that SADC WRTC played the role of the steering committee for the project. However, this Committee did not function effectively. This body was to monitor and evaluate the outputs of the parties under contract and set targets and deadlines. Absence of this function provided avenues for overlooking or non-performance of certain tasks, as is the case with some training activities and development of hydrological products of national and regional interest. So the fairest conclusion would be to say that the steering process of the project was more formal than operational. An effectively functioning steering committee should have been aware of neglected activities like non-validation of data by NHSs and inability to access data on the RDB and called for their rectification. Such unachieved components should have been picked and redressed before the end of the pilot phase. The absence of a functioning steering committee or a body within the institutional arrangement to 'wield the big stick' was a serious flaw in the implementation of the project and partly contributed to non-realization of some components of the project.

The Project Steering Committee met 3 times (in 1998 at the inception of the Project, in Luanda in 1999 and in Johannesburg in September 2000). The evaluation team did not get reports of the two last meetings. If decisions were taken at those meetings, there was no document usable for an evaluation process to crosscheck the decisions with what has been actually achieved.

(vii) The arrangement of having a TA to support the PRC under the overall technical supervision of WMO in theory can ensure the technical achievement of the project. What was however missing was a mechanism to certify that the set targets and deadlines have been met before payment was made to the contractors. The technical supervisor (WMO) had no input in the processing of invoices submitted by TA for payment. Such a certification by the technical supervisor would have ensured acceptance of the results and that the set targets were met before payment was made. In the absence of such certification of the TA's invoice by the technical supervisor, processing of TA's invoices by SADC/WSCU amounts to endorsement without prior certification. A similar mechanism exercised by a steering committee for the other contractors would have ensured that tasks assigned to the contractors were carried out in full and also guaranteed more achievement under the project.

6. RECOMMENDATIONS

(i) The first phase of the SADC-HYCOS project should be consolidated. This should include, in particular, an implementation of all the outstanding tasks, including preparation of products of national and regional interest. Since the objective is to have an operational system for collecting and disseminating hydrological data and information at the regional scale, the logical way forward is no other than build on the foundations of Phase One. In all, it is necessary to nurture the project beyond the pilot phase in order to realise the huge potential that the project has in making water a tool for socio-economic development and meeting the developmental goals and objectives of the Regional Strategic Action Plan of SADC.

(ii) Member countries should take complete ownership of their equipment that was made available under the SADC-HYCOS project. This is to ensure that they are accorded due consideration when it comes to allocation of resources required for their operation and maintenance. National budgets should necessarily include funds for this purpose.

(iii) Outstanding stations that were planned for installation but were not constructed during the first phase of the project should be installed as soon as possible.

(iv) Countries should make use of their passwords to download data of other participating countries when needed. Measures to improve on regional data exchange and dissemination should be taken immediately.

(v) As a necessity, follow-up training must be conducted in the following areas:
- Operation and maintenance of DCPs
- Programming of DCPs for data transmission
- Data quality and validation

- Internet and website

(vi) Efforts should be made to ensure uninterrupted operation and data transmission of the DCPs. A diagnostic/trouble-shooting routine for DCPs should be made available to each of the NHSs to ensure that they are no longer dependent on the PRC for operation and maintenance of the stations.

(vii) All participating NHSs should start and maintain the validation of data received through the project web site.

(viii) Countries should step up measures to fight vandalism and ensure security of the DCPs.

(ix) The TA has to submit, as soon as possible, a financial statement that will elaborate on unused project funds.

(x) The existence of the Regional DataBase should be made known to as many potential users of the hydrometeorological data and information as possible.

(xi) The project could be made more affordable by procuring equipment and spares from within the SADC region.

(xii) At this stage of the project, the potential benefits of the project have been more amply demonstrated. The technical feasibility of the project and the ability of NHSs to cope with this new technology have been established without doubt. However, for the project to meet the developmental goals of SADC and the objectives of the Regional Strategic Action Plan of SADC, it is unlikely that the present network of stations in the pilot phase can provide the necessary data and information to meet the above aspirations. It is therefore strongly recommended to expand the network of stations in a second phase to produce the needed data to promote water as a tool for socio-economic development and to meet the needs of the countries in the project. Another strong case for a second phase is the need to protect the investment and effort committed to the pilot phase, which has been largely successful and produced a verifiable demonstration effect within the participating countries and in the SADC region and beyond.

7. PROPOSALS FOR CONTINUATION OF THE PROJECT

(i) The project document for Phase Two of SADC-HYCOS should be prepared by harmonization of the two available documents entitled "Elaboration of Scope, Design and Budget for the Consolidation and Expansion of SADC HYCOS Phase 2", Draft Report, October 2000, prepared by the SADC WSCU through funding by CIDA; and "SADC-HYCOS Phase II, Consolidation and Expansion of the Hydrological Cycle Observing System of the SADC Sub-region", Draft Proposal, July 2001, prepared by WMO.

Going through these project proposals, it is noted that the "flavour" of Phase Two is much more "user-oriented", rather than "data collection oriented", as was the case for Phase One. It is implicitly assumed that the process of Phase One has been profitable, that the regional co-operating spirit is there, and provided that financial resources will be available and appropriate governance of the project will be put in place, the participating countries are able to achieve a region-wide data collection process and to expand and manage a common regional data base.

(ii) Putting in place all the achievements of Phase One has been challenging enough for hydrologists, technicians, etc. However, it should also be noted that the real interest of the "outer world" is the applications of these efforts, the famous "hydrological products". The list of these applications will have to be defined in detail during the first stage of Phase Two, and to make more profitable the HYCOS project, the applications should be as many as possible. Possible examples of these are applications are:

- flood forecasting in the Zambezi basin
- flood forecasting in the Limpopo basin
- wetland status monitoring
- seasonal forecasts of low flows
- monitoring of recessions during the dry season

(iii) The Project Regional Centre (PRC) is a very important party in the implementation of the regional project as it forms the centre of data collection

and dissemination. Therefore, the decision as to which regional institution should host the PRC for subsequent phase(s) of the project should be made by the SADC countries themselves, based on necessary considerations including technical and administrative capacities.

(iv) The station network under the second phase should be expanded to become more responsive to regional data needs such as for environmental monitoring, including flood and drought warning; transboundary flow monitoring; basic water management; basin inventories; etc. This will broaden the use base of the project and draw in more interest from many sectors. The stations should also be based on hydrological considerations in the basin, and should integrate into the regional network.

(v) Site selection for allocation of project stations should be done by the respective countries. The same is expected in determining the number of sensors required and transmission interval for each station depending on national and regional needs. Care should be taken to avoid locating DCPs at problematic sites in difficult terrain as this ultimately makes it impossible to install all the required probes and sensors.

(vi) Prior to installation of equipment it will be necessary to make preliminary site visits, jointly by PRC and respective country staff to plan necessary civil engineering works. Experience gained from the first phase has shown how civil works delayed the implementation of DCP installation in a number of countries

(vii) Equipment installation should be designed such as to inhibit vandalism and theft, which are rampant in many countries.

(viii) The project web page and regional electronic network should be in place and functioning well before embarking on the installation of DCPs. The delayed functioning of the web page in the first phase partly accounted for the non-validation of data.

(ix) The identified lapses in the implementation of some of the project activities can be easily corrected by putting in place a mechanism for verifying and certifying outputs of contractors before invoices are honoured, and holding contractors responsible for outputs not delivered. In future HYCOS projects, payments to be made to a contractor or any service provider to the project should base on verification of work and authorization by the Supervising Agency.

(x) The possibility of reducing the cost of the project by procuring equipment from within the SADC region should be explored. This could make operation and maintenance of stations affordable by many countries and, hence, contribute to sustainability.

(xi) The time allocated for training of project personnel should be made adequate to ensure that participants grasp all the necessary skills. This will make countries less dependent on the PRC and effectively reduce project costs.

(xii) There should be a functional Steering Committee that will make a close follow up and monitor the progress of project implementation. The Committee should identify lapses and delays and take corrective measures in time.

Annexture A

TERMS OF REFERENCE OF THE MISSION

1. Preamble

The SADC-HYCOS project, referred to hereafter as "the Project", is defined by a project document prepared by the WMO Secretariat, Geneva in July 1996. The document was approved by the SADC Water Resources Technical Committee (WRTC) in late 1996.

The Project is funded by the European Commission with an amount of 1 964 600.

Administrative problems related to the awarding of the supply and service contracts, as well as for the establishing of the Imprest Fund at the Pilot Regional Centre (PRC), delayed the start of the Project which was institutionally launched at the SADC-HYCOS Initial Technical meeting which took place from 20 to 23 April 1998, in Pretoria, RSA. The Project, initially scheduled for a duration of 2 years was extended twice, without additional resources, at the request of SADC/WSCU and WMO. The SADC-HYCOS project will terminate on 31 August 2001.

The project document stipulates (paragraph 5.1.5) that "An independent evaluation will take place in the second year of the Project. It will require appointing a consultant for 1.5 month. The consultant will visit the PRC and some of the participating countries and WMO. He will prepare a draft report along the line of a framework established in agreement with SADC and EU. This report will be submitted to SADC and EU for comments. The consultant will then prepare the final evaluation report which shall include proposals for a possible continuation of the Project".

Considering the short remaining time available, it was proposed during the fourth meeting of the WHYCOS International Advisory Group (WIAG), held in Geneva from 29 June to 1 July 2001, that the evaluation should be carried out by a team of two consultants which would divide the country visits. WMO Secretariat proposed to SADC/WSCU the names of two water resources specialists from Sub-Saharan Africa, who have not been directly involved in the Project. This proposal has been endorsed by SADC/WSCU. The experts are Mr. Datius Rutashobya, team leader (Tanzania) and Mr. Jullius Wellens-Mensah (Ghana).

The present document defines the Terms of Reference (ToRs) of the SADC-HYCOS evaluation mission.

2. General purpose and framework of the assessment

The SADC-HYCOS project had three main purposes in order to reach the overall objective to develop the national and regional capacity in the fields of water resources assessment, monitoring and management.

(i) Provide SADC with one of the necessary operational tool (information system) for the sustainable improvement of regional integrated water

resources assessment, monitoring and management for a peaceful and sustainable development of the region;

(ii) Assist the participating countries in developing their own national capacity in these fields to allow them to fully participate in and benefit from the Project;

(iii) Collaborate with other national, regional and international projects and programmes, towards the modernization, rationalization and improvement of the efficiency, cost-effectiveness and sustainability of the water resources and related fields information systems in the continental part of the SADC region and at the international level.

The objective of the assessment of SADC-HYCOS is to produce a clear an comprehensive report, stating successes and failures of the Project in relation with the expected results. The assessment report should not only compile strengths and weaknesses in the Project achievements, but shall point out the reasons for these successes and failures and relate them with technical, financial, institutional or other reasons. This would allow the donor and the stakeholders of SADC-HYCOS to draw lessons from the Project, which will be used as input for improving the specifications and the design of future phases of the Project, as well as for preparing other HYCOS projects.

3. Methodology

The inputs to the assessment report will rely on two different sources of information:

Background information and documents ;

Findings, information and documents collected by the experts during a 3-week mission in the SADC region, during which they will notably visit the Pilot Regional Centre (PRC) of the Project and several of the participating countries and interview the Directors of the National Hydrological Services (NHSs) and other participants and stakeholders which have been directly involved in the Project as required.

A hard copy of draft report will be submitted by the team leader to :

- The European Commission, attention Mr Lucrecio Blazquez, AIDCO C/6, 200 rue de la Loi, 1049 Brussels, Belgium;
- SADC Water Coordination Unit, attention of Mr Phera Ramoeli, Red Cross Building, 23 Mabile Road, Maseru, Lesotho;
- The Delegation of the European Commission, attention Mr Joseph Bloemarts, 167 Constitution Road, P.O. Box 518, Maseru 100, Lesotho;
- WMO, attention Mr John Bassier, Department HWR, 7 bis, avenue de la Paix, CP 2300, CH-1211 Geneva, Switzerland;

not later than 15 days after the completion of the field mission. The team leader will be responsible for incorporating the comments into the final assessment report. This should be done not be later than 15 days after receiving the last comments.
All material of the draft and of the final report (text, graphs, maps, etc.) shall be in digital format and incorporated into commercial word processor files.

4. Background available information

The relevant documents to be used during the assessment are the following:

(a) The SADC-HYCOS project document and annexes, prepared by WMO (July 1996) which has been the reference for funding and implementing the Project;
(b) Periodical reports submitted by the Technical Assistance to the Project;
(c) Periodical reports prepared by the PRC of the Project;
(d) Periodical evaluation and supervision reports of the Project prepared by the WMO Secretariat for the European Commission;
(e) Reports of meetings of the SADC Water Resources Technical Committee, where SADC-HYCOS was addressed;
(f) Any other document of interest which might be provided to the experts during their mission by any of the participating institution to the Project.

WMO is prepared to provide the experts with a hard copy and, whenever available, with an electronic copy of documents (a), (b), (c), (d) and part of (f). SADC/WSCU will provide documents (e).

5. Outline of the assessment report

Within the SADC-HYCOS project document, the following components have been highlighted:

- General and specific objectives of the Project;
- Activities and actions to be carried out to reach the objectives;
- financial resources to carry out the scheduled activities;
- participants responsible for specifics activities (implementation of one or several of the activities, coordination, supervision, etc.);
- working arrangements and procedures between participants.

The assessment should crosscheck the actual achievements of the Project with the previously defined objectives of the project document, addressing successively the following aspects:

5.1 Technical aspects of the Project

The following objectives had been stated in the project document:

1. Installation of a real time data collection and transmission system (§ 3.3.1).
2. Improvement and /or development of Data Exchange and Dissemination systems (§ 3.3.2)

3. Development/ improvement of a regional electronic network (§ 3.3.3).
4. The development and implementation of a Regional Data Base (§ 3.3.4).
5. Preparation of products of national and regional interest (§ 3.3.6).
6. Training (§ 3.3.7).

The report should assess precisely the level of achievement of each of the objectives and elaborate on the conditions of the execution of the related activities which had to be carried out to reach the objectives

5.2 Institutional and managerial aspects of the Project

(a) Role of the participating countries (§ 5.2.3)

The National Hydrological Services (NHSs) of the participating countries had a key role to play in the Project. It was assumed that the NHSs would participate in the implementation of the national segment of SADC-HYCOS, provide the required national staff to carry out field operations and desk studies and support as necessary the missions of the PRC and Technical Assistance and ensure the security of the equipment.

The assessment should clearly establish country by country the level of participation of the respective NHSs in the Project, and as required, elaborate on the difficulties some of the NHSs might have had to fulfil the requirements stated in the project document. In particular, the report should assess in detail the process put in place by the NHSs in validating the information transmitted by the DCPs and their capacity to keep their data base up to date.

(b) Role of the PRC (§ 5.2.2)

The PRC had a key role in the Project, as shown by the extensive list of responsibilities and duties included in the project document. Among many other activities, it was assumed that the PRC would :

- Assist the NHSs for the installation, operation and maintenance of the DCPs;
- Maintain and operate the METEOSAT Direct Receiving Station, store the data in an electronic archive (raw data) and notify, as appropriate, the NHss on any problem on their DCPs;
- Participate in the development and implementation of a regional operational data base for the data collected through the SADC-HYCOS network. The data shall be validated at the national level and the regional data base should become the corner stone of the Project:
- Develop, manage and implement a training programme for activities related to the SADC-HYCOS project implementation.

The assessment shall evaluate the role played and the inputs provided by the PRC during the Project in its different components, in relation with the resources allocated to the PRC by the Project to carry out its duties.

(c) Role of the Technical Assistance – TA (§ 5.1.2)

When the Project was prepared, it was assumed that the participation of the Technical Assistance, selected on the basis of the strict tendering procedures used by EC, would provide the Project with an effective technical component. Among other duties, TA would implement the DCP network in collaboration with the NHSs, prepare the regional data base software, implement the Web site of the Project and carry out required training sessions in all components of the Project.

The duties of the TA, which are summarized in § 5.1.2 of the project document, were identified as group of activities or "TASKS". The Tasks have been elaborated for the purpose of the tendering procedure which has been used to select the TA. Six Task packages, identified as Task A to Task F, with their respective financial breakdown are described in § 5.4 of the project document. Each Task is related with the Project objectives listed in 5.1 above.

The assessment shall evaluate the performance of the TA during the Project, in relation with the expected outputs described in the project Document and with the proposals and workplan submitted by TA when responding the tender.

(d) Role of WMO (§ 5.2.4)

The role of WMO was to supervise and facilitate the implementation of the Project and to provide a technical and scientific support to the PRC and to the countries.

The assessment shall evaluate the input provided by WMO to the Project.

(e) Role of SADC (§ 5.2.1)

It is stated in the project document, that SADC will facilitate the smooth implementation and the review and evaluation of the Project, notably through its Water Resources Technical Committee.

The assessment shall evaluate the input and support provided by SADC to the Project.

(f) Creation of a Regional Centre (§ 3.3.8)

One important objective of the Project was to provide the SADC Member States with an effective Regional Centre for hydrological data collection and dissemination (refer to § 3.3.8 and to considerations of Appendix A of the project document "Recommended Host Institutions for the SADC-HYCOS Pilot Regional Centre").

The report should assess the technical capacity of the Pilot Regional Centre and the contribution provided to the Project. Comparatively to other potential alternatives, the assessment should establish if the PRC would have the capacity, the resources and the commitment from the Department of Water Affairs and Forestry (DWAF) of South Africa, to play this technical and institutional role in the future.

(g) Sustainability of the Project

The evaluation report shall address the issue of the sustainability of the Project, in its different components, once the external support will come to an end. Especially the following aspects should be highlighted :

Field Data collection component :

- Personal allocated by the NHSs to operate and maintain the DCP network.
- Regular budget in the NHSs for expenditures covering the operation of the network (maintenance of equipment, cost of regular field surveys, ground transportation, replacement of equipment which has been vandalised or destroyed by floods, etc.)

Regional database and Web Server :

- The assessment should evaluate the capacity and the commitment of the NHS hosting the PRC, for sustaining on the long term the regional information system on water resources. This may concern :

  Data Staff
  Processing equipment
  Communication equipment
  Consideration and support to the concerned NHS at National level

The evaluation shall clarify the conditions of the sustainability of the Project after the completion of the externally supported phase. The situation of the NHSs and of the PRC regarding the issues of sustainability and the suggestions and proposals from these key stakeholders should be highlighted in the report.

5.3 Benefit of the Project for the participating NHSs and for end-users at national and regional levels

The general objectives of the Project included to provide the SADC region with an in formation system on water resources and to assist the participating countries in developing their own national capacity in these field. SADC-HYCOS was not intended to carry out water resources planning activities, but to provide end users responsible for such duties with updated data and information on the status of water resources at the regional scale in order to better carry out their missions (water resources planning, flood warning, dam operation, drought management, etc.)

The assessment shall point out to what extent these ultimate objectives were fulfilled and elaborate as required on the reasons of partial achievements in these domains in relation with the Project design or the Project implementation.

6. Work Programme and Itinerary of the mission

The timeframe and itinerary of the evaluation mission in the SADC region has been prepared in collaboration with the PRC of the SADC-HYCOS project. A tentative provisional work programme and itinerary for the two selected consultants is attached as Annexture B.

Annexture B

WORK PROGRAMME AND ITINERARY OF THE MISSION

Date	Datius Rutashobya	Julius Wellens-Mensah
7/11/2001	Tanzania Hydrology	
8/11/2001	Tanzania Hydrology & DCP visit	
9/11/2001	DCP visit	

12/11/2001	Arrive Pretoria	
13/11/2001	Pretoria	Arrive Pretoria
14/11/2001	Discussions at PRC	Discussions at PRC
15/11/2001	Depart for Maseru, Lesotho	Depart for Maseru, Lesotho
	Meet with SADC WSCU	Meet with SADC WSCU
16/11/2001	Meet with SADC WSCU & EU	Meet with SADC WSCU & EU
	Lesotho Hydrology & DCP visit	Lesotho Hydrology & DCP visit
17/11/2001	Maseru	Maseru
18/11/2001	Depart for Botswana	Depart for Swaziland
19/11/2001	Botswana Hydrology	Swaziland Hydrology
20/11/2001	Botswana Hydrology & DCP visit	Swaziland Hydrology & DCP visit
21/11/2001	Depart for Harare, Zimbabwe	Depart for Lusaka, Zambia
22/11/2001	Zimbabwe Hydrology	Zambia Hydrology
23/11/2001	Zimbabwe Hydrology & DCP visit	Zambia Hydrology & DCP visit
24/11/2001	Return to Pretoria	Return to Pretoria
25/11/2001	Consultant discussions	Consultant discussions
26/11/2001	Discussions at PRC	Discussions at PRC
27/11/2001	Depart for Mozambique	Depart for Namibia
28/11/2001	Mozambique Hydrology	Namibia Hydrology
29/11/2001	Mozambique Hydrology & depart for Pretoria	Namibia Hydrology & depart for Pretoria
30/11/2001	South Africa Hydrology & DCP visit	South Africa Hydrology & DCP visit
1/12/2001	Compile reports of country visits	Compile reports of country visits
2/12/2001	Compile reports of country visits	Compile reports of country visits
3/12/2001	Depart for Maseru	Depart for Maseru
4/11/2001	Meet with SADC WSCU	Meet with SADC WSCU
	Return Pretoria	Return Pretoria
5/12/2001	Procure missing information	Procure missing information
	Drafting of report, Liaising with PRC	Drafting of report, Liaising with PRC
6/12/2001	Drafting of report	Drafting of report
7/12/2001	Travel to Dar es Salaam	Travel to Accra

Annexture C

TASKS ASSIGNED TO VARIOUS PARTIES IN THE PROJECT

3.1 ROLE OF THE PARTICIPATING COUNTRIES

- Participate in the installation of the national segment of SADC-HYCOS and support as necessary the missions of the PRC and technical assistance;
- Undertake normal hydrological field operations as necessary. In particular, this includes the regular survey of river channel cross sections and regular review of stage-discharge rating curves.

- Undertake field maintenance activities, as required. This includes routine maintenance and actions taken in response to problems identified through satellite monitoring;
- Validate the data collected through the DCPs network;
- Transfer regularly the validated data to the PRC;
- Facilitate the utilization by the project of existing national facilities notably for data exchange and dissemination;
- Participate in the workshops, attachment programmes, etc. organized by the project;
- Disseminate the data to national, regional and global users according to the agreements establishment with SADC;
- Contribute to the further development of the SADC-HYCOS objectives and practices by playing an active role as a partner in the project; and
- Ensure the security of the facilities in the participating countries.

3.2 MAIN TASKS OF THE PRC

- Review the list of stations proposed by the participating countries and prepare the final list of SADC-HYCOS DCPs to be installed. This list will be prepared with close co-operation with the national bodies responsible for hydrological networks. The final list shall be approved by SADC member countries before starting the implementation of the network;
- Prepare a draft implementation plain for SADC-HYCOS which will include the final list of stations;
- Prepare and present an implementation plan for SADC-HYCOS to the SADC-ELMS Water Resources Technical Committee for approval;
- Make the necessary arrangements for the inclusion of SADC-HYCOS DCPs in the METEOSAT DCS;
- Assist the national hydrological teams (NHT) for the installation, operation and maintenance of the DCPs. These teams will have been trained for these operations at the PRC by the manufacturer of the DCPs as part of its terms of reference and by technical assistance. In particular the PRC prepare and organize with the participating countries the missions for the technical assistance;
- Maintain and operate the METEOSAT Direct Receiving Station, receive the data from Darmstadt, Germany via the satellite and store it in an electronic archive (raw data);
- Disseminate in real-time or near real-time (same day) the raw data received from the DCPs to all participating countries, using all possible existing means;
- Maintain daily monitoring of the DCPs. Notify, as appropriate, NHTs on any problems;
- Participate in the development and implementation of reliable regional data dissemination and exchange systems (GTS segments, Internet, etc) between the national hydrological bodies, and the PRC, in order to assure the reliable and timely circulation of the different information fluxes;
- Participate in the development and implementation of a regional operational data base for the data collected through the SADC-HYCOS network. The data loaded into the data base shall be validated at the national level and transmitted through

the data exchange and dissemination system to the PRC according to a schedule to be agreed upon by the participating countries.

- Organize, in agreement with the participating countries the exchange and dissemination of the data collected by the SADC-HYCOS network at the regional and international levels;
- Develop, manage and implement, in coordination with SADC and WMO, a training programme for activities related to the SADC-HYCOS project implementation such as:

  - DCPs operation and maintenance,
  - Satellite data transmission,
  - Internet and World Wide Web,
  - Data quality and consistency checking,
  - Data processing (primary and secondary),
  - Preparation of products of national and regional value, etc.

Such a training programme shall include regional and national training courses, workshops, attachment programmes, etc.

- Propose actions, in coordination with SADC, to facilitate and encourage technical and scientific co-operation and collaboration in the field of water resources assessment, monitoring and management among the participating countries for the benefit of the SADC member countries and of the SADC region as a whole.

The PRC will undertake the above-described tasks with the support of technical assistance and of WMO as technical and scientific advisor.

3.3 MAIN TASKS OF THE TECHNICAL ASSISTANCE (TA)

- Assist the PRC for the preparation of the implementation plan;
- Assist the PRC and the countries for the implementation of the SADC-HYCOS network of DCPs;
- Assist the PRC and the countries for the development and implementation of the Regional Data Base (RDB);
- Development/improvement of an electronic network;
- Support to the PRC and the countries for the use of the RDB for the preparation of hydrometeorological products;
- Support to the PRC for the organization of training activities; and
- Organization for the use of existing segments of the Global Telecommunication System (GTS) for data exchange and dissemination.

3.4 ROLE OF WMO

- Evaluation of tenders;
- Contacts and support to allow the project to make use of the METEOSAT DCS and of other existing segments of the GTS, provided the technical and

administrative requirements of the operator of the satellite, EUMETSAT, are fulfilled;
- Development of the necessary codes for the transmission of the data through the GTS;
- Contacts with the contractors (equipment and services) including visits to their facilities;
- Monitoring of the project through:

  - missions to the PRC and to the countries,
  - report (six-monthly) to the SADC ELMS WRTC and participation in any meeting of relevance for the project, including the SADC-HYCOS Steering Committee meetings (one a year),
  - preparation of the progress reports, of the draft final report and of the final report, after its approval by SADC and EC;

- Technical and scientific support to the PRC.

3.5 SADC WATER SECTOR OBLIGATIONS

- Have the overall responsibility for monitoring and coordination of the Project's implementation;
- Reach agreements with cooperating partners on the financial and technical assistance for the implementation of the Project;
- Chair Project progress review meetings;
- Prepare the relevant Project progress reports according to the SADC procedure.

Annexture D

PERSONS INTERVIEWED

Name	Position/Designation	Organization/ Department	Country
Mr G.G. Gabaake Mr B. Jay Mr Kalaote Kalaote Ms O.M. Serumola Ms B.T. Mathangwane Mr Daniel B. Kemiso Mr S. Moalosi Mr B. Letsholathebe	Director Chief Hydrological Engineer Principal Hydrologist Senior Water Engineer Senior Chemist Water Engineer Water Engineer Principal Technical Officer	Department of Water Affairs Hydrology Division	Botswana
Mr Seth Tau Ms Mamutsoe Ntseo Mr Thelejane Thelejane	Principal Hydrologist Senior Hydrologist Hydrologist	Department of Water Affairs	Lesotho

Mr Motono Maseatile	Senior Technician		
Mr Custudio Vicente Mr Belarmino Chivambo	Hydrologist Water Resources Engineer	National Directorate of Water Regional Water Resources Administration for the Southern Region (ARAL-SUL)	Mozambique
Ms Antje Eggers	Chief Hydrologist	Department of Water Affairs	Namibia
Mr Stefan van Biljon Mr Felix Wulff Mr Hannes Calitz Mr Gerhard Booysen Mr Graeme Mostert	Director:Hydrology & PRC Coordinator Deputy Director (Hydrometry) & PRC Programme manager Senior Industrial Technician Consultant (IT) Auxilliary Services Officer	Department of Water Affairs and Forestry	South Africa
Mr Raphael Sangweni Mr Dumsani Mudzebele Mr Petros Simelani Mr Elphy S. Fakodze Mr Sipho Taala Mr Patrick Zondo Mr Jerry Khumalo	Senior Water Engineer and Head of Department Hydrologist Senior Hydro technician Hydro Technician Hydro Technician Hydro Technician Hydro Technician	Water Resources Department	Swaziland
Mr B.A.S. Luhumbika Mr J. Mihayo Mr Jerome Dukuduku Mr Y. Maswaga Mr Raymond Mngodo Mr M. Mwanamaziku Mr Felix Peter Mr Boni Baraka	Director of Water Resources Assistant Director (Hydrology) Senior Hydrologist Senior Hydrologist Hydrologist Technician Technician	Department of Water Resources	Tanzania
Mr Adam Hussein Mr C. Chileshe Mr H. Sikazwe Mr L. Mullala Mr T. Jere Mr B. Mbewe Mr F. Phiri Dr Z. Phiri	Director Project Manager, SADC-HYCOS project Asst. Project Manager, SADC-HYCOS project Computer Operator/Data Entry Artisan (Welder) Artisan (Mason) Mechanic Programme Manager, Water Resources Action Programme (WRAP)	Department of Water Affairs	Zambia
Mr G. Mawere Mr E.K. Madamombe Mr Wellington Dzvairo Mr M. Musariri	Chief Hydrologist (Acting Director) Data & Research Manager Engineer/Hydrologist Hydrologist	Department of Water Development Zimbabwe National Water Authority	Zimbabwe
Mr Stefan van Biljon Mr Felix Wulff	Director:Hydrology & PRC Coordinator Deputy Director (Hydrometry) & PRC Programme manager	Department of Water Affairs and Forestry	PRC

Mr Hannes Calitz Mr Gerhard Booysen Mr Graeme Mostert	Senior Industrial Technician Consultant (IT) Auxilliary Services Officer		
Mr Lawrence Ramosoe Mr E.M. Mokuoane Dr T. Chiramba Mrs P. Molapo Mr L. de Almeida Mr C.R. Mosito Ms L. Sekoboto Dr S. Puyoo	Ag. SADC Water Sector Coordinator Senior Engineer Programme Manager Senior Engineer Senior Water Resources Engineer/Liaison Officer Senior Environmentalist Principal Legal Officer French Technical adviser	SADC Water Sector Coordination Unit	SADC/WSCU

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