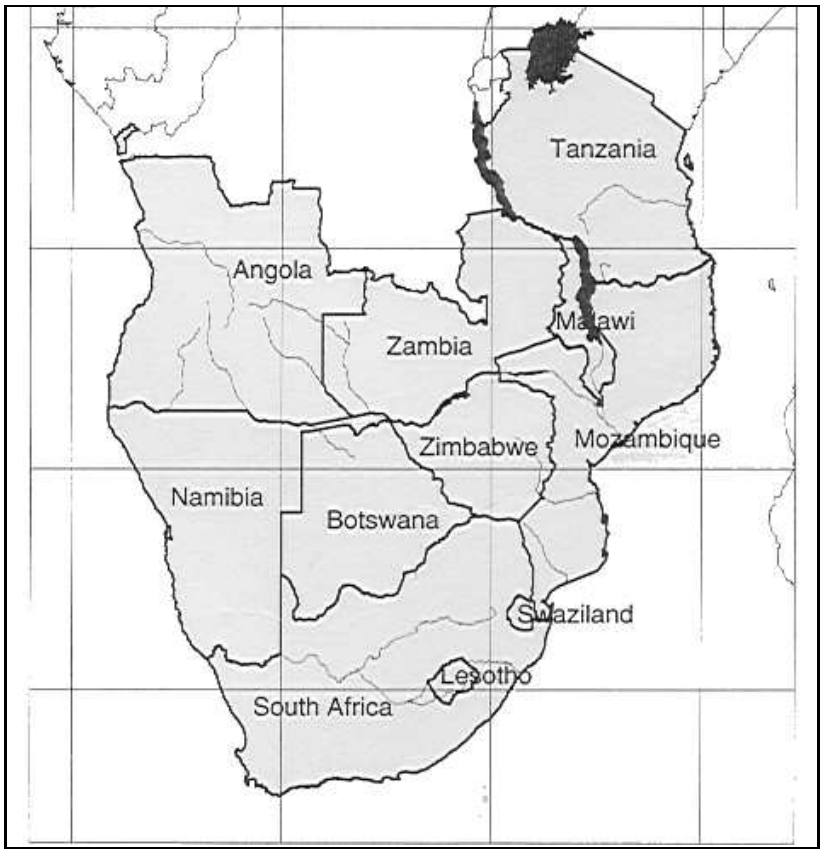
SOUTHERN AFRICAN DEVELOPMENT COMMUNITY
HYDROLOGICAL CYCLE OBSERVING SYSTEM

(SADC-HYCOS)

PROJECT DOCUMENT



Geneva, July 1996

1. SUMMARY

The Southern African Development Community (SADC) is an economic grouping of twelve countries. This project document refers to the eleven Southern African countries which occupy an area of about 7 million square kilometres of the African continent. Most of these countries are semi arid and arid, thus having limited water resources. There are a number of international river basins out of which seven cover most of the sub-region.

The water resources development in many SADC countries is still at a low level and is mainly limited to hydropower and a few, small municipal water supply and irrigation schemes but demands for irrigation, hydropower and domestic and industrial use will grow rapidly. No serious conflicts between the users or the usage of water resources have been reported yet but there are a number of incidents where the use of water resources in the SADC has created conflicts of interest both physically and environmentally, and at national and regional levels.

Although SADC has created some opportunities, the co-ordinated and integrated development of these basins, between or among the riparian countries, have so far been very limited. These initiatives are dependant on the existence of reliable water resources information systems, both at national and regional levels, covering not only the collection and the analysis of data but also the exchange and dissemination of these data and related information.

The aim of SADC-HYCOS is therefore to develop/strengthen the regional co-operation and collaboration for water resources assessment, monitoring and management. For that purpose the project has to address several problems such as: the lack in many SADC countries of sustainable and reliable hydrological services; the lack of consistency of the data collected in the SADC region; and the lack of a regional integrated water resources information system.

As already endorsed by the SADC Summit in 1994, the project will: (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; (ii) assist the participating countries in developing their own national capacity in these fields; and (iii) work, together 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.

The project will create a network of fifty Data Collection Platforms (DCPs) installed at key sites mainly on international rivers. The DCPs equipped with "intelligent" sensors for water quantity, quality and meteorological variables will transmit the data in real time through the METEOSAT Data Collection System (DCS). The data will be received in real or near real time by all the participating countries either directly or through existing segments of the Global Communication System (GTS) of the World Meteorological Organization (WMO). The project will also create a Data Exchange and Dissemination System (DEDS), including the use of Internet networks, in the region and a Regional Data Base (RDB). Training will be provided for the operation and maintenance of the DCPs, the use of the GTS and Internet, the management of data bases and the primary and secondary processing of the data saved in the RDB created by the project.

Among the main activities to be undertaken are the tendering and selection for the supply of the equipment and for the technical assistance, the preparation of the contract with WMO which will act as the supervising agency on behalf of SADC, the installation of the equipment, the development of a regional data base and the implementation of training and attachment programmes.

A Pilot Regional Centre (PRC) hosted by an existing regional institution selected by SADC member countries will implement the project with the support of technical assistance and of WMO. The total estimated cost of the project is 1 964 600 ECU.

Several indicators will be used to monitor the project ranging from the number of data captured and saved in the electronic archive of the RDB to the degree of satisfaction of the national, regional and international users of the system.

It is assumed that the SADC member countries will remain committed to develop their co-operation and collaboration in the field of the water resources, as demonstrated by their signing of the

Protocol on Shared Watercourse Systems in August 1995[1], and that the national segments of the system will be integrated and operated and maintained as part of the national networks.

2. BACKGROUND

2.1 SADC sectoral policy

The Southern African Development Community (SADC), established through a Treaty, is an economic grouping of 12 Southern African countries comprising the Republic of Angola, the Republic of Botswana, the Kingdom of Lesotho, the Republic of Malawi, the Republic of Mozambique, the Republic of Namibia, the Kingdom of Swaziland, the United Republic of Tanzania, the Republic of Zambia, the Republic of Zimbabwe, the Republic of South Africa and Mauritius. The main objective of this treaty is to advance co-operation, coordination and integration of socio-economies of Member countries. At the regional level, SADC has its Secretariat, Commissions and coordinating Units. The Secretariat is mainly the executive branch, where coordination of all SADC's activities are performed. The Commissions are the technical arms of the Secretariat, which implement technical programmes and are limited to two at present. The rest of SADC technical programmes are performed through Coordinating Units for each sector. Each member country was given sectors to coordinate and implement their programmes, on behalf of SADC. The Environment and Land Management Sector (ELMS) where water resources are dealt with, was assigned to the Government of the Kingdom of Lesotho and its Coordinating Unit (CU) is located in the Ministry of Agriculture, Cooperatives and Marketing, at Maseru. The funds for running the Unit come from two principle sources: contributions by the Lesotho Government and those from the donor community, particularly the Nordic countries. At present only one national hydrologist is working in the domain of water resources at SADC ELMS CU.

Under the supervision of the SADC Technical Committee of National Experts on Environment and Land Management (who are national Sector Contact Persons), SADC-ELMS CU plans, develops and implements regional water resources programmes and projects. The SADC ELMS Technical Committee 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. Originally, the Committee was assisted by the Water Resources Subcommittee which steered programmes and projects related to water resources. In June 1995, the Council of Ministers of SADC approved the upgrading of this Subcommittee to a fully fledged Water Resources Technical Committee (WRTC), which can also make recommendations and call upon ministers responsible for water resources to consider them.

The institutional framework for the water resources in each country is basically similar: the Department of Water, Water Affairs or Water Resources, is responsible for water resources monitoring and management in each country. The officers of these national departments are in constant contact with each other, discussing matters of regional importance or mutual interest, through regional meetings under the auspices of SADC ELMS, or through bilateral arrangements between two or more countries. These opportunities provided by regular meetings create favourable circumstances for consultations and collaboration in water resources activities of common interest.

Opportunities created by SADC such as the Zambezi River Action Plan [2] (ZACPLAN) and its core project ZACPRO 6 aimed at developing and implementing an Integrated Water Resources Management Plan for the entire Zambezi River are being utilized to develop and implement common regional strategies and integrated water resources and related management. The Protocol on Shared Watercourse Systems in the SADC region has been signed in August 1995 and proposes a Monitoring Unit for regional water resources monitoring and management.

2.2 Features of the sector

The present SADC region represents about 130 million people or about 20 per cent of the population of Africa. The continental part of the SADC region (11 countries) occupies an area of about 7 million square kilometres experiencing geographical and climatic conditions varying from sub-equatorial

[1] The Protocol was signed by all SADC Member Countries, except two which needed further internal consultations, in August 1995.

[2] The Action Plan for the Environmentally Sound Management of the Zambezi River System has been initiated by UNEP. ZACPLAN was adopted in 1987 as a SADC programme.

rain-fed vegetation to the oldest desert in the world, in Namibia. But most of the countries of SADC are semi arid and arid, thus having limited water resources, a situation which has aggravated during the recent years with the occurrence of drought conditions all over Southern Africa, even affecting the largest surface water bodies within the region, the Zambezi river, the fourth largest African river basin and Lake Malawi, the second largest African lake. There are fifteen international river basin in the SADC countries, out of which seven cover an area 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 countries share at least two international river basins, with a maximum of nine for Mozambique. The co-ordinated and integrated development of these basins, between or among the riparian countries, have so far been very limited.

The SADC region has a water capita availability similar to Europe and better than Asia (about 5 000 cubic metres per second). However, this figure masks important disparities within the region and estimates for the year 2025[3] suggest that six countries will suffer water scarcity under several population growth scenarios.

Drought is a frequent event in the region and 1981-84, 1991-92 and 1994-95 droughts were region wide events.

Demands for irrigation, hydropower and domestic and industrial use will grow rapidly. The water resources development in SADC is still at a low level and is mainly limited to hydropower and a few, small municipal water supply and irrigation schemes. However, in economic terms, water resources are playing a significant role in the socio-economic development in the region. A major proportion of the region's electricity is generated from hydropower installations. A total capacity of more than 10 000 MW has already been developed, with 4 500 MW in the Zambezi River basin at Kariba, Cabora Basa, Kafue Gorge and Nkula. There is a further development potential of 8 000 MW in the Zambezi alone. Currently more than 280 0000 hectares of land are irrigated, with the potential exceeding 8 000 000 hectares. Freshwater fisheries are also an important source of food. It is estimated that more than 160,000 tons of fish per year are harvested in SADC, mainly from natural lakes such as the Malawi/Nyasa (48 000 tons), and Tanganyika, and artificial lakes, such as Kariba and Cabora Basa. Industries associated with fisheries provide significant employment opportunities. Shipping, in particular in Lakes Malawi/Nyasa and Tanganyika, is a major economic asset. For example, the annual passenger and cargo handling amounts to more than 200 000 and 50 000 tonnes per year, respectively, in lake Malawi.

Current access to safe drinking water and adequate sanitation facilities is limited and the demand is growing. Only Zimbabwe and Swaziland have managed to provide near complete access to water to their urban populations and no continental SADC country provides optimum access to its rural population.

Although there are no serious conflicts between the users or the usage of water resources there are a number of incidents where the use of water resources in the SADC has created conflicts of interest both physically and environmentally, and at national and regional levels. For instance, mining and industrial water uses, such as copper mining, and fertilizer manufactured in Zambia, have created a water pollution problem in the Kafue River, which is also a source of municipal water supply. The regulation of the flow at the Cabora Basa and Kariba reservoirs is altering the natural flow regime of the Zambezi River, but it is necessary to ensure adequate flows at the two power stations, an important factor in satisfying the electricity power demand from them. The closure of the Cabora Basa dam in the late 1970s, to fill its lake, which produced significantly lower water levels in the Shire River and affected its navigability and fisheries. Mozambique, the downstream country for most of the international rivers in the SADC region, recovering from a long national war, is now facing the fact that most rivers entering the country are dry or have limited flow as compare to the situation fifteen years ago. Due to the development of agriculture pollution is raising very rapidly in the lower reach of the Orange river, a natural border between Namibia and South Africa.

2.3 Problems to be addressed

In order to meet increasing demands and development goals it will therefore be necessary to make tradeoffs between uses, utilize water more efficiently and recognize ecological issues. This will requires concerted actions at river basin, national, regional and international levels. This will notably require an improvement of regional co-operation, notably in the fields of water resources information,

[3] Sustaining World Population and the Future of Renewable Water Supplies. Population Action International, Washington, D.C.,1993.

drought management, management of international waters, and land management and watershed protection. This will require the development and /or improvement of: (I)the knowledge base on water resources, both quality and quantity, and water uses which is vital to make informed decisions; and (ii) the dissemination and exchange of information within the SADC region.

All these initiatives are dependant on the existence of reliable water resources information systems both at national and regional levels covering not only the collection and the analysis of data but also the exchange and dissemination of these data and related information. Recent surveys (1988-1994) under the Sub-Saharan Hydrological Assessment (SSAHA) Project[4] and for the WMO/UNESCO[5] report on Water Resources Assessment have revealed a serious decline in hydrometeorological data collection and management in many African countries. The SSAHA study showed that the hydrological services in the region had deteriorated seriously. It concluded that the hydrological services were inadequately equipped and offered inferior water resources information. They were unable to effectively and significantly contribute to water development and management.

This situation applies to most of the countries of the SADC and the ongoing projects like ZACPRO 6 and ZACPRO 5 cover only the Zambezi river basin and lack a system for data collection and updating the data base generated so far by ZACPRO 6, while the AAA.3.4 project is only dedicated to hydropower generation in the same basin.

The main problems to be addressed, in order to achieve the objectives of the SADC programmes, are:

(a) Lack of sustainable and reliable national hydrological services in many SADC countries

Each SADC Member state has a hydrological service but, as pointed out by the reports of the SSAHA, they are generally lacking equipment, transport and for many of them, technical expertise, notably as regards the use of modern efficient and cost effective technology. According to the conclusion of SSAHA, this situation is attributable to two major causes. The first is the severe economic difficulties, prevalent throughout the continent, which have led to cuts in general public spending. The second is the lack of awareness of the economic value of hydrological information by many policy and decision makers of Sub-Saharan Africa, which causes hydrological services to be perceived as a lower priority within the development process than many other services, thus exacerbating under-funding. Given the competing demand for water resources among various uses, notably hydropower, irrigation and water supply, and the nature of the regional river basins, good hydrological services at the national level, as national components of the regional service, are required for equitable sharing of the water resources and for effective water resources management and reduction of environmental damage and conflicts among users and member states.

[4] Executed by the World Bank in collaboration with the African Development Bank, EC, the Government of France, UNDP and other UN agencies. In the SADC sub-region, this assessment was conducted only in 1995 in Namibia and in 1996 in the Republic of South Africa.

[5] WMO/UNESCO (1991) Water Resources Assessment. Progress in the Implementation of the Mar del Plata Action Plan and a Strategy for the 1990s.

(b) Lack of consistency of data collected in the SADC region

Consistency of data is one of the major problem to face when dealing with integrated water management, especially in the case of international rivers. Use of common or at least standardized practices, methodologies, equipment is recommended. This consistency problem has to be addressed in the SADC region, notably in terms of data acquisition, quality checking, primary and secondary data processing and data archiving through the improvement of the capacity of the national services in the region and of regional co-operation and collaboration.

(c) Lack of a regional integrated water resources information system in the SADC region

The lack of a regional water resources information system is recognized as a major stumbling block in the planning and management of integrated water and related resources development and in the management of water related natural disasters, at the regional and national scale. In SADC, each country currently uses data collected from its own territory and, therefore, fails to get a total picture of what is happening in an entire international river basin. This obviously results in inconclusive and unsatisfactory decisions, often based on trial and error methods of water resources management. The efficient operation and management of water resources developments and the equitable sharing and utilization of their benefits cannot be achieved in the absence of the timely collected, processed and disseminated consistent hydrological data.

2.4 Beneficiaries and parties involved

2 4.1 At the SADC level

The River Basin Management Institutions to be established under Article 3 of the Protocol on Shared Watercourse Systems (Monitoring Unit, River Basin Commissions, River Authority or Boards) will be the main beneficiaries since SADC-HYCOS is anticipated to be a tool for monitoring SADC freshwater resources, member countries' compliance with the Protocol legislation and general water resources and environmental management in SADC.

Already existing regional river basin authorities, such as the Cunene River Commission, the Zambezi River Authority, and the Okavango Authority, will benefit from a system for timely acquisition of much needed data for the day-to-day management and sharing of water resources of international rivers. Without such information, it will be difficult for these river basin authorities to undertake integrated planning, management and investment in water resources development in a rational manner, as required of them by their mandates.

2.4.2 At the national level

National services responsible for water resources monitoring and assessment, that is, hydrological services, will not only be able to rehabilitate their capacity to perform their routine tasks but be also able to easily send, receive and exchange data and information from outside their national territories, a facility which is necessary for the management of their water resources in international rivers.

2.5 Other interventions

Currently, there are a number of on going or planned regional water resources development, management and river activities in SADC. The Zambezi River Basin Action Plan (ZACPLAN), adopted in 1987, dominates these activities. The ZACPLAN programme has eight projects called ZACPROs. The core project ZACPRO 6, which deals with the development and implementation of an Integrated Water Resources Management Plan for the entire Zambezi River, is expected to produce the plan and begin implementing it within the next three years. The other ZACPROs of relevant significant to HYCOS-SADC are ZACPRO 2 and 5. ZACPRO 2 has developed the proposed Protocol on Shared Watercourse Systems for the whole of the SADC region. ZACPRO 5 develops a network of selected hydrometeorological stations for the Zambezi River basin, as part of a unified water resources quantity and quality monitoring system for this basin. The network has been greatly improved under Phase I of ZACPRO 6, and Phase II aimed at (i) developing simulation models for planning and management of water resources in the Zambezi River Basin; (ii) preparing the integrated water resources management plan itself, considering the various scenario that may exist; and (iii) developing the regional and national institutional capacity to secure sustainability of the project will be implemented at the Zambezi River Authority (Lusaka, Zambia).

However, the scope of the selected monitoring network covers only the Zambezi River basin and lacks a system for data collection and for updating the database.

The other regional projects of relevance are:

(a) FINNIDA/SATCC/ WMO - Meteorology Project for SADC countries (two phases), which improves meteorological services. Its benefits are going to be utilized in the HYCOS-SADC project;

(b) RAF/88/004 - WMO/UNDP Drought Monitoring Centres, some of whose goals and outputs will be strengthened by HYCOS-SADC facilities and its products;

(c) WMO/ECA - African Centre for Meteorological Applications to Development;

(d) RAF/87/097 WMO/UNDP project: Strengthening of the Meteorological Data Collection and Exchange in Africa.

The national projects of relevance are:

(a) BOT/83/003 - WMO/UNDP project: Meteorological Services (Botswana)

(b) MLW/84/016 - WMO/UNDP project: Agrometeorology/Data Processing (Malawi)

(c) MLW/88/011 - WMO/UNDP project: Flood Forecasting and Warning System for the Lower Shire Valley (Malawi)

(d) ZAM/87/002 - WMO/UNDP project: Strengthening Agrometeorology in the Meteorological Department (Zambia)

(e) ZAM/87/009 - WMO/UNDP project: Strengthening of the Hydrological Service (Zambia)

(f) ZIM/86/03 1 - WMO/UNDP project: Agrometeorology and Data Processing (Zimbabwe), and

(g) a project not being implemented yet, which will be funded by NORAD for the installation of five Data Collection Platforms (DCP) in Zambia, with a satellite based (METEOSAT) transmission system.

2.6 Documentation available

The most important part of the available documentation relevant to this project has already been quoted. It essentially consists in:

- UNDP 1987. The Action Plan for the Environmentally Sound Management of the Zambezi River System has been initiated by UNEP. ZACPLAN was adopted in 1987 as a SADC programme.
- Population Action International, Washington, D.C.,1993. Sustaining World Population and the Future of Renewable Water Supplies.
- World Bank/UNDP 1993. SSAHA National and regional reports.
- WMO/Unesco (1991) Water Resources Assessment. Progress in the Implementation of the Mar del Plata Action Plan and a Strategy for the 1990s.
- SADC 1995. Protocol on Shared Watercourse Systems.
- SADC-ELMS/WMO (1994) Hydrological Cycle Observing System for the Southern African Development Community (HYCOS-SADC) Phase I, Draft Project Document.

3. INTERVENTION

3.1 Overall objective

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. The SADC Member countries have clearly 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.

The development objective of SADC-HYCOS is to develop and/or strengthen the national and regional capacity to effectively co-operate and collaborate in the field of water resources assessment, monitoring and management as a support to the SADC policy in the matter as expressed, notably in the Protocol on Shared Watercourse Systems signed by all the SADC countries but two in August 1995.

3.2 Project purposes

The project has three main purposes in order to reach the overall objective to develop the national and regional capacity building in the field 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.

3.3 Results

The expected results for the project which will cover the eleven countries of the continental part of the SADC region and will last two years are the following:

3.3.1 The installation of a real time data collection and transmission system with:

Fifty (50) Data Collection Platforms (DCP) installed at benchmark hydrological stations selected from a list of stations proposed by the participating countries (see **Attachment A**). The selection of the station is part of the implementation of the project (see 5.2.2). The variables to be measured are listed in **Table 3.1**, with an indication of the frequency of measurement for each variable.

- Water level would be determined using a piezometric pressure probe placed in the river.
- Rainfall will be recorded using a tipping bucket rain sensor.
- Air temperature, relative humidity, wind speed and radiation (net radiation) will be measured to calculate potential evaporation by using a combination formula (such as the Penman or Penman - Monteith formula). These data are also valuable to national meteorological agencies.
- Water temperature, electrical conductivity and turbidity will be measured to indicate the physical and chemical characteristics of the river water, which can be used to determine some aspects of water quality.

Table 3.1 HYCOS-SADC: Data to be acquired and transmitted

Environmental variable	Frequency of measurement per day
1. Water level (upstream)	1 to 6 (depending on size of river)
2. Water level (downstream)	(idem)
3. Water conductivity	1
4. Water temperature	1
5. Turbidity	1
6. Air temperature	8 (synoptic hours)
7. Rainfall	24, plus daily total
8. Relative humidity	8 (synoptic hours)
9. Wind speed	8 (synoptic hours)
10.Wind direction	8 (synoptic hours)
11. Net radiation	8 (synoptic hours)
Housekeeping variables	
12. Battery voltage	1
13. Solar panel voltage	1
14. Memory status	1
15. Temperature inside instrument housing	1

Data acquisition frequencies indicated in the table are seen as a minimum and will certainly be much more higher (average values will be transmitted together with extremes). Manufacturers may propose additional housekeeping variables.

Out of the fifty DCPs, **forty** (40) will be equipped with 6 sensors (upstream and downstream water levels, rainfall, air and water temperature and conductivity). The **ten** (10) remaining DCPs will receive the following additional five sensors: turbidity, air humidity, net radiation, wind speed and direction.

Each of the DCPs will be equipped with a METEOSAT transmitter which will allow the data captured on the ground by the sensors to be transmitted using the Data Collection System of this satellite operated by EUMETSAT in Darmstadt, Germany. Since METEOSAT is a geostationary satellite located at about 36 000 km above the Gulf of Guinea, data from any location in Africa can be transmitted through METEOSAT during (a) defined time slot(s). The daily time slot(s) for each DCPs and the frequency(ies) to be used are attributed by the operator of the satellite in concertation with the owner of the DCPs.

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 admission of a DCP in the METEOSAT DCS requires the owner of the DCP to fill an admission form to be sent to EUMETSAT through the World Meteorological Organization (WMO) Secretariat in Geneva, Switzerland, by the Permanent Representatives with WMO of the country where the DCPs is installed.

All the DCPs will be self-powered using a solar panel, a regulator and a battery.

Each DCPs will be equipped with an in-situ data logger as a backup in case data being lost during the transmission process.

Since the data captured and transmitted in real time by the DCPs will be loaded into an electronic archive located at the PRC, it will be very easy to assess the efficiency of the system. The PRC and the national agencies responsible for the national segments of the SADC-HYCOS network will also be requested to keep a record of any incident occurring in the data acquisition and transmission system. Regular field visits are planned as part of the project and shall provide the mean to assess the status of the system.

3.3.2 The improvement and /or development of Data Exchange and Dissemination systems (DEDS).

There are several ways of receiving the data collected by the DCPs and transmitted to the satellite. In all cases, the data are first downloaded in Darmstadt and reformatted. Then, if agreed upon with EUMETSAT, the data could be either sent back through the satellite and received at a METEOSAT

Direct Receiving Station (MDRS) or/and through the Global Telecommunication System (GTS) of WMO via Offenbach or directly from Darmstadt through specialized networks, such as TRANSPAC, X25, etc. It is also possible to receive the data from the GTS centres of Bracknell (UK), Rome (Italy) and Toulouse (France) via METEOSAT, through MDD (METEOSAT Data Distribution) stations currently installed at the natioanl meteorological agencies.

3.3.2.1 The Pilot Regional Centre (PRC) (see 5.2.2) selected for the project is equipped with such an MDRS. This MDRS will receive and process data transmitted on the WEFAX channels by the DCPs. Such a device comprise:

Hardware with a paraboloidal antenna and mount with a preamp/frequency down converter integrated in antenna feed, a telemetry receiver and synchronizer, a microcomputer with colour screen and 200 - MB hard disk

Software with the following functions:

(i) ***acquisition* of METEOSAT** satellite telemetry containing DCP messages, selection of DCPs to be received, print-out of DCP result in hexadecimal or ASCII and permanent monitoring of transmission quality.

(ii) ***processing and output*** of data as physical values, data output as graphics, generation of results files and databases configurable by the operator, and data dissemination to other computers.

The MDRS installed at the PRC will be able to handle at least 100 DCPs which corresponds to a standard equipment.

3.3.2.1 **Only one** national hydrological agency in the SADC region(Department of Water Affairs and Forestry of South Africa) is equipped with a MDRS. Three countries have MDRS installed at their national Meteorological Service, Institute or Weather Bureau. **All** the national meteorological agencies **but one** are equipped with a Meteorological Data Distribution (MDDs) User Stations able to receive data from DCPS installed in the African continent. In this case, the data received in Darmstadt from the satellite should be formatted and sent to Toulouse via Offenbach and from Toulouse through METEOSAT to all the MDDs. It seems that existing MDDs could be used for the reception without important changes. **All** the meteorological agencies in the region are able to receive the data from the DCPs through the GTS. The data received in Darmstadt from METEOSAT are formatted and sent to Offenbach. Then, through a main telecommunication network, the data could reach the Regional Specialized Meteorological Centre (RSMC) in Nairobi and the Regional Telecommunication Hub (RTH) of Pretoria. From this RTH, the data could be disseminated to all the participating countries through the public telecommunication network. The data for Tanzania could be transferred directly from Nairobi.

The most flexible approach will be adopted for the improvement and/or development of the regional DEDS in order to take advantage of the existing possibilities for the countries to receive the data from the DCPs (raw data) in real time or near real time (same day). Use of the GTS needs that prior agreements should be discussed and made, and that the data transmission and the protocols for transmission should conform with WMO codes and regulations. In addition, the data transmitted through MDDs and GTS will be received by the national meteorological services and agreements and procedures for the transfer of the data to the national agencies in charge of the national segments of HYCOS - SADC should be established.

An objective indicator of the efficiency of the DEDS will be the volume of the data available in the regional and national data bases and the ease of access to these data bases.

3.3.3 The development/ improvement of a regional electronic network

The regional electronic network will interconnect the relevant national data bases and information systems with (I) the PRC and, (ii) later, the other regional and global data bases and information systems.

The regional network would have different functions such as:

- electronic mail;
- file and document transmission;
- electronic fora;

- database access.

This network will be dedicated (i) to transfer the SADC-HYCOS data after validation by the national hydrological agencies from these agencies to the PRC, (ii) to exchange information concerning the operation and the maintenance problems concerning the SADC-HYCOS network, (iii) to improve the co-operation and collaboration between the hydrologists of the region through formal and informal easy and cheapest communication, and (iv) to contribute and participate to other ongoing regional and international projects and programmes such as those related to drought monitoring/forecasting and climate change.

There are already numerous Internet linked networks on the African continent. In the region, few hydrological agencies are connected to Internet. Each national agency responsible for hydrology and water resources is equipped with PC's (486, 33 MHz, 8 Mb RAM, 110 to 120 Mb hard drive, two communication channels COM1 and COM2). The network will be developed and/or improved using these PC's which will be equipped with modems and the appropriate communication software, data base interface and bridges as necessary.

Once the network is completed, any national hydrological agency in the SADC region should be able to receive e-mail and to respond. This is the most easy way to objectively assess the status and performance of the system.

3.3.4 The development and implementation of a Regional Data Base (RDB)

An operational data base aimed at providing consistent, accurate, updated and timely available data from the SADC-HYCOS network will be developed and implemented. In addition to this operational aspect, the data base will also play a vital role in the process of regional and national capacity building towards improving co-operation and collaboration. The common data base will provide the physical basis to develop training activities, notably in the field of data quality control and primary and secondary data processing, data retrieval and hydrological data base management. The characteristics of the data base will be: modular, interactive, user-friendly, menu-driven, computerized system, accessible by PC's under Windows, on line access with diverse output options as regards content, format and mode of display. Existing hydrological data base management software might be chosen or adapted to meet the needs of the project. Appropriate bridges between existing national software should be developed to improve data exchange and dissemination in the region.

The exact content of the data base in terms of data files will be discussed and agreed upon by the national hydrological agencies participating in the project with a view to the existing and potential users at national, regional and international levels. The following is therefore provided as a basis for discussion

(i) Fixed data : pertaining to watershed characteristics (such as boundaries, hydrographic network, geomorphology, soils, land-use, climate, aquifers, outcrops, hydraulic structures, etc); hydrological and meteorological observation networks for each watershed in the region ;

(ii) Dynamic data files (real time) : anticipated time of arrival of stormwater at a site, actual arrival time, water levels and flooded area, water quality (rise of concentration of a pollutant above a threshold value - anticipated and actual) ;

(iii) Historic data pertinent to : the state of water at a single station (water level, water quality, discharge) ; the balance of water volume in a watershed (inflows, outflows, sources of natural and anthropogenic pollution) ; mass balances of pollutants in a watershed at any part of it ;

(iv) Data for monitoring the state of hydraulic structures on the hydrographic network ; of the observation network (including available data records) ; of the geometry of river beds (affected by silting and/or erosion) ;

(v) Hydrological parameters for the planning of hydraulic structures for : water storage and use; flood control ; pollution control ; regulation of flow ; planning the operation of hydraulic structures.

The structure and content of the data base should take into consideration that two historical regional data bases are being implemented, one is the Zambezi River Basin Database under Phase I of

ZACPRO 6, and the other is the Southern African FRIEND[6] data base. It is foreseen that the FRIEND database and the one from 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.

The view of the participating countries might be different as far as the future of the data base is concerned. This future might be: (i) the strengthening of the regional data base located in a regional institution, which is the way chosen for the Zambezi data base being installed at ZRA, or (ii) a decentralized data base organized as a network of compatible consistent national data bases interconnected with automatic and protected data transfer and query possibilities. Access to data should be agreed upon by the participating countries in accordance with the national regulations, the regional requirements and the international guidelines and recommendations in this matter.

Whatever should be the future of the regional data base, the centralized phase appears to be essential in terms of training, coordination and exchange of view. In the same time a technical support will be provided to the national data bases.

The data base should be easy to access and the number of queries could be a good indicator of its value for users at national, regional and international levels.

3.3.6 Preparation of products of national and regional interest

From the real time operational data base itself and from the related historical data bases of both the FRIEND project and ZACPRO 6 it will be possible to prepare such products like:

- Maps of : hydrographic network of a river basin or any part of it ; observation networks (hydrological and meteorological) ; hydraulic structures related to water and mass balances ; geomorphology and soils ; land-use ; climatology (rainfall, potential evaporation, evapotranspiration) ;
- Graphs : rating curves ; hydrographs (historic, synthetic) ; probability distribution curves of discharges and water levels ;
- Tables : historical data pertaining to components of water and mass balance parameters.

Close co-operation will be established with other ongoing projects and programmes in the region (i.e. Drought Monitoring Centre, Early Warning Unit, etc) to prepare appropriate products as needed.

Again, the most objective verifiable indicator of the degree of completion of this part of the project should be the interest of users at different levels and the co-operation established with other projects and programmes.

3.3.7 Training

Among the expected results of the project training is obviously integrated in the different results discussed above. Training will be organized through different ways including:

- 2 weeks training by the manufacturer of the DCPs for operation and maintenance purposes;
- 3 weeks training at PRC for installation and system set-up;
- 3 missions of 7 weeks each as support to the countries for in-situ installation and system set-up;
- 3 weeks of mission in the region as support for on job experience for the maintenance and operation of the DCPs;
- 6 workshops for 11 trainees of 1 week each organized at the PRC for:
    - Use of DEDS and electronic network;
    - Data base management;
    - Data quality control;
    - Primary and secondary data processing;
    - Water quality monitoring, etc.

[6] FRIEND stands for Flow Regimes from Experimental and Network Data and is a UNESCO project. The Southern African FRIEND Project is supported by the Overseas Development Administration from The UK.

- 10 attachment programmes of at least 1 month each allowing one representative of each participating countries to work at the PRC with the regional data base to prepare products of national interest;
- 5 individual technical visits and/or specific training of 1 month each.

Other training activities might be proposed by the PRC as needed for the implementation of the project.

The degree of achievement of the above results will be the best indicator for the training activities provided within the framework of the project.

3.3.8 Creation of a Regional Centre

SADC may wish to transform the Pilot Regional Centre established for the implementation of the project into a permanent structure, the Regional Centre for regional co-ordination and collaboration in the domain of water resources assessment, monitoring and management. This Centre may assist the Monitoring Unit in the application of the SADC Protocol on Shared Watercourse Systems.

3.4 Activities

3.4.1 Tendering and selection for the supply of the necessary equipment for the real time data collection and transmission system as described in 3.3.1. Tender document should include the training for operation and maintenance of the equipment.

3.4.2 Tendering and selection for the technical assistance needed for supporting the PRC and/or the countries to:

- prepare the implementation plan, select the stations to be integrated in the SADC-HYCOS network, organize a SADC-HYCOS technical and scientific meeting;
- install, operate and maintain the network of DCPs;
- develop and implement the Data Exchange and Dissemination System (3.3.2);
- develop and implement the e-mail network through Internet (3.3.3);
- develop and implement the regional data base and organize support to the national data bases (3.3.4);
- prepare hydrometeorological products of national and regional interest (3.3.6);
- Organize and/or implement the training activities (3.3.6) including:
  - the attachment programmes,
  - the workshops,
  - technical visits and/or specific training.

3.4.3 Preparation of the contract for the supervision of the project and the technical and scientific support to the PRC. This contact will be by direct agreement with WMO.

3.4.5 Preparation of the Terms of Reference for the evaluation of the Project which should be conducted during the second year.

4. ASSUMPTIONS

A number of external factors would be instrumental in the success of the project.

4.1 Assumptions at different levels.

A precondition to the start of the project was the selection by the SADC member countries of the host institution for the PRC which will play a vital role in the implementation of the project. During a special meeting held in Pretoria, South Africa on 1st ans 2nd February 1996, and on the basis of the recommendations prepared by a mission fielded to the candidate host institutions by EU and SADC (see Attachment B) the SADC-ELMS Water Resources Technical Committee (WRTC), identified the Department of Water Affairs and Forestry (DWAF), South Africa, as the most suitable institution to host

the PRC. The role and responsibilities of the PRC will be clearly stated in an agreement signed by SADC and DWAF.

It is assumed that following the selection of the host institution for the PRC, an agreement will be signed between SADC and this institution. Such an agreement will describe the role, responsibilities and tasks of the PRC and the nature and level of external support requested. It is therefore assumed that the host institution will remain committed to actively support the PRC for the implementation of the project.

It is also assumed that at the national level the governments will remain committed to support their national hydrological services in terms of budget and personnel and that the national services will:

(i) operate and maintain the national segments of SADC-HYCOS as part of the national network;

(ii) validate the raw data received from the DCPs and send back the validated data to the PRC;

(iii) participate in and benefit from the different training possibilities; and

(iv) consider that they are all partners and stakeholders in the system.

Above all it is assumed that the SADC member countries will remain committed to implement the Protocol on Shared Watercourse Systems and therefore develop and support the necessary tools, SADC-HYCOS being one of these tools.

4.2 Risks and flexibility

The HYCOS project faces two types of potential risk:

4.2.1 Technological failure

The HYCOS project uses modern computer and satellite technology. Whilst some of the technology to be involved is very new, most of the components are well tested in the field and have successfully been used for a number of years. The risk of the project failing for technical reasons to meet its objective of providing a working, sustainable satellite-based data collection system is therefore real, but small.

4.2.2 Institutional failure

The project relies on the active participation of national hydrological services, with limited funds supplied from the project for the installation of the DCPs if necessary. The operation and maintenance of the national segments of the project are part of the normal activities of the national services. However, the withdrawal or non-participation of some countries does not jeopardize the success of SADC-HYCOS as a whole; it merely means that those countries will not be able to enjoy the benefits of the system, and that data from those countries will not be available through SADC-HYCOS.

The SADC-HYCOS data base is intended to be available to all SADC participating countries. Some countries, however, may be unwilling to release hydrological data from SADC-HYCOS DCPs installed within their national borders. It is proposed that countries can only participate in HYCOS if they are willing to make their data available to the other SADC countries, under conditions discussed with the SADC bodies concerned.

This is a technologically-advanced regional project, but simple in concept and in implementation. Moreover, the experience from numerous projects implemented by WMO and other agencies is very convincing in assuming that SADC-HYCOS can be successfully executed. Another major obstacle to the project development can be the lack of trained personnel. However, the training required for specific systems within SADC-HYCOS is incorporated in the proposed project itself.

A regional project, such as HYCOS, has inherent risks of natural, political, social, financial, economic and other origins, which should be pointed out whenever possible. However, the SADC-HYCOS project has considerable flexibility which should minimize risks arising from these sources. The main risks and their probability of occurrence are:

Risks	Probability
Lack of counterpart funds for infrastructure.	Small, since most of the infrastructure is already in place, and the SADC-HYCOS stations are integrated in the national network
Lack of trained staff.	Little since the project integrates relevant training activities.
Delays in project implementation.	Possible, but avoidable if the schedule of activities is monitored carefully.
Little use of project's products.	Products are required in the framework of the SADC Protocol on Shared Watercourse Systems
Failure of the SADC political support	Little, since the Protocol on Shared Watercourse Systems was adopted in August 1995.

5 IMPLEMENTATION

The project will be implemented by the PRC hosted by an existing regional institution selected by the SADC member countries (see Attachment B). The PRC will implement the project with the support of Technical Assistance (TA) funded by the project and with the technical and scientific support of WMO acting as the supervising agency.

5.1 Physical and non-physical means

5.1.1 Equipment

- 40 DCPs with 6 sensors (upstream and downstream water levels, rainfall, air and water temperature and conductivity
- 10 DCPs with 5 additional sensors (turbidity, humidity, wind speed and direction and net radiation)
- 10 field conductivity metres
- 5 sets of spare parts
- 10 mounting kits
- 11 M card or EEPROM readers
- Training by the contractor (2 weeks)

5.1.2 Technical Assistance

- 6 weeks assistance to the PRC for the preparation of the **implementation plan**, which shall include the final list of stations selected for approval by the countries, the organization of a SADC-HYCOS technical meeting and the preparation of the report of the meeting.
- Technical support to PRC and/or countries for installation, operation and maintenance of the DCPs through:
    - 2 weeks at PRC for preparation access to METEOSAT DCS
    - 2 weeks training at PRC for installation of the DCPs,
    - 3 missions in the countries (7 weeks each) to support in-situ installation and system set-up
    - 3 missions in the countries (11 weeks each) for operation and maintenance with a technician from the PRC
- Financial support will be provided to some countries for installation of the DCPs

Technician(s) from the PRC and from the countries shall be involved in the above-mentioned activities

- Development and implementation of the regional data base and support to national data bases. 2 missions (3 and 4 months) at the PRC and provision for the procurement of software
- Development and implementation of an e-mail network. 2 missions (5 and 7 weeks) and provision for equipment (modem and software).
- Development and implementation of a data exchange and dissemination system, through

segments of the WMO GTS. 2 months including a mission and a training session at the PRC. This task shall be subcontracted to WMO.

- Support PRC for the development of products from the data base. 4 months mission at the PRC.
- 5 individual technical visits and/or specific training of 1 month each.
- 6 training sessions at PRC of 1 week each for 10 trainees.
- 10 attachments programmes of at least 1 month each.

The PRC shall manage the above training activities with the countries, in terms of travel and DSA. The PRC shall also implement the attachment programmes. The input of technical assistance shall therefore be limited to its participation in the 6 training sessions by providing an expert and by organizing and/or implementing the technical/scientific visits.

5.1.3 Supervision and facilitation

- 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 (see 5.1.2);
- 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 (twice a year) to the SADC ELMS WRTC and participation in any meeting of relevance for the project, including the SADC-HYCOS Steering Committee meetings (once 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.

5.1.4 Imprest fund

This fund shall cover:

- Travel and DSA for the personnel of the PRC participating in the technical assistance missions in the region;
- Initiatives from the PRC in terms of meetings, small additional equipment, training and technical assistance as needed for the implementation of the project.

5.1.5 Local personnel

The PRC and participating countries will made available the necessary personnel, mainly an hydrologist, a technician and any other scientific, technical and support personnel necessary for the implementation of the project. This personnel will be trained as necessary through the technical assistance described in 5.1.2 or through the imprest fund (5.1.4). The salary of this personnel will be supported by the institution hosting the PRC. The extra cost such as travel and perdiem related to the implementation of the project will be payed by the project through the imprest fund.

5.1.6 Local infrastructure and equipment

The host institution will made available to the PRC the necessary infrastructure and equipment needed for the implementation of the project and especially the METEOSAT DRS, the training facilities, computer facilities, communication facilities and offices.

Inputs from the PRC shall be agreed upon through an agreement signed between the host institution and SADC.

5.1.5 Evaluation

An independent evaluation will take place in the second year of the project. It will require to appoint 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 includes proposals for a possible continuation of the project.

5.1.4 Contingencies

To cope with equipment and airfare increase and possible extra services to be authorized by the Contracting Authority.

5.2 Organization and procedure

5.2.1 Role of SADC

SADC will be the Contracting Authority and will facilitate the smooth implementation and the review and evaluation of the project, notably through its Water Resources Technical Committee.

5.2.2 Role of the PRC

The primary role and responsibilities of the PRC will be liaison co-ordination and initiation, through activities in monitoring, networking, training and assistance for the successful implementation of the project. The PRC shall serve as a focal point of a regional network grouping all the participating countries.

On behalf of SADC and according to an agreement to be signed prior between the DWAF of South Africa and SADC, the PRC will implement the project under the supervision of WMO and with the support of technical assistance and of WMO.

The main tasks proposed to the PRC are:

- 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 plan for SADC-HYCOS which will include the final list of stations;
- Prepare and present an implementation plan of 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 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 mean;
- 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. Since this regional data base is the physical corner stone and the heart of the system, all the participating countries should be closely involved in its development;
- 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 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 as indicated in 5.1.2 and of WMO as technical and scientific advisor.

5.2.3 Role of the participating countries

In each of the participating countries, the designated national agency responsible for hydrological services will coordinate local SADC-HYCOS activities and carry out field operations on a day-to-day basis. The participating countries will provide the required national staff who will remain closely associated with SADC-HYCOS operations in their countries. The countries will also provide the necessary means including the vehicles for the field missions to be undertaken by the PRC and the technical assistance.

The specific role of the designated national agency includes the following activities:

- Participate in the installation of the national segment of HYCOS - SADC 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

established 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;
- Ensure the security of the facilities in the participating countries.

5.2.4 Role of WMO

The role of WMO is to supervise and facilitate the implementation of the project and to provide a technical and scientific support to the PRC and to the countries. In this regard, WMO will notably prepare and submit to SADC ELMS the necessary monitoring reports (every 6 months) and draft final and final reports, which will inturn be submitted by SADC ELMS to the EU For that purpose WMO will conduct the following activities:

- Evaluation of tenders;
- Contacts/visits(EUMETSAT and contractors);
- Development of codes for GTS (T.A sub-contract);
- Monitoring:
  - 6 missions to PRC and countries of 15 days each;
  - preparation of six-monthly and final reports;
  - overall assistance to PRC.

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 set of data exchanged on the Global Telecommunication System (GTS) of the WWW Programme includes initially the meteorological data required for the operation of the WWW Programme, which is considered as the basic WMO Programme to assist in the implementation of other Programmes. The set of data exchanged includes also other environmental data such as hydrological, agrometeorological, oceanographical, radiological and seismological data.

The GTS includes telecommunications components which could be used to satisfy requirements in terms of exchange and distribution of data within the framework of the implementation of the SADC-HYCOS Project.

Under a subcontract, part of the technical assistance, WMO will arrange access for SADC-HYCOS to existing segments of the GTS, including free access to the METEOSAT Data Collection System (DCS), provided the technical and administrative requirements of the operator of the satellite, EUMETSAT, located in Darmstadt, Germany, are fulfilled.

5.3 Timetable (see Table 5.3.1)

5.4 Cost estimate and financial plan

Activity/component under technical assistance contract	Total cost in ECU	Type of input
Procurement of : - 40 DCPs with 6 sensors (upstream and downstream water levels, rainfall, air and water temperature, conductivity - 10 DCPs with 6 additional sensors(turbidity, humidity, wind speed and direction, net radiation) -10 field conductivity metres - 5 sets of spare parts - 10 mounting kits - 10 M card or EEPROM readers - Training by the contractor (2 weeks) **TOTAL COST**	475 000 150 000 8 000 33 000 33 000 37 400 16 000 **752 400**	Equipment
TASK A assist PRC for: final list of stations (2 weeks) preparation of the implementation plan (3 weeks) SADC-HYCOS technical meeting and report (1 week) **TOTAL COST**	 **20 000**	Technical assistance Contractor
TASK B Assist the PRC and the countries for the installation operation and maintenance of the DCPs - 2 weeks mission at PRC for administrative arrangements - 2 weeks mission at PRC for training related to installation - 3 missions (7 weeks each) to provide assistance for DCPs installation and systems set-up - 3 missions (11 weeks each) to provide assistance for operation and maintenance - support to some countries for installation of the DCPs **TOTAL COST**	 50 000 **296 000**	Technical assistance Contractor
TASK C Assist, the countries and the PRC for the development and implementation of the regional data base - 3 months mission for assessment and proposal - 4 months mission for implementation - provision for software **TOTAL COST**	 96 000 20 000 **116 000**	Technical assistance Contractor
TASK D Development and implementation of an e-mail network - 5 weeks mission for assessment and proposal - 7 weeks mission for implementation and training - provision for modems and software **TOTAL COST**	 48 000 20 000 **68 000**	Technical assistance Contractor
TASK E Support to PRC and countries for the preparation of hydrological products - 4 months at PRC including a workshop **TOTAL COST**	 **64 000**	Technical assistance Contractor
TASK F Support to PRC for the organization and implementation of training activities - preparation of the training programme with PRC - 6 training sessions at PRC of one week each with 10 trainees - implementation of 5 technical /scientific visits of 1 month each **- 10 attachment programmes of 1 month each at PRC** **TOTAL COST** (excluding travel and DSA for trainees)	 **28 000**	Technical assistance for training Contractor
Use of segments of GTS for data dissemination and exchange - 1 mission of 5 weeks at PRC and in the countries - preparation of a proposal - implementation and organization of a workshop at PRC **TOTAL COST**	 **35 000**	Technical assistance subcontract with WMO

Travel and DSA for Training sessions for 10 trainees at PRC of 1 week each with external support to assist PRC - 6 training sessions **TOTAL COST**	 **30 000**	Training Funds managed by PRC under supervision of WMO
Travel and DSA for Technical visits and/or specific training of 1 month each - 5 individual visits and/or sessions - 10 attachment programmes at PRC (1 month each) **TOTAL COST** (see TASK F)	 **74 000**	Training idem
Imprest fund: - initiatives from PRC in terms of meetings, training, additional equipment and technical assistance needed for the implementation of the project -Travel and DSA of PRC personnel **TOTAL COST**	 100 000 74 000 **174 000**	Managed by Technical assistance and PRC

Specific activities	**Cost ECU**	
Supervision of the project		
-Evaluation of tenders (including 1 mission to SADC ELMS CU)	10 100	
-Contacts/visits(EUMETSAT and contractors) including travel costs	17 675	
-Monitoring:		
- Review of the technical and administrative technical assistance reports	12 100	
- 5 missions to PRC and countries of 15 days each	55 125	
- preparation of six-monthly and final reports	12 100	
- overall assistance to PRC	12 100	
- Contingencies	10 000	
TOTAL COST (including support Agency cost)	**129 200**	
Evaluation of the project by an external expert		
- 3 weeks mission to PRC and some countries	12 000	
- preparation of the report	6 000	
TOTAL COST	**18 000**	
Contingencies (8%)	**150 000**	
Total cost for the project	**1 964 200**	

Table 5.3.1 Timetable
(in months)

Activity/Tasks	2	4	6	8	10	12	14	16	18	20	22	24
Preparation of the Implementation Plan (IP)	*											
SADC-HYCOS technical meeting (approval of the IP by countries)	*											
Delivery of the equipment at PRC		*										
Training by the manufacturer for DCPs operation and maintenance		*										
Training for DCPs installation			*									
Installation of DCPs by countries			*	***	*							
Missions in support to some countries for DCPs installation and set-up				***	**							
Missions in support to countries for DCPs operation and maintenance							***		***		***	
Development and implementation of the Regional Data Base (RDB)			***	*		***	***					
Development and implementation of the electronic networking			***		***	**						
Preparation for access to segments of the GTS			***		**							
Preparation of products from the RDB										***	*	
Training sessions						*		*		**		*
Attachment programmes							***	***	***	***	***	***
Technical/scientific visits								*	*	*	*	*
Supervision	*	*	*	*	*	*	*	*	*	*	*	*
Evaluation												**

Time 0 is the date of the arrival of the technical assistance at the PRC to help in the preparation of the implementation plan and SADC-HYCOS technical meeting (approximately 1 month after the purchase order for the equipment would have been sent)

Cost per type of input

Equipment	:	752 400
Technical Assistance (including imprest fund)	:	750 000
Training:		165 000
Supervision	:	129 200
Evaluation	:	18 000
Contingencies	:	150 000
Total ECU		**1 964 600**

5.5 Special conditions and accompanying measures taken by SADC

SADC countries have selected the host institution for the PRC. The host institution and SADC have to sign an agreement establishing the role, activities and tasks of the PRC and the means: (I) to be provided to the PRC by the project, and (ii) to be put at the disposal of the PRC by the host institution for the implementation of the project. The member countries have to agree on the role of their national agencies and on the means to implement the project.

6. FACTORS ENSURING SUSTAINABILITY

6.1 Policy support

The SADC head of States Summit has approved the concept of a SADC-HYCOS in January 1994 and this project is part of the SADC ELMS programme (AAA.7.9). All SADC member countries but two have signed the Protocol on Shared Watercourse Systems and are committed to improve their co-operation in the field of water resources assessment, monitoring and management. The countries have proposed the stations they would like to integrate in the SADC-HYCOS network on the basis of their importance at both national and regional levels, mainly on international rivers upstream and/or downstream the border. The countries have also requested that this operational project be implemented by a regional centre hosted by a regional institution with the human, technical and scientific capacities to sustain the project.

6.2 Appropriate technology

The technical aspects have to be considered in terms of their capacity to meet the needs expressed by the users, their reliability and efficiency within the socio - economic environment of the SADC region, their cost effectiveness, their compatibility with existing systems and their possible implication for the environment.

6.2.1 Data acquisition and transmission system

6.2.1.1 Data acquisition

The proposed solution for SADC-HYCOS includes DCPs equipped with automatic sensors, "intelligent" data collection systems and on site data logger. The main advantages as compared to other solutions are: (I) to avoid human error in the readings of the instruments and to minimize gaps due to observer failure; (ii) to avoid traditional problems of graphical recording on chart or paper tape, both of which are very sensitive to climatic conditions; (iii) to allow the direct transfer of the data, in digital form into computerized databases; (iv) to modulate the rhythm of data acquisition according to the dynamics of each of the parameters measured and to the real needs; (v) to have the possibility of the raw data being processed in the field before their transmission; and (vi) especially for water level measurement, to have the possibility of locating the measurement site away from the collection site, to take advantage of the best hydraulic conditions, with lower installation costs and a higher degree of accuracy.

These new DCPs are currently in use in the African environment and they have proved considerable advantages in reducing the gaps and errors in the time-series of data collected, this one being of the major problems pointed out by the SSAHA.

6.2.1.2 Data transmission

It is proposed to use METEOSAT DCS for the transmission of the data collected by the SADC-HYCOS key stations. Contrary to the general opinion the choice of real-time satellite transmission is not necessarily related, **or not only** related, to the degree of urgency the data are needed at the receiving point. Two other functions of satellite telemetry have to be considered, especially in the case of SADC-HYCOS and according to the needs expressed. For some of the stations selected, a need for real-time data could exist for a particular use (flood forecasting, reservoir operation, etc.) but for all of them the main interest of using satellites is (i) to secure and speed up the data transmission and, (ii) to permit remote control of the status of the DCPs. As far as data transmission security is concerned, a recent WMO report concludes that although a number of meteorological data are currently collected at stations, the slow and incomplete national collection of such data by a number of National Meteorological Centres in Africa and their onward transmission to the respective Regional Telecommunication Hubs, was the result of the very poor status of the telecommunication systems used in the region. The main recommendation of the report was, therefore, that there was a need to use Data Collection Platforms (DCPs) and Data Collection Sytems (DRSs) using the capability of METEOSAT[7].

The control of the field stations is normally ensured in traditional hydrological networks by control and maintenance visits. The SSAHA has demonstrated that shortage of funds and problems of transport were very acute. Therefore any possibility of field trip optimization should be considered.

Considering the primary objective of SADC-HYCOS, the establishment and implementation of a network of key stations providing reliable, up-to-date, continuous flow of data, for the monitoring of regional water resources, the technical choice proposed appears to be the most appropriate solution. This solution is fully compatible with the existing traditional data collection and transmission systems available in the SADC region and no specific impacts on the environment could be reasonably foreseen except positive ones through the establishment of a regional monitoring tool for environmental variables.

The cost estimate of alternatives should take into consideration the fact that if the cost of capital investment for the proposed data acquisition and transmission system is higher than for traditional systems, then as already demonstrated, two types of benefit could be anticipated by using the modern technology proposed for SADC-HYCOS: (i) direct savings in operation and maintenance cost, as demonstrated in a report prepared by ORSTOM for the rehabilitation of the hydrological network of Benin[8], and (ii) indirect savings, which are difficult to quantify in terms of money such as, saving of time of personnel in the routine operation of existing systems and the use of this time for generating more beneficial development related to the users needs for products, the security and quality of data produced, the reduction of time lag between observation, control and dissemination, and ease of user access to the data base.

6.2.2 Regional data base and electronic network

These two components of the proposed SADC-HYCOS will be able to provide SADC ELMS, and the national agencies of the participating countries, with tools for the regional monitoring of the water resources, the exchange and dissemination of data and products and the interconnection with other national regional and global databases and information systems. This solution is fully compatible with the need to integrate the data from the database with other types of information using information system. These electronic media have already demonstrated that they were reliable, cost effective and, in fact, absolutely necessary for data storage, retrieval, processing and dissemination. The PC's (486) provided by SADC to each hydrological national agencies of the member countries for the operation of their national databases could be easily, and at low cost, equipped with modems, and they will, therefore, constitute the basis for the regional electronic network in the field of water resources and a segment of more general information system on water.

6.3 Environmental protection

This project is in no way seen as potentially armful for the environment. The data and the information which will be produced and disseminated by the system will participate to an environmentally

[7] Final report and recommendations concerning the implementation and use of Data collection platforms (DCP) and DCP Retransmission System (DRS) Equipment in Regional Association (RA) I (Africa). WMO, April 1993.

[8] La télétransmission satellitaire: une méthode de gestion plus économique des réseaux hydrologiques dans les pays en voie de développement. ORSTOM, Montpellier, avril 1987.

safe management of the water bodies in the SADC region.

6.4 Socio-cultural aspects/women in development

Some of the products to be prepared by the PRC on the basis of the data and information collected by the system should be oriented to the general public for its information and motivation. Negative social implications will be very limited if any, since these stations, even equipped with"intelligent" sensors, will still need an observer or a watchman. Positive impacts can be anticipated through the considerable improvement of staff technical skills.

6.5 Institutional and management capacity

The project will be implemented by a PRC hosted by an existing regional organization involved in operational hydrology. The PRC will be supported by this organization and by the project. The national agencies which will be responsible for the national segments of the system appear to be committed and to have, in general, enough means to include these segments in the national networks. However, the success of the project is based on the full participation of the countries which should consider themselves as stakeholder in the system.

6.6 Economic and financial analysis

The economic justification and cost effectiveness of HYCOS - SADC have to be considered in the light of two facts of particular importance in the SADC region: (i) the present and future availability of the water resources, and (ii) the distribution of the main water resources within a large number of international river basins.

6.6.1 Renewable fresh water resources availability in the SADC region

Water is a central resource in the SADC region. In 1955, all the 11 continental SADC countries had abundant per capita water resources. Rapid population growth, recent periods of drought and the mismanagement of the existing water resources, including pollution, have resulted in water scarcity situation for four out of the 11 countries. Estimates for the year 2025 suggest that six countries will suffer water scarcity under all water/population growth scenarios[9]. This will, among other consequences, slow down or even make impossible the development of these countries. But the actual situation could be even worse, either due to a higher demographic pressure, or to an oversimplified hypothesis used for the calculation.

6.6.2 International river basins in SADC

There are fifteen international river basin in the SADC countries, out of which seven cover an area 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 countries share at least two international river basins, with a maximum of nine for Mozambique. Water resources and political and economic development in SADC have not yet reached a stage where their utilization can result into political conflicts. However, although there are currently no serious conflicts between the users or usage of water resources at the national and regional levels, the probability of these is increasing as the pressure on the limited and irregularly distributed resource is growing. In addition to the problems already quoted in 2.2 some potential regional conflicts have already be identified[10] such as: the Chobe-Vaal Water Project, the Southern Okavango Integrated Water Development Project, the Batoka Gorge Hydroelectric Project and the Bulawayo Water Diversion Project.

There are a number of projects related to regional water transfers. Some are being implemented, such as the Lesotho Highlands Water Project for the export of water to RSA of 70 $m^3 s^{-1}$, which is about half the country's water resource. Some are still under discussion and will benefit from the creation of a "neutral" up to date regional information system, which could be referred to by all parties.

It is essential, both at the national and regional levels, to develop the effective management of

9 Sustaining World Population and the Future of Renewable Water Supplies. Population Action International, Washington, D.C.,1993.

10 International Environmental Conflict Resolution. The role of the UN. J.M. Trolldalen.

the water resources. This requires basically three conditions :

(a) **The regional vision** of water resources assessment, monitoring and management supported by the political will for the integrated socio - economic development of the SADC member countries;

(b) **The institutions** to translate the political agreement into actions;

(c) **The tools** to allow the institutions in charge to fulfil their tasks.

In the case of SADC, the regional vision already exists and is being politically endorsed, for instance through the Protocol on Shared Watercourse Systems, established under the SADC Treaty and signed by all the SADC countries but two in August 1995.

The tools are still to be created and SADC-HYCOS is one of them, since both the report of the International Conference on Water and the Environment[11] and the fresh water chapter (Chapter 18) of Agenda 21 recognize that knowledge of the hydrological cycle, in terms of both quantity and quality, is the essential basis for effective water management. Such knowledge is based on the data collected through hydrological networks, generally operated by the national hydrological services and there is already quite a body of information providing financial justification for effective hydrological data collection.

A large number of cost-benefit assessments have been conducted worldwide[12,13]. For instance the benefit-cost ratio found for hydrological networks in Australia and in Canada are respectively of 6/3 and 9/3. A recent report[14] prepared for the Ontario Region of the Environment Canada regarding an assessment of the hydrometric network, stressed that "those agencies, private and public, that are involved in the planning, design, and operation of water and water related infrastructure will also continue to require real-time and historical records upon which to base many economic decision" and also that "the biggest network related deficiency, therefore is the lack of reliable, generalized water information describing the availability and trends in the resource that can be widely and efficiently applied". A rough estimate for the SADC countries of the value of hydrological data has been conducted, based on the SSAHA. Estimates of the future demand for water in each country and projected water supply investment for urban, rural and agricultural purposes have been carried out (see **Table 6.6.1**).

11 CWE, 1992. *The Dublin Statement and Report of the Conference.* International Conference on Water and the Environment.

12 Cost - Benefit Assessment Techniques and Users Requirements for Hydrological Data. OHR No.32. WMO-No.717, WMO, 1989.

13 Economic and Social Benefits of Meteorological and Hydrological Services - Proceedings of the Technical Conference (Geneva, 1990). WMO-No.733, WMO, 1991.

14 R.V. Anderson Associates Limited, 1992. *Networks in Transition.* A review of the Federal Hydrometric Network in Ontario, Canada.

Table 6.6.1

Country	Population (millions)		Increase (millions)		Water supply cost (1989) US $ million			Irrigation present area (1,000 ha)	Irrigation projected increase (1,000 ha)	Irrigation cost (1989) US $ million	Total capital cost (1989) US $ million
	1989	2010	Urban	Rural	Urban	Rural	Total				
Angola	9,7	17,4	4,3	3,4	1,883	310	2,194	10	10	150	2,344
Botswana	1,3	2,7	0,48	0,92	210	84	294	6,5	6,5	97,5	392
Lesotho	1,7	2,9	0,55	0,65	241	59	300	2	2	30	330
Malawi	7,9	16,1	1,83	6,37	802	581	1,383	21	21	315	1,698
Mozambique	15,5	28,8	6	7,3	2,628	666	3,294	70	50	750	4,044
Swaziland	0,7	1,4	0,36	0,34	158	31	189	51	50	750	939
Tanzania	26	55,7	11,91	17,79	5,217	1,623	6,840	140	50	750	7,590
Zambia	7,6	15,8	4,89	3,31	2,142	302	2,444	21	21	315	2,759
Zimbabwe	10,1	21,5	4,36	7,04	1,910	642	2,552	144	50	750	3,302

Source: World Bank and UNDP (1990)
Notes: (1) Assume 100% access to water.
(2) Assume urban demand of 120 litres/capita/day (l/c/d).
(3) Assume rural demand of 50 l/c/d.
(4) Assume capital cost of US $ 10 m^3/year for urban water supply.
(5) Assume capital cost of US $ 5 m^3/year for rural water supply.
(6) Assume capital cost of US $ 15,000 per ha for irrigation.
(7) Assume existing irrigation is doubled up to a maximum of 50,000 ha.

The necessary investment in hydrological assessment, including staff and staff related cost, was, then, calculated. Then, using the coefficients found in Australia and in Canada (percentage of the capital cost of the investment in the sub - sector using the data), the benefits of using hydrological data were calculated. Benefit -cost ratios range from 3.6 to 69.4 indicating that the acquisition and use of hydrological data in SADC is of great benefit to all countries (see **Table 6.6.2**).

The project may provide basic data and processed data (information) in a timely way for economic decision-making. The use of the information must improve the performance of economic systems, such as agricultural irrigation projects, hydropower plants, together with schemes for navigation, drought, floods, etc.

The benefits derived from SADC-HYCOS will affect several different levels of activity. First, at the general level, improved, and more accurate databases will lead to a more precise and timely information products, and therefore, to a more efficient decision-making process at all levels for the purposes of planning and operations. The cost of the SADC - HYCOS information should be considerably more cost effective than that provided by conventional data collection methods. Second, the SADC-HYCOS system, will complement existing data collection systems, and will serve as a catalyst for further improvements in the national hydrological services.

Table 6.6.2

Country	Capital costs		Annual capital expenditure (1989-2010)		Annual benefit (1989-2010)		Annual expenditure on data collection (1989-2010) US $ million	Benefit-cost ratio
	Water supply US $ million (1989)	Irrigation US $ million (1989)	Water supply US $ million	Irrigation US $ million	Water supply US $ million	Irrigation US $ million		
Angola	2,194	150	104,46	7,14	10,44	1,42	0,171	69,4
Botswana	294	97,5	14,01	4,64	1,40	0,92	0,654	3,6
Lesotho	300	30	14,30	1,43	1,42	0,28	0,465	3,7
Malawi	1,383	315	65,85	15,00	6,58	3,00	0,963	10,0
Mozambique	3,294	750	156,86	35,71	15,68	7,14	1,308	17,5
Swaziland	189	750	8,99	35,71	0,9	7,14	0,135	59,6
Tanzania	6,840	750	325,71	35,71	32,58	7,14	3,300	12,0
Zambia	2,444	315	116,57	15,00	11,64	3,00	0,762	19,2
Zimbabwe	2,552	750	121,53	35,71	12,16	7,14	0,519	37,2

Source: World Bank and UNDP (1990)
Notes: (1) 1989/90 prices have been used where ever possible
(2) Benefit factor for water project = 5%
(3) Benefit factor for irrigation project = 10%
(4) Annual expenditure on data collection assumed to be 3 x salaries
(5) Total annual benefit assumed to be 2 x annual benefit for irrigation and water supply (see Table 2)

The modern approach that combines state-of-the-art computer and satellite technologies should attract and motivate young skilled professionals that must further improve and develop the service. Third, at the regional level, SADC-HYCOS will provide a comprehensive information product to be used for regional water-related projects, for international river water treaties, for water-related disease control schemes, etc. This aspect of derived benefits is associated with reducing water quantity and quality externalities within the river basin. And, fourth, SADC-HYCOS will contribute to the international meteorological databases that are used to improve understanding of global weather and climate phenomena.

On the basis of discussions with SADC ELMS and with typical users of hydrological data and from knowledge of the general field, it is possible to conclude that:

(a) HYCOS is demand-driven;

(b) Donor countries are already investing in selected components of HYCOS;

(c) There are well defined users for HYCOS within the SADC region with, in some cases, funds available to spend on the installation and/or maintenance of the infrastructure

The benefits of HYCOS are clearly linked to:

(a) Enhanced economic benefits for defined users;

(b) Reduced benefits relative to the absence of HYCOS (eg. from flood damage; the effects of drought, etc.);

(c) An enhanced national infrastructure that is necessary for national development;

(d) Integrated resource management of international river basins and the alleviation of potential disputes;

(e) Inputs to global issues (e.g. climate change, environmental monitoring, etc.).

Since SADC-HYCOS is conceived as a regional system designed to enhance the shared hydrological services, hence there is a potential impact of HYCOS in promoting broader understanding and cooperation between the Member countries SADC-HYCOS may also contribute to promoting enhanced awareness and the better understanding of the economic value of hydrological information through the policy and decision makers of SADC.

6.6.3 Sustainability /affordability /recurrent cost /revenues

Previous hydrological data collection systems in the SADC region, as well as in many parts of the world, have failed to provide the necessary services, and in many cases have ceased to operate. **In reviewing the results of SSAHA, it becomes apparent that past systems were often designed with few consideration given to the use of the data collected, notably for timely decision-making**. Therefore, the full value of the collected data has not been realized and the development and maintenance of data collection systems were given the lowest budgeting priority. This explains their current degraded conditions.

The sustainability of SADC-HYCOS is, therefore, based on a completely new approach which takes advantage of:

(I) the spirit of the SADC Treaty aimed at advancing co-operation , coordination and integration of socio-economies of Member countries;

(ii) the strong political commitment obtained by the project from the SADC Member countries at the highest Government levels and the need for a regional monitoring tool for the implementation of the Protocol of Shared Watercourse Systems already signed by all SADC countries but two;

(iii) the development of the WHYCOS concept aimed notably at better integrating national and regional hydrological activities into the development and natural capital management processes through:

(a) **The selection of key stations which have a real national and regional interest such as:**
(i) **allocating and monitoring water rights in international lakes and rivers** (Zambia, Zimbabwe);(ii) **planning and operating of dams and hydroelectric plants** (Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, Zimbabwe); (iii) **planning and operating of irrigation projects** (Lesotho, Mozambique, Swaziland, Tanzania); (iv) **predicting low flow in seasonal streams for drought mitigation programmes** (virtually all counties); (v) **evaluation of the water balance in lakes and swamps for environmental purposes** (Botswana, Malawi, Tanzania);and (vi) monitoring of pollution and salinisation (Orange river and lower reaches of the rivers).

Therefore, the basic SADC-HYCOS network will be demand-driven and action-oriented.

(b) **The use of modern technology** for data collection and real-time transmission, in order to improve the availability and timeliness of reliable up-to-date hydrological and related data;

(c) **The improvement of data consistency and availability with the implementation of a regional data base and a regional data and information exchange and dissemination system, actually allowing users to benefit from the data.** The regional data base will be fed with real-time data from the telemetered stations and with data provided at regular intervals by the national data bases. These data bases will be interconnected to national allied data bases and to other regional and global data bases and information systems through an electronic network, in order to speed up and facilitate data exchange and data and information dissemination;

(d) the importance given by the project to **capacity building**, notably to help the national hydrological services to better **identify the end users**, to **prepare the reliable information expected** by them and to **raise their profile in the eyes of the government and of the public**;

(e) **The implementation of the project by a regional centre** hosted by a selected existing institution in the region, through an agreement with SADC.

In addition, further integration of the data secured in the data base with other types of environmental, demographic, economic and land management information would provide to the region an operational tool for resource planning and management, public policy development and environmental reporting.

Therefore,it is anticipated that the economic value of benefits derived from the HYCOS-SADC system at the national, regional and global levels will be recognized by decision makers and users, so that this regional system can be used as a catalyst for national systems and so that it will receive the appropriate support in terms of budget and skilled personnel.

7. MONITORING AND EVALUATION

7.1 Monitoring indicators

The monitoring of the project will be undertaken by WMO and reported to SADC ELMS Water Resources Technical Committee (WRTC). WMO will submit six-monthly progress reports for the WRTC. In turn SADC ELMS will report to EU.

The monitoring will use some key indicators such as:

- the efficiency of the data collection and transmission system based on the quantity of raw data captured and stored in the national and regional electronic archives;
- the quality and the timeliness of the primary and secondary data saved both in national and regional data bases;
- the level of recognition of the value of the products prepared by the PRC and the participating countries at national, regional and international levels;
- the initiatives taken by SADC to make use of SADC-HYCOS as a tool for the regional co-operation and collaboration for the assessment, monitoring and management of shared water resources.

7.2 Reviews/evaluation

A Steering Committee which will include the members of SADC Water Resources Technical Committee and representatives of the EU, WMO and other, as appropriate, will review the project once a year. In addition, an independent evaluation of the project will be undertaken in the second year (1997/8). The evaluation will notably cover:

- the design of the project;
- the implementation of the project;
- the results obtained as compared with those expected;
- the actual performance of the project in the light of the purposes of the project;
- the visibility of the project at national, regional and international levels.

The evaluation will also provide recommendations concerning the future of the project.

8. CONCLUSIONS AND PROPOSALS

The project deals with the most important natural resources for the SADC region, water. Water scarcity is one of the most important, may be the most important factor which might limit in the near future the socio-economic development of the SADC region. The SADC member countries are very aware of the situation and have already taken a number of initiatives in the domain, one being the Protocol on Shared Watercourse Systems signed in August 1995.

The project proposed for funding to the European Union is a capacity building project to support the initiatives already taken by the member countries of SADC aimed at developing and/or improving the regional co-operation and collaboration in the field of water resources assessment, monitoring and management, both in terms of quantity and quality.

The project will be implemented by a Pilot Regional Centre hosted by the Department of Water Affairs and Forestry of South Africa with the support of technical assistance. The World Meteorological Organization will supervise the project and facilitate access and use of the METEOSAT Data Collection System and other appropriate existing segments of the Global Telecommunication System. However,

activities will be decentralized as much as possible to assure actual appropriation of the project by the countries and to maximize the benefit of the project at national level, through a regionally coordinated approach.

A number of assumptions have been made but none appears to be irrealistic and the risks the project fails is limited.

It is therefore proposed that the project be funded for a total cost of 1 964 600 ECU.