



WWF for a living planet



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High Potential in the Lower Zambezi

A way forward to sustainable development



Version 1.0



Delta Alliance

Delta Alliance is an international knowledge network with the mission of improving the resilience of the world's deltas, by bringing together people who live and work in the deltas. Delta Alliance has currently ten network Wings worldwide where activities are focused. Delta Alliance is exploring the possibility to connect the Zambezi Delta to this network and to establish a network Wing in Mozambique.

WWF

WWF is a worldwide organization with the mission to stop the degradation of the planet's natural environment and build a future in which humans live in harmony with nature. WWF recently launched (June 2010) the World Estuary Alliance (WEA). WEA focuses on knowledge exchange and information sharing on the value of healthy estuaries and maximization of the potential and benefits of 'natural systems' in sustainable estuary development. In Mozambique WWF works amongst others in the Zambezi Basin and Delta on environmental flows and mangrove conservation.

From 28 August to 2 September 2011, WWF and Delta Alliance have organized a joint mission to the Lower Zambezi Basin and Delta, in order to contribute to the sustainable development, knowing that large developments are just emerging. The delegation of this mission consisted of Companies (DHV and Royal Haskoning), NGOs (WWF), Knowledge Institutes (Wageningen University, Deltares, Alterra, and Eduardo Mondlane University) and Government Institutes (ARA Zambeze). Several organizations in Mozambique (Hidroelectrica de Cahora Bassa, ARA Zambeze, Provincial Authorities of Tete and Sofala Province, Research Institutes and National Government Institutes) were visited and some took part in the entire mission in order to understand their main challenges at present in the basin and draft jointly the way forward. The main findings of this mission and a suggestion for a way forward are hence a joint effort of Dutch and Mozambique partners and are presented in this paper.



Organizations represented in the delegation

High Potential in the Lower Zambezi

A way forward to sustainable development

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Version 1.0

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List of abbreviations

ARA	Administração Regional de Águas / Water Board
DNA	Direcção Nacional de Águas / National Directorate of Water
EIA	Environmental Impact Assessment
IWRM	Integrated Water Resources Management
MICOA	Ministério de Coordenação de Acção Ambiental / Ministry for coordination of Environmental Affairs
NCEA	Netherlands Commission for Environmental Assessment
SEA	Strategic Environmental Assessment
ToR	Terms of Reference
WWF	World Wide Fund for Nature
ZAMCOM	Zambezi Watercourse Commission

Foreword

It was a pleasure for me to head a mixed delegation on an identification mission to the Lower Zambezi in Mozambique, jointly organized by Delta Alliance and World Wildlife Fund for Nature (WWF) in close cooperation with their Mozambican counterpart institutions and in consultation with the Netherlands Embassy in Maputo and the Water Mondial delta team.

The mission became aware of the enormous challenges the Lower Zambezi is currently facing as a consequence of the ever so needed economic development. The major objective of the mission was to identify the support Delta Alliance, WWF and their respective Dutch and Mozambican partners could mobilize for a sustainable development of this region. A development that meets the human and economic needs in a healthy balance with the environment.

Through this mission the participants have also offered their support to contribute to the development of the Knowledge to Knowledge (K2K) and Business to Business (B2B) components of the Water Mondial activities in Mozambique and the bilateral programs of the Netherlands embassy.

The delegation consisted of a surprising and interesting mix of people with diverse backgrounds, nationalities and affiliation: Mozambican and Dutch experts working for private companies, governmental and non-governmental organizations, research institutes and universities. This mix appeared to be also the guarantee for very vivid discussions and dialogues, and sometimes refreshing conclusions. All delegation members agreed that the relatively pristine ecosystems need special attention. This paper summarizes some of the findings and conclusions of the mission. It should be considered as a discussion paper and a guide for future discussion : a Version 1.0 that will get regular updates.

The partners in the delegation are committed to support a number of short-, mid- and long-term activities that should contribute to a sustainable development of the Lower Zambezi. The conclusions and proposed activities have actually been well received by the National Directorate of Water (DNA) and the Ministry of Environment (MICOA). The only way forward is to achieve full ownership over the future plans by Mozambican partners. This will require a good understanding of the local demand.

I would like to congratulate all the delegation members with their commitment to find ways to secure this beautiful region for future generations from a human, an economic and an ecological perspective. I believe this can become a perfect example of a successful cooperation between public, private and civil society organizations. This will need also the participation of the economic actors in the region.

Tineke Huizinga-Heringa
Chair person Delta Alliance International



Aerial view of the Lower Zambezi

Introduction

At present major developments are just emerging in the Lower Zambezi Basin and Delta

Many and major developments are just emerging in the Lower Zambezi Basin and Delta. Various additional dams and hydropower extension schemes are planned in the Lower Zambezi. Another major development is mining in Tete Province. The first coal of the mines has been produced and exported through the Port of Beira just a couple of weeks ago. Hence, many infrastructure developments are taking place in Tete province and the city of Tete is booming. Other developments include an increase of irrigated agriculture and navigation in the Lower Zambezi River to facilitate the transport of coal. There are also developments ongoing in tributaries of the Zambezi, the Shire River basin in particular in Mozambique, and plans for further dam development in the Kafue catchment in Zambia.

Definition of sustainable development (Brundtland, 1987)

Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

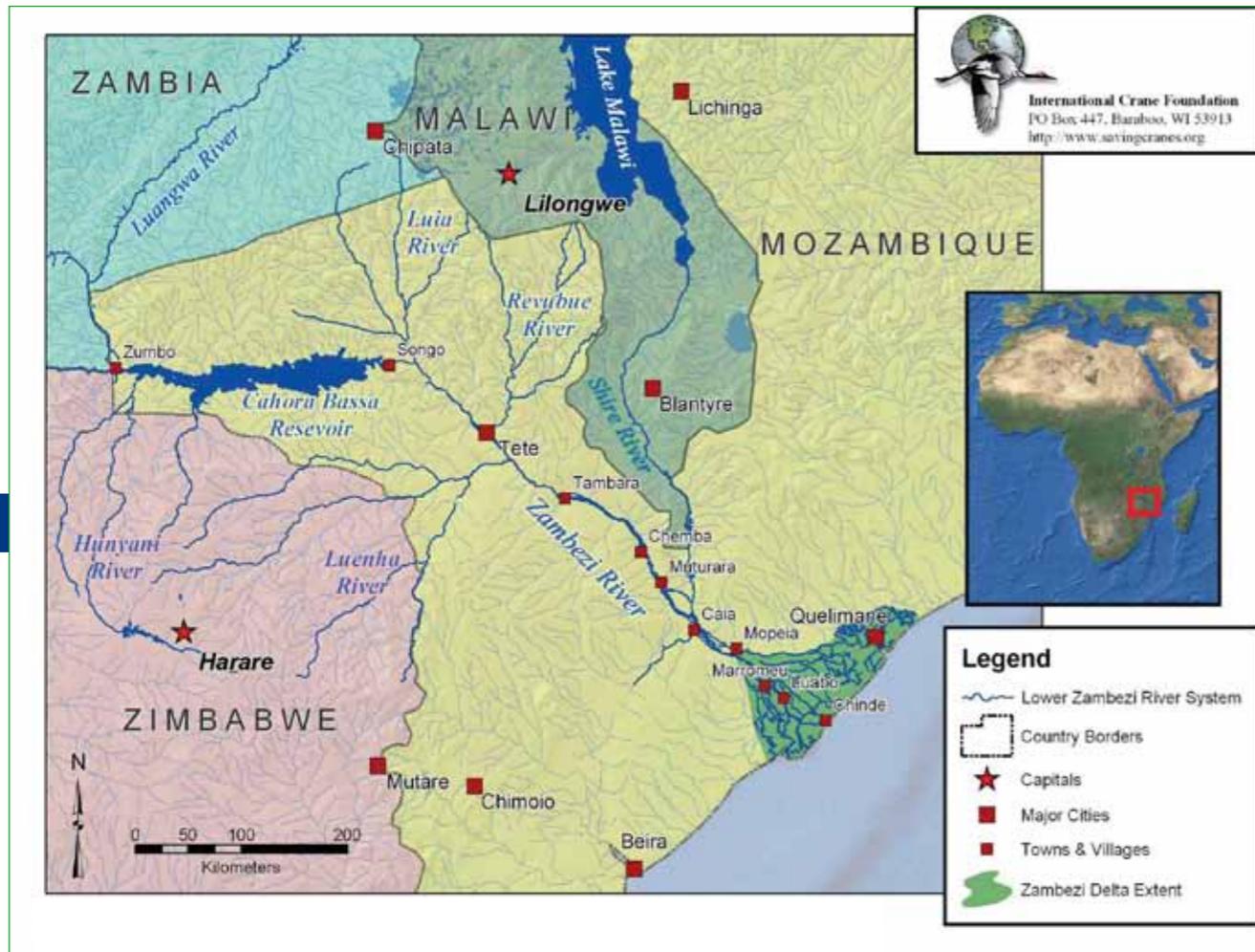
It contains within it two key concepts:

- the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."



This position paper aims to support and guide organizations in sustainable development of the Basin and Delta

This position paper provides an overview of the major developments in the Lower Zambezi Basin and Delta and indicates the main issues that play a role with these developments. Furthermore it suggests a way forward with actions as perceived by the delegates from the Netherlands and Mozambique on the short and mid-term and a long term vision. The information in the paper reflects the information obtained in the various meetings during a mission to the Zambezi Basin and Delta, extended with available reports and literature and expertise that was present in the mission delegation. The position paper is intended as a starting point for long term cooperation in the basin with the ultimate aim to support organizations in sustainable development of the Basin and Delta.



Zambezi River Basin (source: World Bank (2010))

The Zambezi River is one of the largest rivers in Africa and still relatively natural.

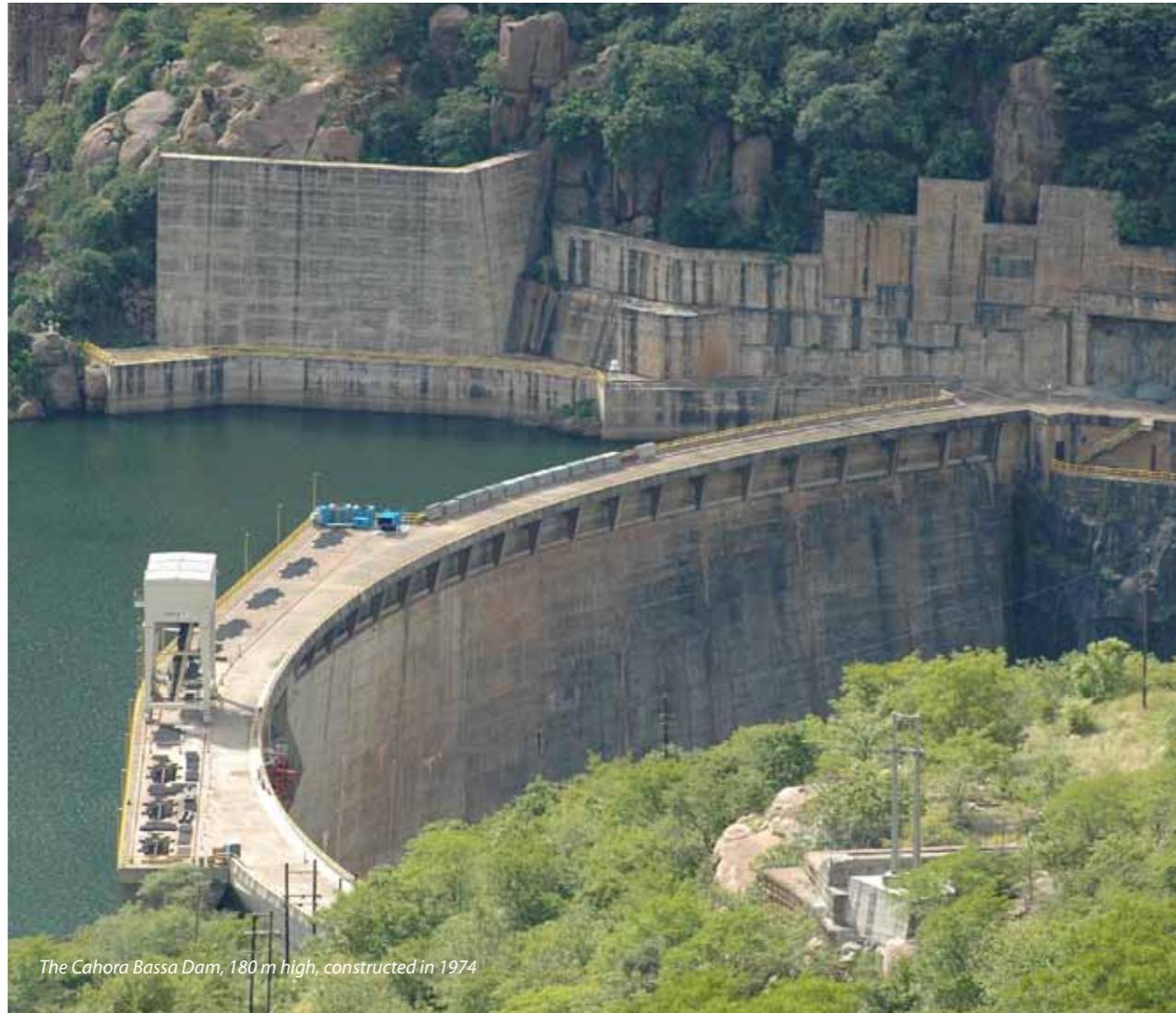
The Zambezi River is the fourth largest river in Africa (2574 km). It is the lifeline for many people and provides unique habitats for nature. It has its origin in Zambia and flows through Angola, along the borders of Namibia, Botswana, Zambia again, and Zimbabwe, to Mozambique, where it empties into the Indian Ocean.

To meet several human development needs the river has been modified, most apparent by the construction of huge dams in the mainstem and some of the tributaries of the Zambezi basin to meet the energy demand of Southern Africa. Lake Cahora Bassa in Mozambique, is one of the two large reservoirs in the mainstem of the Zambezi created by the construction of hydropower dams. Since the construction (in 1974), the flow downstream of the Cahora Bassa dam (called Lower Zambezi) is strongly attenuated and yearly inundation of the riparian floodplains has disappeared. This has severely distorted the Zambezi River's natural flood regime which is the driving ecological process supporting pervasive wetland and riparian habitats, riverine fisheries and subsistence agriculture. As a consequence, biodiversity values have greatly declined and development perspectives for people are jeopardised as they depend on cer-

tain ecosystem services for their survival and economic development.

WWF is executing an Environmental Flows programme (amongst other programmes) in the Zambezi to restore the natural yearly inundation of the riparian floodplains. The prospects for this restoration are very good, in particular in Mozambique, providing new opportunities for nature and people in this part of the basin, without jeopardising hydropower production. Apart from the impacts of the dam, the Lower Zambezi Basin and Delta are nearly natural (see footnote) and with national reserves and a Ramsar site in the Delta (the Marromeu Complex). This wealth of natural resources can well be considered the most important 'capital' for a sustainable economic development of this region.

We foresee a future where ecological capital will greatly support sustainable economic development. This will require a paradigm shift whereby we truly appreciate the African natural resources and find custom-made solutions designed by African forerunners in the field of economic development and ecological conservation.



The Cahora Bassa Dam, 180 m high, constructed in 1974

Developments in the basin

Hydropower

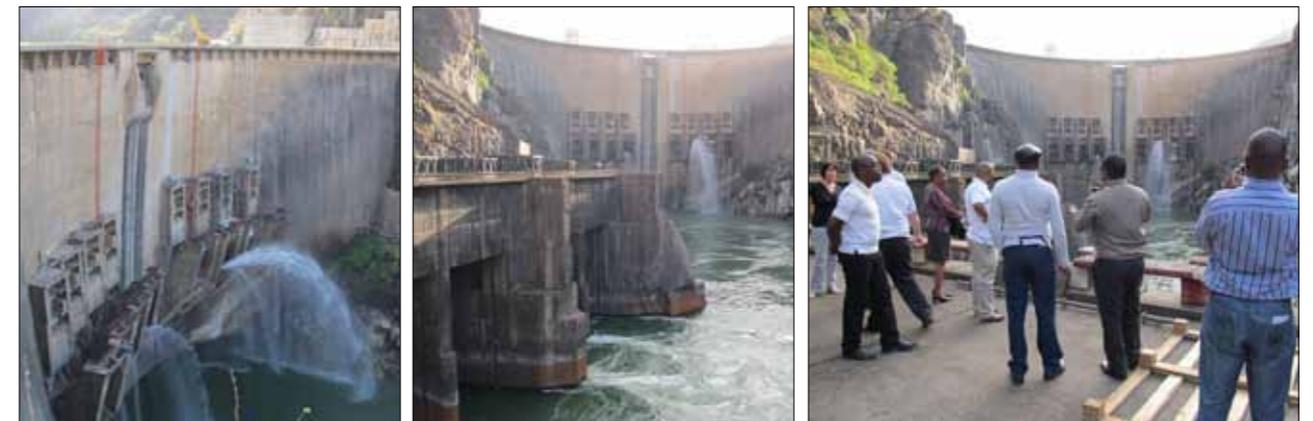
Large Hydropower schemes exist in the basin...

There are several large hydropower schemes present in the Basin. The three largest schemes are (Worldbank, 2010):

- Cahora Bassa Dam, 2075 MW, 12th largest storage area in the world, located in Mozambique, built in 1974
- Kariba Dam, 1470 MW, 3rd largest storage area in the world, located in Zimbabwe
- Kafue George Upper, 990 MW, located in Zambia

... with major impacts on the Lower Zambezi Basin and Delta

The dams had a large impact on the flow downstream of Cahora Bassa, in the Lower Zambezi River and Delta. Most noticeable is the disappearance of the natural (yearly) medium size inundation of the floodplains (providing valuable water and nutrients to people and nature). It is replaced by unpredictable (irregular) large floods in times people have crops on the field, causing disaster for people and nature, even leading to death under local population and livestock. Nature in the Marromeu Complex in the Zambezi delta, the first RAMSAR site in Mozambique, depends heavily on the natural floods. To maintain the RAMSAR site, as well as to improve the livelihoods of people (agricultural production, fisheries, safety), restoration of natural river regime is considered a very positive, large impact measure. Surveys indicated furthermore major changes to the morphology of the river-floodplain system due to flow regulation and reduction in sediment loads. Many secondary channels have been isolated from the main channel, with consequences for biodiversity. Shrimp production in the Delta has shown a decline of 60% between 1978 and 1995 (Davies *et al.*, 2000).



Hydropower extension schemes and new dams are considered throughout the Zambezi Basin...

Throughout the Basin new dams and hydropower extension schemes are considered. SADC (2011) indicates that a total of 17 schemes are identified for the middle Zambezi Basin, consisting of 5 new dams for hydropower generation, extensions to 4 existing hydropower schemes, 5 new dams for irrigation water supply, and 3 new dams for irrigation water supply and hydropower generation. In the Lower Zambezi Basin a total of 6 schemes were identified consisting of 4 new dams for hydropower generation and 2 dams for irrigation water supply. In total approximately 10000 MW can be generated with the new proposed schemes (see Table below).

Proposed new hydropower dams and hydropower extension schemes in the Zambezi Basin

Middle Zambezi			Lower Zambezi		
Scheme	Location	Output	Scheme	Location	Output
Victoria Falls North Bank	Zambezi main stream, Zimbabwe	300 MW	MphandaNkuwa	61 km downstream Cahora Bassa	1800 MW
Devils Gorge	Zambezi mainstream, head Lake Kariba	1200 MW	Kholombidzo	Shire River, downstream of Liwonde	180 MW / 170 MW
Batoka Gorge	54 km downstream of Victoria Falls	1600 MW	Baroma	Downstream Mphanda Nkuwa	444 MW
Kafue Gorge Lower	65 km upstream of confluence Kafue River and Zambezi River	450 MW	Lupata	Downstream of Baroma	654 MW
Mupata Gorge	Between Kariba and CahoraBassa	640 MW			
Victoria Falls South Bank	Zambezi main stem	390 MW			
Kariba extension	Kariba	600 MW			
CahoraBassa Extension	CahoraBassa	1200 MW			
Itezhi-Tezhi	Kafue River	80 MW			
Total		6460 MW			3248 MW

... resulting in further challenges to optimize the operation of dams

At present the relation to international electricity companies dominates dam operation and reservoir management. Hence, the large negative economic and ecological impacts downstream. A desire to use the reservoirs of these dams also for other purposes (like agriculture, but also downstream subsistence use of maintenance of ecosystem services, will therefore be a huge challenge. Another major challenge is synchronization of dam releases. Thus far, the dam operations itself and the lack of synchronization have caused major disasters downstream of the dams. Synchronization of dam releases will require (not yet existing) data sharing and modeling as well as advanced monitoring systems and advanced capacities of dam operators and river management organizations.

WWF started a program to optimize dam operations and restore the natural flows...

WWF has initiated the Joint Zambezi River Basin Environmental Flows program. The objective of this programme is to restore the natural flow regime of the river while not jeopardizing hydropower production significantly, by – amongst others – reoperation of dams into multi-purpose dam operations. This program will therefore ‘make explicit the water requirements (quantity, timing, and quality of water flows) to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems.’ In close cooperation with dam operators and river basin authorities tools and processes for advanced flow forecasting and monitoring will be implemented (WWF, 2010). Dam release harmonization is part of the programme, as the programme covers dams in Zambia, Zimbabwe and Mozambique with plans for extending into Angola and Malawi.

Relation to international electricity companies

The Cahora Bassa Dam produces electricity for South Africa (1600 MW), Zimbabwe (300 MW) and Mozambique (100 MW). The relation to international electricity companies dominates the dam operation

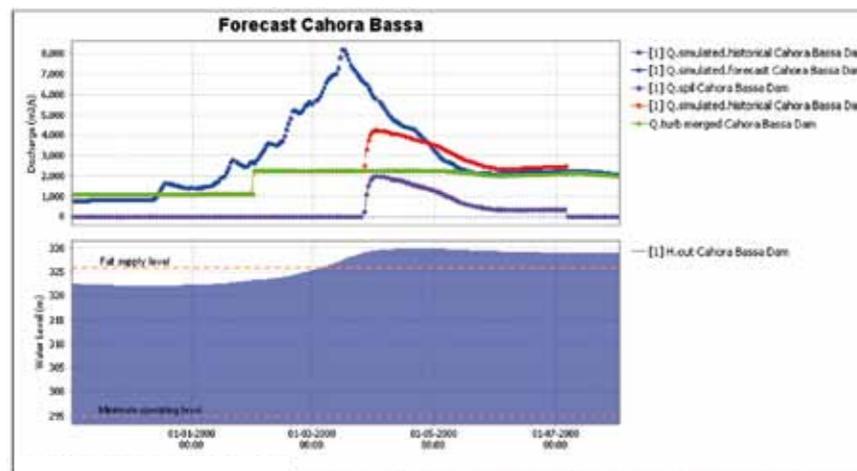


... with promising first results

The studies carried out within the WWF partnership program concluded that there is space for optimization of dam operation to account for environmental flows and flood protection, without compromising hydropower production. A major breakthrough by the partnership programme is a number of agreements in 2011 between dam operators and river authorities and ministries in Zambia, Zimbabwe and Mozambique on data exchange, forecasting and multi-purpose dam operations. After many years of no communication at all between the different countries and agencies, daily data exchange and joint release planning is already operational. The first benefits of these agreements are that dam releases during the coming wet seasons are closely coordinated between Kariba and Cahora Bassa, in consultation with the respective river authorities. It is expected that damage downstream will be minimised. Furthermore, Cahora Bassa has agreed to keep the spill gates closed until December and to plan with WWF and partners for an appropriate/environmental release during the wet season to provide water for dry tributaries like the Salone depression.

Further awareness should be created by linking the different water users in the basin

In order to create more awareness among the different water users in the basin interaction between them should be promoted. Several platforms exist like the Joint Operations Technical Committee by dam operators and river authorities, including basin stakeholders from Zambia, Zimbabwe and Mozambique and the recently ratified ZAMCOM).



Forecast for Cahora Bassa system (SADC, 2011)

A strategic hydropower assessment at basin scale is required

It is obvious that the energy demand in the region (Southern Africa) will increase in the coming years and that hydropower is one of the options to respond to this growing demand. Although being a renewable energy source, it is far from sustainable in many cases, hence the removal of hydropower dams around the world at present like at large in the United States. Construction of new dams should be considered with care, taking all the benefits as well as negative impacts into account. The benefit/socio-economic and ecological impact ratio can especially be improved if hydropower planning is done at river basin (Zambezi) level. It is well understood nowadays that especially the negative impacts can be greatly reduced by better selection of the dam sites, whereby some river sections are kept dam-free and already heavily modified sections could accommodate several dams. In this way key ecosystem services can be maintained, like river flow and sediment transport. Another practical tool for more sustainable development of hydropower is the application of the Hydropower Sustainability Assessment Protocol (HSAP) developed and endorsed by the International Hydropower Association (IHA) and several NGO's. (see <http://peakwater.org/tag/international-hydropower-association-ih/>).

Mining and navigation

Mining is booming business in Mozambique, with large challenges to both the Mining Companies and the Mozambicans.

Mining is booming business in Mozambique in general and especially in Tete Region. That region contains the second largest source of coking coal in the world which is of high quality while the country is considered stable enough for large investors. International Mining Companies (Vale, Rio Tinto/Riversdale) have obtained large concessions for coal mining in that area. Already a lot of investments have been made by the mining companies (doing studies, invest in infrastructure and prepare mines). At present mining operations are ongoing and the first coal is recently exported through the port of Beira. The mining activities impose large challenges to both the Mining Companies and Mozambique.

Coal mining in Tete

The coal mining in Tete Region will be done by means of open cast mining. The earth above the coal will be removed and is placed in an area outside the mining area. Following this the coal will be removed from the mining pit and transported to the coal preparation (wash) plant. The coal will be washed in order to remove the dirt and

rocks within the coal. Two types of coal will be produced in the area: coking coal and thermal coal. Coking coal is used in the steel making process and thermal coal is used for power generation. When the mine is empty the earth that was above the coal will be placed back and cover the mine.

The major issue for the mining companies is logistics, ...

In discussion with representatives from several mining companies it became clear that their major issue is logistics. It is envisaged that over 40 Million Tons will be produced and need to be exported each year. Three transport routes are investigated at present: 1) transport coal by train over the Sena Railway between Beira and Moatize and export coals from the port of Beira (railway capacity at present 6 Million ton / year), 2) transport coals over the Zambezi river to offshore and reload coal into large bulk carriers (proposed capacity 10 Million ton / year) and 3) transport coal by train to Nacala Port and export from there (railway to be constructed with proposed capacity of 24 Million ton / year). As the mining companies want to transport as much as possible coals out of the region in a minimum time span it is proposed to develop all three transport routes.



This will be a frequently seen in the surroundings of Tete



Transport of coal over the river in barges of 350 m long and 35 m wide

... for the city and region of Tete the major issue is population growth, ...

Tete city and region already experience large population growth due to the mining activities. This will increase pressure on the services, schools, hospitals and the roads in the city and region. According to the Provincial Director of Public Works and Housing the province anticipates on this increase in population. There is however no masterplan available for the expansion.



... and for ARA Zambeze the major issue is the effect of the mining process and coal transport on the water resources

The task of ARA Zambeze is to manage the water resources and in this case also advise the national and provincial government about the mining developments. Two major issues are:

- 1) the effect of the mining process on water quality. The major problem with water quality is that after rainfall on the open mine sulfuric acid is formed, which may leak into groundwater or nearby rivers. This process is known as acid mine drainage (AMD) and can cause large pH shifts. At present no information is available to assess the possible pollution by mining and mining companies claim they have all measures installed to prevent pollution.
- 2) the effect of dredging for navigation on river flow and sedimentation processes. Major capital and maintenance dredging are foreseen. This could severely affect present ecosystem functions downstream and thereby local people and nature. With the information that is available at present the effects cannot be fully reviewed.

At ARA Zambeze there is next to lack of sufficient information a lack in capacity to fully understand these issues and advise the government about it. It would be greatly beneficial for all involved, especially downstream stakeholders, if they would be more involved in the development of mining plans and mitigation measures.



What will be the effect on ground water and drinking water reservoirs?

The mining activities will significantly and unavoidably affect the Lower Zambezi Basin landscape...

The coal mining will be done by means of open cast mining. The concessions cover approximately half the province of Tete. The pits that will be created are about 60 m deep. This type of mining will unavoidably have a significant effect on the environment and landscape surrounding Tete. In general effects include amongst others removal of existing vegetation, degradation of air quality, alteration of current land use and landscape, lowering of ground water table and infiltration of poor quality of water into the ground.

... and the Zambezi river itself

The Lower Zambezi river has never been dredged and navigation has only taken place in the past by Sena Sugar from Marromeu to the coast. This in itself makes the Lower Zambezi rather unique in the world as it is one of the few large rivers not dredged or channelized by dykes. Riverdale has recently conducted and submitted a limited EIA to the Ministry of Environment (MICOA) regarding the transport of coal over the Zambezi River. Although this EIA has concluded that the environmental impact of this particular dredging proposal is limited, it is the cumulative impacts that are of great concern to the experts participating in the mission. It is very reasonable to assume that this first dredging activity is the start of much more and large scale dredging. The 'permanent' solution desired by the barging companies to solve the annual, high cost of dredging the Zambezi is very probably deepening the channel and building dykes. That is, channelizing the river as with the Mississippi and many European Rivers, disconnecting distributary channels and preventing natural inundation of large floodplains. This will definitely impact hugely on many ecosystem services, vital for nature and local (subsistence)

people, which will be extremely costly to restore or even impossible if that would be desired in future. So, the most important issue for many downstream users, including nature, is how to assure that the river channel remains natural and is not deepened and channelized.

Transport over the Zambezi will enhance and/or limit other developments

When the river is made navigable it will be used for more than only the transport of coal. Malawi would like to use the river as well for transport of goods and has already constructed a harbor along the Shire River. It will be beneficial to mining companies to maintain a relatively high river level so that barges have more river depth while limiting dredging. Next to the possible impacts as mentioned above, it could also affect requirements for discharges by Cahora Bassa dam. The development of navigation from Tete to the delta will furthermore limit the development of dams for hydropower in that stretch of the Zambezi River.

The economic opportunities that mining creates are of national importance which makes mining companies economically and politically powerful

The economic opportunities created by mining in Tete region are very important to the nation. The concessions will bring money and taxes will provide additional revenue to the government. For the people in Tete region new employment opportunities will become available, not only in the mining business, but also in the supporting businesses (hotels, shops, etc...). Because of the large investments by the mining companies, mining companies are politically very powerful companies. Although the mining creates the above economic benefits, the mining companies are mainly foreign investors and hence will have the largest share in the value chain, 'exporting' most added value of the natural resources exploitation to the foreign countries. From sustainable development perspective it would be interesting to explore how a significant part of the added value in the value chain could remain in Mozambique.

Decisions about mining developments are made at national level

The national government takes the decisions on the developments of mining in Tete. Concessions are provided to the mining companies on national level, and EIAs are also being submitted on a national level. The national government has a major task in planning and judgment of all these developments. Advice is requested by the national governments from provincial authorities and ARA Zambeze. MICOA has a coordinating role in the judgment of the requests of the EIAs that have been produced by the mining companies.

At present the NCEA advises MICOA about a strategic environmental assessment for the Lower Zambezi Basin

MICOA requested the Netherlands Commission for Environmental Assessment (NCEA) to advise the Mozambican Government on a planning model for a multi-sector development plan for the Zambezi catchment, which includes a strategic environmental assessment (SEA). The NCEA was requested to advise on the ToR for the content of the SEA study (see www.eia.nl). Their advise is expected in October 2011.

Proper and integrated evaluation of all the developments in the Basin is the key...

In our discussions with the different stakeholders in the Basin and with representatives from the national government (DNA and MICOA) it was indicated that at present the capacity and tools are missing for the proper and integrated evaluation of the EIAs related to the different developments in the basin. The Delta Alliance - WWF mission delegates offered to provide technical assistance to assess the EIA concerning dredging, which was accepted by MICOA.

... especially for dredging of the Lower Zambezi...

Concerning dredging, evaluating each dredging proposal in a piece by piece manner does not enable the Mozambique government and affected stakeholders to oversee and therefore properly assess the most probable longer term dredging of the Zambezi and it's cumulative impacts. As dredging could be very directive for future development and conservation directions in the near future, it is of utmost importance to oversee the big picture of dredging. The study of NCEA is therefore very appropriate and should provide such a tool to the national government. Time is of essence.

...for which the Mozambican government will be partly responsible

Furthermore it was indicated in the meetings that in the contracts with the mining companies the government of Mozambique has accepted responsibility for provision of transport infrastructure for mining. This could ultimately create a difficult situation for the government as the government will thus need to respond to the negative impacts from the developed transport routes, instead of the mining companies benefitting from the infrastructure.



Agriculture

Agriculture is the second largest water user in the basin and will grow significantly the coming years

In order to improve the food security for the rapidly growing population large investments are needed for agricultural development. Many of the constraints for agricultural development are linked to institutional development, infrastructure and water resources. After hydropower agriculture is the largest water user in the Zambezi Basin. Several large agriculture schemes exist in the lower Zambezi and there are plans to further increase the irrigated agriculture area. The table below provides an indication of the existing, future and upper limit irrigated area potential in the Lower Zambezi Basin taken from World Bank (2010).

Zambezi Delta	Ha/year
Existing situation	7,664
Identified projects	106,774
Upper limit potential	231,774
Tete region	
Existing situation	52,572
Identified projects	108,193
Upper limit potential	508,193

Overview irrigated agriculture, Zambezi Basin in Mozambique



Several specific projects in the Zambezi Basin in Mozambique were mentioned

During our conversation with the provincial directors of Tete and Sofala province several new irrigated agriculture developments were mentioned including 37,000 ha of sugar cane in Mutarara, Tete Province and 15,000 ha of sugar cane in Chemba district, Sofala Province. Furthermore plans exist to increase production of rice in Mopeia area, Sofala Province. Most areas in Sofala Province that are within the Zambezi Basin however are nature conservation areas.

It is noted that in the Shire Basin, which connects to the lower Zambezi near Caia, also several irrigated agriculture projects are identified (an increase from approximately 60,000 ha / year to 160,000 ha / year, (World Bank, 2010).



Existing pipe system at Mopeia (Agrifood Consulting International, 2005)

National Irrigation Strategy

Since December 2010 Mozambique has a national irrigation strategy. The objective of the strategy is formulated as follows: "To contribute to increased productivity and agricultural production for food security, generate surpluses of agricultural products for export, increasing employment in rural and peri-urban areas, and farmer income through a sustainable exploitation of hydro-agricultural potential". In the short term (2012) a National Program of Irrigation will be formulated and its implementation will be started.

These projects will put a claim on the land and available water resources in the basin which need to be evaluated together with other developments

The projects indicated above will put a claim on the land and the available water resources. In the previous sections activities of hydropower, mining and navigation were mentioned. The different activities should be evaluated together in order to verify the availability of water for the different developments. In Beck and Bernauer (2011) it was indicated that with all the future developments availability and demand for water are not in balance at different locations in the basin.

Various constraints were identified for food production related to water management which calls for an Integrated Water Resources Management approach

A recent Dutch – Mozambican food security mission noted the following constraints related to water management: i) the high dependence on water in international river basins, ii) the highly variable climate with frequent floods and droughts, iii) historical underinvestment in water infrastructure and iv) conflicts and water sharing. Therefore, the introduction of an Integrated Water Resources Management approach is urgently needed. The delegation proposes to start with the preparation of a so-called water map. In order to guarantee a sustainable increase of the food production the IWRM approach should be combined with the principles of the Green Growth concept.

Nature development and conservation

The Marromeu Complex is a large nature conservation area in the Zambezi Delta

Downstream of the hydropower and mining developments the Marromeu Complex is situated. The Marromeu complex, which covers a large (southern) part of the Zambezi Delta, is a large and important nature conservation area in the Basin. It consists of the Marromeu Buffalo Reserve, two forest reserves and four hunting concessions. In 2004 the Marromeu Complex was designated as the first and only wetland of international importance (RAMSAR-site) by the government of Mozambique, because of its large size and value for biodiversity, ecosystem services and human livelihoods.



Hippo's are part of the Marromeu complex...

WWF is, together with the Mozambican government and other organizations, working on the protection of this area of high biodiversity value

Several studies have been carried out in close consultation with local stakeholders in order to get insight in for example the number of species that live in the basin, bushfires, conflict between humans and wildlife and possible ways to mitigate it and assessment of sustainable economic development options. The Marrromeu Complex has the largest mangrove forest along the African coast, vital for species and protection of people from the sea. On the basis of these studies a comprehensive management plan for the Marrromeu Complex has been developed waiting final approval by government. There are advanced plans to include the North bank of the Zambezi delta in this RAMSAR site in the near future. From a climate resilience delta perspective, conservation of the Marrromeu Complex is an important effort.

Freshwater flow into the complex is very important

Several initiatives have been started in order to maintain the freshwater flow into the complex. The environmental flow program by WWF is the largest initiative. It will make explicit the water requirements (quantity, timing, and quality of water flows) to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems. It will also implement environmental flows in cooperation with dam operators and river basin authorities. (WWF, 2010). As this programme is a transboundary initiative, protection of headwaters and free-flowing rivers upstream is also on the agenda. An exciting environmental flows experiment planned for later this year (2011) is reconnection of the Salone distributary river in the delta which is also one of the aims of the Marrromeu Complex wetlands management plan.



The modern way of approaching new developments is an ecosystem approach...

Throughout this paper, the impacts of large developments planned in the basin (dredging, mining, agriculture developments, navigation) on nature and especially the Marrromeu Complex have been elaborated. It is especially the 'traditional' development approach of developing large infrastructural works without valuing the natural system properly that lead to large negative impacts on nature and local livelihoods. The modern way of approaching new developments is an ecosystem approach, in which the ecosystem is considered an important support base and ecosystem services are preserved if possible and are an integral part of the economic development direction of such developments.

... in which economic development and ecological conservation support each other

Economic development and ecological conservation should not be perceived as opposing, but as interdependent and supportive to each other. The Lower Zambezi has a wealth of natural resources which can well be considered the most important 'capital' for a sustainable economic development of this region. We foresee a future where ecological capital will greatly support sustainable economic development. This will require a paradigm shift whereby we truly appreciate the African natural resources and find custom-made solutions designed by African forerunners in the field of economic development and ecological conservation. In the context of expected climate change impacts, the well-functioning ecosystem in the Zambezi Basin will probably play a key role in climate change adaptation strategies. This will be further assessed.



Institutional Developments

There are many (governmental) institutes active in the Basin

Different international, national, regional and provincial institutes are active in the Zambezi basin and are partly responsible for or make use of the water resources. Some of these institutes are just started:

- ARA Zambeze, exists for 6 years only, still a small organization with about 35 staff
- National Water Resources Institute, just started (2011)
- Zambezi Valley Development Agency, just started (2011)
- Zambezi Watercourse Commission (ZAMCOM), agreement signed in 2004 and it recently ratified (September 2011) by the basin states

These organizations are still in the phase of developing their capacity and capability to perform the tasks that they are responsible for. At present the capacity of ARA Zambeze is too little to manage and review the effects on the water resources related to the large and fast developments in the basin described above.



How to construct the house of governmental institutes...

A twinning relation between ARA Zambeze and Waterboard De Dommel will improve the capacity of ARA Zambeze

Waterboard De Dommel (from the Netherlands) is assisting ARA Zambeze by means of a twinning relation. In a recent visit (June 2011) the major challenges for ARA Zambeze were discussed. It was decided to develop two plans with ARA Zambeze: a business plan and an integrated water management plan. It is urgent to develop these plans because of the fast developments especially in the mining industry at present. Funding possibilities are elaborated for these plans by Waterboard De Dommel. The World Bank and the Dutch Government are on the brink of launching financial support to IWRM initiatives in the Zambezi Basin in Mozambique, which may (partly) support these plans.

Cooperation between Government institutes, Companies, Knowledge Institutes and NGOs need to be enhanced.

The persons that we have spoken to during the mission are aware of the advantages that cooperation between the different organizations may provide: 1) available data can be shared and 2) synergy can be reached with cooperation. The existing cooperation between the different organizations should be further enhanced in order to be able to pick these fruits of cooperation.

Conclusion

An integrated approach for sustainable development is necessary...

With all these developments indicated above it is clear that there will be competing claims on land and water in the basin. This calls for an integrated approach in the planning of these developments in order to develop the region in a sustainable way: meeting the needs without compromising the ability for future generations to meet their own needs.

... and now is the time to act for Mozambican organizations

Many developments in the Lower Zambezi are just emerging as illustrated in the sections above: large hydropower schemes are in the planning phase, rapid mining developments will continue in Tete region, with possible transport of coal over the Zambezi River, large investments in irrigated agriculture are taking place. Therefore, now is the time to act for Mozambican organizations (Government, Companies, NGOs and Knowledge Institutes) in order to let these plans be developed in a sustainable way.

There is 'High Potential' in the Lower Zambezi...

As the title of this paper indicates, there is 'high potential' in the lower Zambezi. High potential for the development of natural resources, but also high potential for sustainable development of these natural resources. The Lower Zambezi Basin is still a pristine area without major developments at present and this creates an opportunity and a responsibility to develop in a sustainable way. There are many examples around the world that show the consequences when developments are not sustainable. Let us learn from these examples. It starts with awareness of other stakeholders in the basin and collaboration of stakeholders. For this 'high potential' was observed as well during the mission. In discussions with the several organizations we have visited we noted an open attitude for cooperation. High potential to develop sustainably.



Get everybody committed to the integrated approach

... and we are willing to support.....

We, the delegation of this mission, are willing to support the different stakeholders in the basin on their way to develop the area in a sustainable way by promoting long term partnerships and collaboration between different stakeholders in the basin, by supporting Mozambican organizations to improve their capacity and capabilities and by responding with technical assistance on specific requests. During the mission we have discussed and agreed with Mozambican organizations several short and mid-term actions that aim at promoting collaboration and partnerships and provide technical support. We want to commit ourselves to these actions.

..... in close cooperation with other programmes

We like to cooperate closely with other initiatives like the programs of the Netherland Embassy, Water Mondiaal, Waterboard de Dommel and the World Bank.

Why?

Because we care.



Way forward

There is 'High Potential' in the Lower Zambezi for sustainable development and now is the time to act

As concluded in the previous chapter there is a high potential in the Lower Zambezi: high potential for development of the natural resources (hydropower, mining, irrigated agriculture), high potential for sustainable development as the basin is relatively pristine and high potential to do the developments sustainably as there is an open attitude between the various stakeholders in the basin. As many developments are just emerging, now is the time to act.

Several actions were discussed with Mozambican organizations to make the next steps on the short and midterm to assist in sustainable development

In discussion with the Mozambican organizations several actions for the short and mid-term and a few long term boundary conditions are formulated to assist in sustainable development of the basin. The actions aim at building and supporting partnerships and collaboration between stakeholders in the basin and assist Mozambican organizations in urgent issues where specialist advice is required. As we believe in a true demand-driven approach as the key to successful implementation of these actions, these actions should be further discussed with the organizations and institutes we have visited during the mission. The actions are described below.

What we can do on the short term

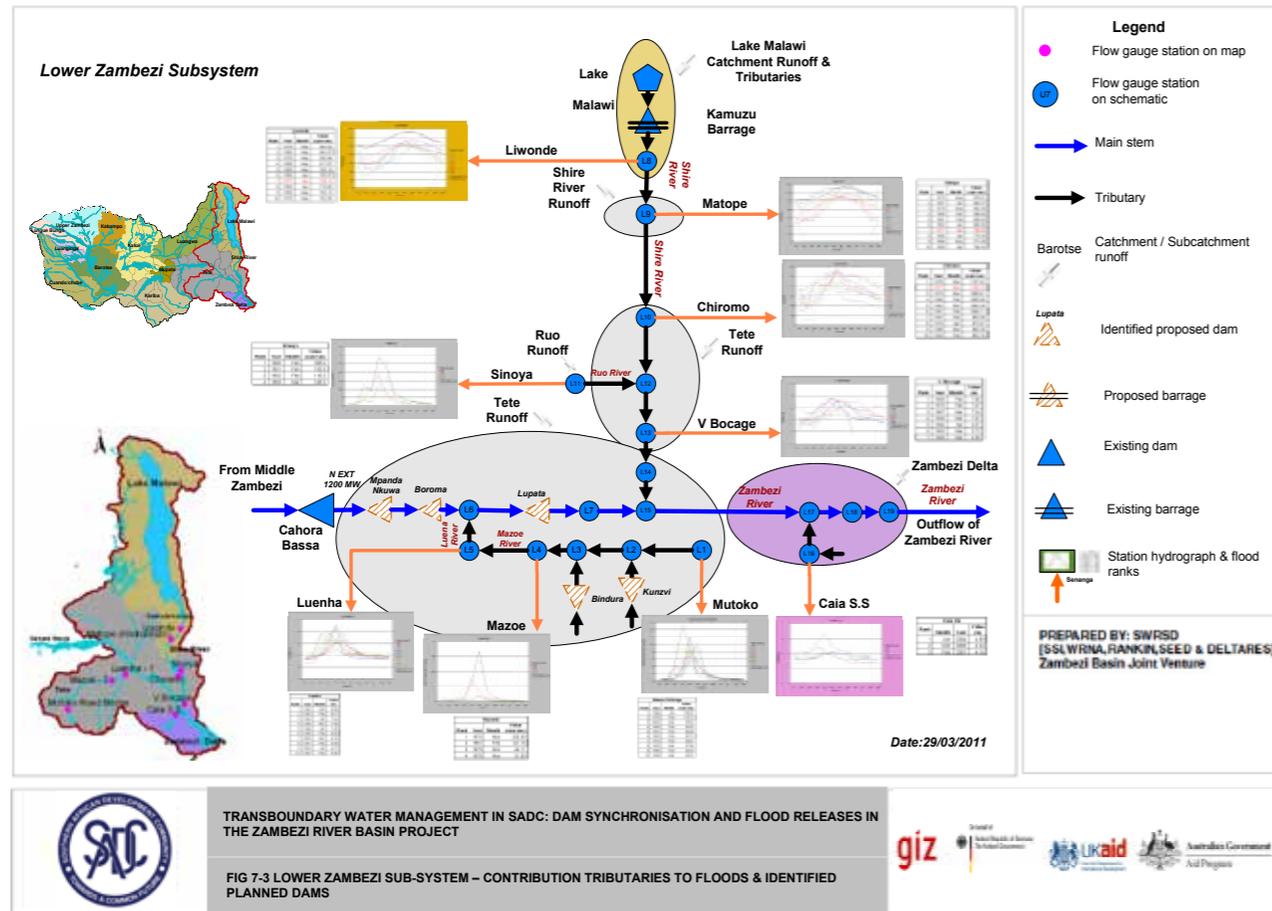
The following actions have been formulated for the short term:

1) Compose Position paper to be communicated at the highest level

The findings of this mission are summarized in a position paper (this paper), which can be communicated to different institutes in Mozambique and worldwide. This will create awareness of the issues at present in the basin and may assist in getting support for sustainable development of the region.

2) Prepare Basic maps of Zambezi that function as starting situation and reference

In order to evaluate the different developments we suggest to prepare basic maps of the (Lower) Zambezi Basin and Delta with a clear indication of the available water and the different water users in the basin. This map can function as a starting situation and reference for future developments in the basin. Furthermore it stimulates interaction between the different water users in the basin and it creates awareness for the situation of other water users.



3) Add Zambezi to the Delta Alliance comparative assessment of the world main deltas

The comparative assessment of the vulnerability and resilience of the world main deltas was carried out under the coordination of the Delta Alliance. The main deltas in the world are assessed following a general framework which allows for comparison of the vulnerability and resilience of the different deltas. When the Zambezi Delta is added to this assessment it is easier to link the developments in this delta to other deltas in the world and exchange of knowledge between different deltas. This can be the start of a Mozambican Wing to the Delta Alliance Network.



4) Clarify the dredging / water quality issues

- With the rapid mining developments two major issues are important:
- 1) Dredging and navigation of the Zambezi Rivier
 - 2) Effect of mining on the water quality

It was noted that capacity and capability are limited to address these issues properly. We offered to MICOA technical assistance in assessing the EIA submitted and the main issues that play a role in dredging/navigation and effect of mining on water quality.

5) Create commitment to the integrated approach

During the mission an open attitude was observed at the different organizations and institutes that were visited, including the economic actors. This creates an opportunity to get everybody committed to the integrated approach for sustainable development of the Zambezi Basin and Delta in Mozambique. In discussion with Mozambican organizations we would like to provide support in the organization of this commitment.

The delegation would like to commit themselves to these actions and complete them before the end of 2011

The delegation of the mission, under guidance of Delta Alliance and WWF, would like to commit themselves to these actions and complete them before the end of 2011. This will be done in consultation and cooperation with the Mozambican organizations and institutes that were visited during the mission.

Example of an interactive map of the lower Zambezi Basin (SADC, 2011)

What should be done on the mid-term

The following actions are formulated for the mid-term:

1) *Initiate upgraded monitoring in the Lower Zambezi*

The limited amount of good quality data limits the review of the impacts of several developments in the basin and underlines that the monitoring system should be upgraded. Several basin-wide activities have already been started to monitor the Zambezi River. Monitoring activities at present are mainly focused on water quantity (in order to prepare flow forecasting models). Water quality monitoring is limitedly developed but is becoming more important with the mining activities and the increase in agriculture in the basin.

2) *Establish a Mozambican Wing to the Delta Alliance network*

The Zambezi Basin and Delta would be a very interesting extension to the Delta Alliance network. As a relatively pristine basin and delta they provide valuable knowledge to the Delta Alliance network. The Delta Alliance network may provide knowledge and experience on sustainable developments of Deltas. The establishment of a Mozambican Wing to the Delta Alliance network will facilitate this process of knowledge exchange.

3) *Contribute to and create empowerment of (Mozambican) institutions*

Many institutes in Mozambique that are active in water management or development of the Zambezi Basin are just being started and have limited capacity and capability to perform the tasks that they are responsible for. This makes them vulnerable for large and powerful companies that are planning developments in the basin. By supporting the Mozambican institutions and assisting in the development of required knowledge and organization of cooperation, empowerment of the institutions can be created.

External funding, link to existing initiatives and coordination of actions

Mid-term actions are subject to external funding. Dutch expertise in the field of e.g. morphology (where to dredge), drought and flood forecasting and irrigated agriculture can be made available. Furthermore these actions should be linked to existing and ongoing initiatives in the basin (like the support from NCEA to MICOA and the support of Waterboard De Dommel to ARA Zambeze). The Delta Alliance (through the Mozambican Wing) may initiate and play a coordinating role in the mid-term actions.

Long term characteristics

Long term boundary conditions for sustainable development were formulated...

The delegation formulated a few long term boundary conditions for sustainable development of the basin and Delta (in random order):

- Supportive and demand driven research
- Well-functioning and independent operating institutes (ARA)
- Trans-boundary water resources agreement and management
- Proper monitoring system
- Well-functioning flow forecasting system

... which may function as the foundation on which sustainable development can take place.

The delegation is aware that there are already many initiatives started in the basin that contribute in one way or the other to the sustainable development of the basin. These long term boundary conditions should serve as the foundation on which sustainable developments can take place.



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