Water for agriculture and energy in Africa
The challenges of climate change

Report of the ministerial conference
15-17 December 2008
Sirte, Libyan Arab Jamahiriya

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- The African Ministers Council on Water (AMCOW)
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- The New Partnership for Africa s Development (NEPAD)
- The International Water Management Institute (IWMI)
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Acronyms and abbreviations

ACPC	African Climate Policy Centre
ADB	African Development Bank
ADEA	Association for the Development of Education in Africa
AfDB	African Development Bank
AFREC	Africa Energy Commission
AGRA	Alliance for a Green Revolution in Africa
AgWA	Agriculture Water Partnership
AMCEN	The African Ministerial Conference on the Environment
AMCOW	African Ministerial Council on Water
AMESD	Africa Monitoring the Environment for Sustainable Development
AR4	Fourth Assessment Report (AR4) of the United Nations Intergovernmental Panel on Climate Change (IPCC)
ARR	Annually Renewable Resource
AU	African Union
AWF	African Water Facility
CAADP	Comprehensive Africa Agriculture Development Programme
CAS	Country Assistance Strategies
CBFF	Congo Basin Forest Fund
CDM	Clean Development Mechanism
CEN-SAD	Community of Sahel-Saharan States
CICOS	Commission Internationale du Bassin Congo-Oubangui-Sangha
ClimDev-Africa	Climate Development in Africa Programme
cm	centimetres
CNR	Compagnie Nationale du Rh ne
CWRAS	Country Water Resource Assistance Strategies
DFID	United Kingdom Department for International Development
EADS	East African Development Bank
EC	European Commission
ECCAS	Economic Community of Central African States
EIA	Environmental Impact Assessment
EUMETSAT	European Meteorological Satellite
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GCM	Global Circulation Model
GEF	Global Environment Facility
GHG	Greenhouse gasses
GTZ	German Technical Assistance
GW	Gigawatt
HDI	Human Development Index
ICA	Infrastructure Consortium for Africa
IBWT	Inter Basin Water Transfer
ICID	International Commission on Irrigation and Drainage
IDB	Islamic Development Bank

IFAD	International Food and Agriculture Organization
IFC	Infrastructure Consortium for Africa
IFI	Infrastructure Financial Institutions
IFPRI	International Food Policy Research Institute
INGA	International Network on Genetics in Aquaculture
IPPC	International Panel on Climate Change
ISFP	FAO Initiative on Soaring Food Prices
IUCN	International Union for the Conservation of Nature
IWRM	Integrated Water Resources Management
JS	Joint Secretariat
km	kilometres
LCBC	Lake Chad Basin Committee
LDC	Least Developed Countries
LHP	Large Hydropower Plants
MDG	Millennium Development Goals
MDTF	Multidonor Trust Fund
mm	milimetres
Mtoe	Millions tonnes oil equivalent
NEPAD	New Partnership for Africa s Development
NERICA	New Rice for Africa
NIB	National Investment Briefs
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OMVG	Organisation pour la Mise en Valeur du Fleuve Gambie / Gambia River Basin Development Organisation
OPEC	Organization of the Petroleum Exporting Countries
PPP	Public Private Partnership
PRSP	Poverty Reduction Strategy Papers
REC	Regional Economic Communities
ROPPA	Le Rs eau des Organisations Paysannes et des Producteurs Agricoles de l Afrique de l Ouest / Network of Farmers and Agricultural Producers Organisations of West Africa
RPCLB	Regional Parliamentary Committee of Lake Chad Basin
RWSSI	Rural Water Supply and Sanitation Initiative
SAP	Strategic Action Plan
SHP	Small Hydropower plants
SME	Small Medium Enterprises
SMI	Small Medium Industries
SOFI	State of Food Insecurity (in the World, FAO)
TDA	Transboundary Diagnostic Analysis
TWh	Terawatt hour
UNDESA	United Nations Department of Economic and Social Affairs
UEMOA	West African Economic and Monetary Union
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
UNSO	United Nations Sudano-Sahelian Office
USAID	United States Agency for International Development

WADB	West African Development Bank
WB	World Bank
WEC	World Energy Council
WWF	World Water Forum

Foreword

Efforts to achieve the hunger and poverty reduction targets reflected in the Millennium Development Goals call upon the international community, particularly FAO and its partners, to assist member countries and the rural poor in facing new global challenges of rising food prices, water scarcity, energy demand and the impact of climate change on food and agriculture. Within this context, FAO, as the chair of UN-Water, jointly with the African Union and the Government of the Libyan Arab Jamahiriya, took the lead in the process which culminated in the Conference on Water for Agriculture and Energy in Africa: the Challenges of Climate Change organized in Sirte, Libya in 2008. The process addressed food and energy security in Africa through a convergent approach which integrates four critical resource factors water, energy, technology and knowledge considering the actual and forecasted scenarios for climate change as the premise and framework for action.

Essential to the process was the identification of investment needs as well as existing and potential financial mechanisms to harness the development of water for agriculture and energy in Africa. The Sirte Conference was a great opportunity to address the financial aspects of water development in Africa, both in terms of costs and sources of funding, within the framework of the Comprehensive Africa Agriculture Development Programme (CAADP) and to ensure that investment commitments are made or confirmed by national governments, bilateral, regional and international financing institutions.

Building on the NEPAD-CAADP estimates that US$37 billion would be needed in investments for land management and water control in Africa between 2002 and 2015, the preparatory work to the Sirte Conference approved a detailed portfolio of about 1 000 projects and programmes for investment in water control for agriculture and energy in the 53 African countries, with a total budget of US$65 billion spread over twenty years.

The Sirte Conference was attended by over 400 officials including 37 Ministers and representatives of various United Nations organizations and civil society. The Conference unanimously approved the Sirte 2008 declaration reaffirming African governments commitment to agricultural development and called for urgent and increased investment in water to meet the continent s growing food and energy demands.

To mobilize the financial support required for water development for agriculture and energy in Africa, adequate follow-up activities should be planned and, as stated in the final declaration, a road map and a mechanism to monitor and evaluate the implementation of the Sirte Declaration are to be designed and implemented.

The scaling up and phasing of the investments into short, medium and long-term priorities - as identified in the CAADP update and by the Sirte Ministerial Conference - should remain relevant for many years to come, certainly for most of sub-Saharan Africa. What is, however, now compelling is to build on the work of the Sirte Conference and to effectively boost investment in water development to achieve food and energy security in Africa. By making such investments a political and financial priority, the international community and the countries concerned would contribute to achieving the targets of meeting the growing demand for food, alleviating poverty

and sustaining economic growth. Just as African countries committed to allocate at least 10 percent of national budgetary resources agriculture and rural development in the 2003 Maputo Declaration on Agriculture and Food Security, development partners will need to increase investment in the water sector to help broaden and accelerate the recent economic and agricultural growth recovery process.

Food and energy security and achievement of the Millennium Development Goals (MDG) cannot be accomplished without substantial investment and donor support for water development in Africa. A road map showing the path for the implementation of commitments made, timely mobilization of financial resources, capacity building and technical assistance is urgently needed in a joint effort led by the African Union, NEPAD and African Development Bank in collaboration with FAO and all other development partners. Such an effort would ensure not only high levels of financial investment allocation but also greater efficiency in planning and delivery.

Jacques Diouf
Director General of FAO
Food and Agriculture Organization of the United Nations
Rome, April 2010

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Report of the Conference

Water for agriculture and energy in Africa: The challenges of climate change

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Date and place of the Conference

The Ministerial Conference on Water for Agriculture and Energy in Africa: the Challenges of Climate Change was held in Sirte, Libyan Arab Jamahiriya, from 15 to 17 December 2008.

Inaugural ceremony

Mr Jacques Diouf, Director-General of FAO, welcomed the honourable delegates and observers, and expressed his profound gratitude to His Excellency Colonel Muammar el Gheddafi, Guide of the Revolution, who, well aware of the importance of agriculture, water and energy for the African continent, had kindly agreed to host this Conference in Libya. The Director-General also thanked the Libyan Government and people for the warm welcome and generous hospitality extended to the participants. He stated that five years after the 2004 Sirte Conference on integrated and sustainable development of agriculture and water in Africa, it was time to review progress made and to discuss the short, medium and long-term actions that were needed to ensure the food and energy security of the continent.

His Excellency Abu Baker Al-Mansouri, Secretary of the General People s Committee of the Authority for Agriculture, Animal Wealth and Marine Resources of the Libyan Arab Jamahiriya, welcomed all participants. He stressed the importance of water for food security and the need to develop the untapped hydroelectric potential of the African continent. Recalling the Maputo Declaration, he called for increased investment in water for agriculture.

Her Excellency Rhoda Peace Tumusiime, African Union (AU) Commissioner for Rural Economy and Agriculture, thanked the Government of Libya and FAO for the partnership with the African Union in convening this important Conference in a context of food insecurity, climate change, rising cost of energy and financial crisis. She indicated that the Commission was working through the New Partnership for Africa s Development (NEPAD) Secretariat and with development partners on a number of initiatives aimed at mitigating the effects of high food prices, and improving agricultural production, productivity and food security. Investments should develop water resources to enable community-based irrigation, modernize existing irrigation and drainage systems, and replace and augment storage capacity in reservoirs and groundwater basins.

His Excellency Bruno Jean Richard Itoua, Chairman of the African Ministerial Council on Water (AMCOW), expressed his gratitude to the Libyan Arab Jamahiriya, AU and FAO for inviting AMCOW to be a member of the Steering Committee of the Conference. Recalling the successive declarations of AMCOW related to water supply and sanitation in Johannesburg, Brazzaville (2007), Tunis and Sharm El Sheikh (2008), he stressed the need to develop water resources for agriculture, energy and socio-economic development in Africa.

Mr Aly Abou-Sabaa, Director of Agriculture and Agro-Industry of the African Development Bank (AfDB) indicated the Bank s commitment to: i) increase irrigation and storage capacity by at least 8.5 billion m^3 over the period 2009-2013 and; ii) accelerate the development of hydropower by

pursuing multipurpose water resources development encompassing energy generation, flood control and drinking water supply.

Mr Mohamad Ali, President of the Islamic Development Bank, gave an overview of the Bank s activities in Africa, in particular the construction of multipurpose dams in sub-Saharan Africa, and pledged its continued support to poverty alleviation and food security in the region.

On behalf of **Mr Abdoulie Janneh, United Nations Under-Secretary General and Executive Secretary of the UN Economic Commission for Africa, Mr Josu Dion , Director, Food Security and Sustainable Development**, stressed the need for timely investment in water resources to unleash the full potential of the agriculture and energy sectors, as that would go a long way in accelerating broad-based socio-economic development, a sound pathway out of poverty and food insecurity. Yet, much remained to be done to translate previous commitments to develop water resources for agriculture and energy, from Maputo (2003) to Sharm El Sheikh (2008), into effective actions.

In his statement, **Mr Cheikh Mouhamady Cissoko, the Representative of Farmer Organizations**, emphasized the contribution of farmers to the agriculture-based development of most African countries. There was therefore a need for much greater investment in agriculture and in the development of farmer capacity, while conserving the natural resource base through its integrated management and paying due attention to indigenous know-how and the sustainable development of lowlands, aquaculture and river navigation.

The full texts of the statements delivered during the Inaugural Ceremony are included in Annex 1.

Opening of the Conference

Election of the chair and vice-chairs and appointment of the rapporteur

Mr Jacques Diouf, Director-General of FAO, declared the Conference open. He reported that consultations among the Delegations had resulted in unanimous consensus on the election, as Chair of the Conference, of Mr Abu Baker Al-Mansouri, Secretary of the General People s Committee of the Authority for Agriculture, Animal Wealth and Marine Resources of the Libyan Arab Jamahiriya. The election was confirmed by acclamation.

The Chair reported that consultations among the Delegates had produced a consensus on nominations for the Vice-Chairs of the Conference and appointment of the Rapporteur. The Conference then approved by acclamation the election of the Vice-Chairs as follows:

His Excellency Andr de Jesus Moda, Vice Minister for Agriculture, Republic of Angola;
His Excellency Yaya Dillo, Minister for Mines and Energy, Republic of Chad;
His Excellency Mahmoud Camara, Minister for Agriculture, Republic of Guinea;
Her Excellency Charity Kaluki Ngilu, Minister for Water and Irrigation, Republic of Kenya; and

His Excellency Abdelssalam Mansour, Minister for Agriculture and Water Resources, Republic of Tunisia.

His Excellency Ayman Abou Hadid, Head of the Egyptian Delegation, was elected as Rapporteur.

Adoption of the agenda and timetable

The Conference adopted the agenda and timetable as given in Annex 2.

Establishment of the drafting committee

The Conference established the drafting committee and elected Mr Ali Rahuma (Libyan Arab Jamahiriya) as chair of the committee. The full composition of the committee is given in Annex 3.

Committee of the Whole

The Committee of the Whole, which was open-ended, examined the following three themes, organized as follows:

Session 1 - Prospects for food and energy demands by 2015 and projections for 2030-2050 (Chair: The Honourable Mohammed Mahmood, Deputy Minister for Energy, Kenya)

This session discussed the prospects for food and energy demand by 2015 and the projections for 2030 and 2050, based on the key drivers of population and income growth and under the threat of climate change. With a doubling of total population by 2050 and considering the economic growth of the continent, FAO estimated that food demand in sub-Saharan Africa alone would more than triple between 2000 and 2050. Regional trends in food import bills continued to rise to unprecedented levels, seriously affecting the balance of trade of most countries in the region, while sub-Saharan Africa was the only region of the world in which the number of people without access to electricity was projected to increase. The session discussed national strategies, performance of the agriculture and energy sectors, the relative contributions of rainfed and irrigated agriculture, and climate change adaptation strategies.

Recognizing that smallholders made up the majority of the population in most African countries, the session recommended that policy decisions and budget allocations prioritize assistance to farmers to adapt to climate change. Budgets also be made available for large-scale infrastructure support for irrigated agriculture and hydropower generation. Infrastructure should be designed to take account of the best estimates of predicted climate change.

Each country should develop policies to ensure cereal availability, whether under irrigation or rainfed conditions or imported from elsewhere. Regional approaches to problems should include integrated water resources management for transboundary rivers to make best use of available natural resources. The key consideration in all investments should be economic viability.

Agriculture should be adapted to the best estimate of climate change scenarios and countries that contributed more to climate change should contribute to funding such adapatation. Ministries of Agriculture and Energy should be involved in the climate change debate and agricultural research and extension priorities should be adapted to the changes expected from climate change.

Session 2 - Assessing investment requirements: defining investment envelopes for water control in Africa (Chair: H.E. Mahmoud Camara, Minister for Agriculture, Guinea)

This session discussed the investment envelopes needed to address future food and energy demands. Based on preparatory work for the Conference, which collated ongoing and pipeline projects on water for agriculture and energy across the countries of the continent, and previous estimates by NEPAD-CAADP (Comprehensive Africa Agriculture Development Programme) and others, the session discussed current investment trends and strategies, priorities for investment and the structure of existing investment portfolios, their adaptation to future needs, and their impacts on poverty reduction and growth.

The session noted the significant irrigation and hydropower potential that existed in Africa and the fact that exploitation of this potential remained extremely low. It expressed its thanks to FAO for undertaking a preliminary estimate of investment needs for water control as a means of facing the challenges of higher food import bills and people s limited access to energy. As the information for certain countries was not up-to-date, the session asked FAO to consider the updated information provided by countries for inclusion in the final versions of documents.

The session recognized that poverty reduction was a prerequisite for increasing food production and recommended that smallscale farmers be given priority assistance, to also include provision of inputs and means of production. It further recommended that countries incorporate their agricultural water control investment envelopes in their Poverty Reduction Strategy Papers and develop investment projects to the bankable stage through the African Water Facility to ensure better funding opportunities.

Session 3 - Financing mechanisms and implementation strategies (Chair: H.E. Mamadou I. Diarra, Minister for Energy, Water and Mines, Mali)

This session addressed the financial mechanisms and implementation strategies needed to ensure sufficient investment in water for food and energy to meet demands. It discussed the roles of various sources of funding, including the potential of public-private partnerships, funding strategies and their adaptation to different categories of user and time frames, conditions for successful investment, and scope for enhanced regional integration in boosting investment in water. It made the recommendations given below.

While recognizing the importance of national financing and regional cooperation for implementing strategies to address country needs and boost food production, the session appealed to multilateral agencies for additional funding and called upon developed countries to allocate 0.7 percent of their GDPs as assistance as promised. It further recommended that countries parliaments recognize the priority of agriculture and ensure that a significant budget is allocated to the sector, in consideration of the Maputo recommendation that 10 percent of national budgets be assigned to agricultural production.

The session stressed the need to adapt investment strategies to different types of farmers, taking into account their specific needs, including capacity building, and recommended the adoption of whole food chain approaches to infrastructure development. Noting the linkage between agriculture and energy and the fact that farming and agro-processing required cheap and reliable sources of energy, a proposal was made to establish an energy fund in African countries and to encourage private sector investment in hydroelectric energy.

The session recalled and supported the recommendations of the 2004 Sirte Conference to create an African agricultural development fund, an African investment bank, and a common market for Africa.

As regards public-private partnerships, the session recognized that the most important investors in agriculture were the farmers, who should be encouraged through adequate incentive packages, including subsidized loans. It also recommended that national and foreign investment be encouraged through favourable investment policies, including reform of land tenure policy, where necessary.

While traditional financing schemes such as grants and loans would continue to be important, in particular for lower income countries, such instruments should be used more strategically, with countries negotiating conditions that ensured economic viability.

The session recalled that peace and stability were preconditions for sustainable development and growth and for attracting investment, and recommended that every effort should be made in relevant fora to bring peace and stability to the continent.

Round tables

Saving Lake Chad

This round table was attended by Ministers and many other delegates and observers from the Lake Chad Basin and beyond. The participants emphasized the impact of water scarcity resulting from climate change and uncontrolled human activity. The drastic shrinkage of Lake Chad would be an imminent disaster if no early action was taken. Lake Chad could only be saved through combined action to reverse the degradation and re-establish its former levels and related wetlands, while adhering to the integrated management of the Basin s water resources.

Subject to appropriate feasibility studies, transboundary water transfer from the Oubangui River to Lake Chad was considered an important intervention which would improve base flow and channel storage, prevent groundwater recession, enhance groundwater recharge and permit the reinstatement of traditional activities such as recession farming, fishing and animal husbandry.

All positive and negative impacts had to be considered at the earliest stage, even before the feasibility studies. It was important to consider the water resources of the donor basin, based on past, present and anticipated hydrological data, in order to avoid the emergence of water scarcity in associated basins.

The following recommendations were made:

- an international committee should be created to monitor the transboundary water transfer project.
- an observatory for the Lake Chad Basin should be created;
- several scenarios should be considered for water transfer and alternative measures; and
- donor basin and beneficiary basin stakeholders should be involved in all phases of project preparation and implementation.

Partnership for financing water and energy in Africa

In Africa there is low agricultural productivity in both the rainfed and the irrigated sectors. Around 97 percent of agriculture is rainfed and there are techniques to improve productivity with soil moisture management. The irrigated area is low compared to other regions and there are low levels of water storage on all scales, making Africa vulnerable to climatic shocks.

There is a major funding gap for agriculture and water projects but there is a commitment to increase investment by 6 percent per year to reach an estimated US$10-12 million. One way to close the funding gap is through the many models of public private partnership (PPP). Different types of partnership are needed to fund investment for subsistence and commercial agriculture and for power generation. A significant part of any investment (perhaps 20 percent) needs to be set aside for management and maintenance of infrastructure.

The private sector will always try to minimize costs and maximize benefits from their involvement so PPP needs to be properly structured and regulated. All potential beneficiaries of a scheme should be identified and appropriate ways should be devised for them to participate in the funding. Farm level profitability is vital to attract investment even if governments decide to subsidize some of the capital costs.

Countries need to develop policies and strategies to encourage private investment. The general business environment must be structured so that it encourages companies to get involved in PPP. Apart from issues such as taxation and customs regulations, this could include the overall governance and security situation.

Parallel events

Four parallel events were organized during the Conference:

1. AfDB Strategic Approach on Water for Agriculture and Energy.
2. Food Crisis in the States of CEN-SAD (Community of Sahel-Saharan States): Emergency Actions and Sustainable Perspectives.
3. AgWA (Agriculture Water Partnership): A New Partnership for Agricultural Water in Africa.
4. ADEA (Association for the Development of Energy in Africa): Technology Transfer in Water and Energy Sectors in Africa.

The reports of the parallel events are given in **Annex 4**.

Adoption of the Declaration on Water for Agriculture and Energy in Africa: The Challenges of Climate Change

The Conference adopted by acclamation the Declaration on Water for Agriculture and Energy in Africa: the Challenges of Climate Change, as contained in the Appendix to this chapter.

Participation

The Conference was attended by more than 400 participants, including 37 Ministers, from 48 African countries, 54 representatives of intergovernmental organizations, 34 representatives of civil society organizations, and 10 representatives from six organizations of the United Nations system.

Closure of the Conference

The Ministerial Conference on Water for Agriculture and Energy in Africa: the Challenges of Climate Change, concluded its work and was declared closed on 17 December 2008 at 18.00 hrs.

Annex 1. Full texts of the statements delivered during the inaugural ceremony

Statement of the Director-General of FAO, H. E. Jacques Diouf

Sirte Libyan Arab Jamahiriya, 15-17 December 2008

It is an honour and a great pleasure for me to be with you today in this fine city of Sirte, celebrated birthplace of the African Union.

I should like, first and foremost, to express my profound gratitude to His Excellency Colonel Muammar el Gheddafi, Guide of the Revolution, who, well aware of the importance of agriculture, water and energy for the African continent, kindly agreed to host this Conference in Libya. I should also like to thank, on behalf of FAO and all of you, the Libyan government and people for the warm welcome and generous hospitality.

Almost five years ago, in 2004, the African Heads of State and Government gathered here, in Sirte, to adopt measures for the integrated and sustainable development of agriculture and water in Africa. Five years later, it is necessary to review progress made and to discuss the short-medium-and long-term actions that are needed to ensure the food and energy security of the continent.

This prestigious assembly should make it possible to move from rhetoric to action. Together, we must find concrete and effective measures to address the issue of water in Africa, in a spirit of shared responsibility and enhanced cooperation among all stakeholders, including governments of African countries, donor countries, regional and international organizations, international financial institutions, the private sector and civil society.

The world food crisis

Much has changed since 2004. The world today is in a crisis. The severe financial and economic crisis was preceded by a food crisis that disrupted the international agricultural economy and highlighted the fragility of world food security. It also showed us that reviving agricultural production in poor countries is the only viable and lasting solution to the fight against hunger. We must therefore invest more in agriculture.

The last three years have witnessed a rapid increase in food prices. The FAO food price index initially rose by 9 percent between 2005 to 2006, then by 24 percent the next year, and by 40 percent during the first months of 2008. In July, good prospects for world production led to a decline in the prices of major cereals. Food prices have indeed fallen by 25 percent, but the food price index in October 2008 was still 30 percent higher than it was in October 2006. Input prices have doubled, even tripled, and have become inaccessible to small farmers.

This unprecedented situation has had serious economic, social and political consequences. In 2007, mainly because of soaring food prices, the number of hungry people in the world rose by 75 million, instead of declining by 43 million to achieve the commitment of the 1996 World Food Summit. In 2008, a further increase of 40 million people is expected. In total, the world therefore

has today 963 million undernourished people. This means that almost one billion people out of the 6.5 billion world population suffers from hunger.

State of agriculture and food in Africa

Agriculture accounts for 17 percent of Africa s GDP, 57 percent of its employment and 11 percent of its exports. Its population, which this year reached 967 million inhabitants of which 53 percent are under the age of 20, will reach 2 billion in 2050. Agriculture and related industries are essential to economic growth in Africa, and to a reduction in poverty and food insecurity.

In 2003-2005, 24 percent of Africa s population, or 218 million people, still suffered from chronic undernutrition. In 2007, the food crisis added a further 24 million people to the number suffering from chronic hunger in sub-Saharan Africa. In addition, today 70 percent of its poor people live in rural areas.

Despite the importance of agriculture to society and the economy, its performance has remained below expectations in recent decades. Growth of agricultural production has lagged behind population growth.

Over the past 30 years, Africa s per capita grain output only increased by 0.14 percent per year (0.07 percent in sub-Saharan Africa), triggering a rise in imports of 136 percent, amounting to 56.4 million tonnes in 2008.

There are several reasons behind these results. The use of modern inputs is insignificant. Africa only uses 23 kg of fertilizer per hectare of arable land, compared to 151 kg in Asia. The level is even lower in sub-Saharan Africa which uses only 9 kg per hectare.

Use of selected seeds that made a success of the Green Revolution is very low in Africa: only one-third of seeds are subject to a control system. Transport infrastructure as well as storage and packing facilities are lacking, especially south of the Sahara. Africa s rural roads are where India s were in the early 1970s. Harvest losses are as high as 40 to 60 percent for certain agricultural products.

The consequences are tragic for the continent. Of the 36 countries affected by food crises in the world, 21 are African. Africa s food imports were valued at 49.4 billion United States dollars in 2008, including US$22 billion dollars for grains against US$0.5 billion in 2005.

Energy security

Africa also faces a serious energy deficit. In sub-Saharan Africa, 74 percent of the population had no access to electricity in 2002. In some countries, only 5 percent of the population have access to energy, and the figure drops to 2 percent in some rural areas.

Sub-Saharan Africa is the only region in the world in which the number of people without access to electricity is rising. The number is expected to reach 660 million by 2030, or 50 percent of the total population. Yet the continent has considerable potential for hydroelectricity and solar energy.

At the same time, Africa s demand for energy will double between 2000 and 2030, rising from 500 million to 1 billion tonnes of oil equivalent, due to strong economic growth.

Climate change

Africa must also address the challenges of climate change, notably higher temperatures, greater variability of rainfall and more frequent extreme events, such as floods and droughts.

Climate change will reduce water availability and will lead to an increase in animal and plant diseases.

The United Nations Intergovernmental Panel on Climate Change (IPCC) clearly stated, in its fourth assessment report published in 2007, that global warming and extreme weather events will affect the world s poorest regions most. In sub-Saharan Africa, rainfed crop yields could fall by half between now and 2020. The mitigation of these impacts is going to depend on the investments that will be made in water control, irrigation, storage facilities, rural roads, seed production and multiplication and conservation agriculture.

The role of water

Irrigated agriculture, which occupies 20 percent of the world s arable land, accounts for more than 40 percent of total agricultural production. Irrigated agriculture is much less vulnerable to climate variability and other changes than rainfed agriculture. Yields from irrigated agriculture are three times higher than those from rainfed agriculture.

Unfortunately, in Africa, only 7 percent of arable land is irrigated, with an even lower 4 percent in sub-Saharan Africa, compared to 38 percent in Asia. The continent only uses 4 percent of its water reserves (less than 3 percent in sub-Saharan Africa), against 20 percent in Asia. That means that on 93 percent of Africa s agricultural land, the population has to rely on rainfall to live or rather to survive; and rain is becoming increasingly unpredictable on account of climate change.

Sustainable social and economic development in Africa has to be driven by the development of its agricultural sector, which is the mainstay for 70 percent of its population and 80 percent of its poor. Under such conditions, significant efforts are clearly needed to make African agriculture more productive and more efficient, but also more resilient to climate change. That calls for better control of production factors, especially water. Water control is the key to food security.

The framework for action

It was with this firm conviction that, back in 2003, the New Partnership for Africa s Development (NEPAD) selected water as the central pillar of its Comprehensive Africa Agriculture Development Programme (CAADP). According to the CAADP, the many measures needed to promote agricultural and rural development also require an annual investment of US$4.9 billion in water control and land management to shelter agriculture from the mercy of unpredictable rainfall.

As part of the measures to promote agricultural and rural development, the Blair Report recommended that Africa double its irrigated farmland by 2015, focusing on small-scale irrigation. The cost of such irrigation was estimated at US$2 billion US dollars per year.

Several types of intervention are needed according to specific national and regional contexts. In the short term, small water harnessing, irrigation and drainage works, implemented by and for rural communities, are a priority. These are inexpensive investments involving simple, easy-to-maintain technology. Involving beneficiaries in the design and delivery of such interventions will foster the sense of ownership that facilitates sustainable participatory management.

In the medium term, emphasis must be placed on better utilization of existing large-scale hydro-agricultural works, which required significant investment but which often operate well below capacity for technical and economic reasons, but also for institutional and social reasons.

In the longer term, action should centre on the development of large river basins. Such programmes require integrated management of water resources and identification of major synergies, especially between irrigation and hydro-electric power. Such investment can also target inter-basin transfers and stronger technical and financial mechanisms and coordination policies for better management of water resources.

The resources should first come from national budgets. In Maputo, in July 2003, the African Heads of State and Government pledged to significantly increase national budget allocations to agriculture to at least 10 percent in the following five years. Agriculture must be a priority in investment for development.

Then, in conformity with the commitments of Monterrey, the World Food Summit of 1996 and the second Summit of 2002, Official Development Assistance should be raised. The downward trend in agriculture s share of development aid must be reversed. The same applies to funding from regional and subregional banks and bilateral aid.

Finally, private sector investment in agriculture must be encouraged. The partnership between the private and public sectors must be strengthened.

At the High-Level Conference on World Food Security that was organized by FAO last June, the delegates of 181 countries including 43 Heads of State and Government and more than 100 Ministers reaffirmed the need to produce more. The Conference declaration made clear that investment in agricultural production was the only basis for a lasting solution to the food crisis and that adequate resources should be made available.

During this Conference, you will have the opportunity to discuss the results of the preparatory work which gave a detailed table of projects and programmes of investment in water control for agriculture and energy for each country, with a total budget of US$65 billion spread over twenty years. This is the first time that a short, medium and long-term assessment has been made so thoroughly and so precisely, considering investment in water control at the level of villages, extensive irrigation systems and major river basins, both for agriculture and for hydro-electric power generation.

This work, which was made possible by the collaboration of government services of all African countries and the valuable assistance of regional entities of the African Union, is unique in nature. It was conducted in the spirit of the Paris Declaration on Aid Effectiveness to better take into account the directly expressed needs of countries.

Action at the global level

Besides boosting investment in water control, rural infrastructure and agricultural services in Africa, we must work together at the international stage to forge broad consensus on the final and rapid eradication of hunger from the world. Thus, it is essential to improve the conditions under which farmers work and trade.

That is why I proposed the convening in 2009 of a World Summit on Food Security to ensure greater coherence in the governance of global food security. This Summit should lay the foundations of a new system of agricultural trade that offers farmers in developed and developing countries alike, the opportunity to earn a decent living. They should earn comparable incomes to workers in the secondary and tertiary sectors of their respective countries, if they are to remain engaged in rural activities. To this end, we must have the intelligence and the imagination to devise agricultural development policies, rules and mechanisms that will give us an international trade regime that is not only free, but also fair.

The Summit should also have to find US$30 billion per year to build rural infrastructure and increase agricultural productivity in the developing world. In the immediate term, an Early Reaction Fund should also be considered to revive local agricultural production in the case of crisis, particularly in low-income and heavily food-importing countries.

The time for talk has long passed. The events of the last two years have reminded us just how urgent a massive acceleration of investment in agriculture has become. It is the duty of all parties governments, regional and international institutions, technical and financial partners, the private sector and civil society to build the conditions for the economic, social and environmental viability of such investment and for water resources to be developed for the agricultural, economic and social benefit of the continent.

FAO assisted in the preparation of the Comprehensive Africa Agriculture Development Programme within the framework of NEPAD. FAO is at the disposal of African States to continue to support them in the preparation of continental, regional and national programmes and in the implementation of promising projects.

Thank you for your kind attention

Statement of the Secretary of the General People s Committee for Agriculture, Animal Wealth and Marine Resources H.E. Abu Baker Al-Mansouri

Sirte Libyan Arab Jamahiriya, 15-17 December 2008

It is my pleasure to convey to all of you the greetings of the Leader of the Great First of September Revolution, Muammar Al-Gaddafi, and his best wishes for the success of this Conference, which would not have convened were it not for his support and encouragement. I would like to avail myself of this opportunity to invite his Excellency, speaking on your behalf and in my personal capacity, to grace this conference by his presence, in order to listen to his valuable advice and

guidance which forever aim at the progress and advancement of Africa and its great peoples. Let me also welcome you in the name of the Great Socialist People s Libyan Arab Jamahiriya and in the name of my colleagues in the General People s Committee for Agriculture, Animal Wealth and Marine Resources. I would like to express my appreciation for your presence here and for taking part in the proceedings of the High-Level Conference on Water for Agriculture and Energy in Africa: The Challenges of Climate Change, which we feel honoured that it has been convened in the Libyan Arab Jamahiriya. I would like to extend our sincere wishes for the success of the Conference, and wish you a good, enjoyable and fruitful stay among us.

The main objective of this Conference is to assess water resources in Africa in the light of the rapid increase in the demand for water in the agriculture and energy sectors. The Conference will primarily focus on investment needs and on improving management in order to make use of water resources in rural areas and to expand major hydro-agricultural projects, in addition to developing and building infrastructure along major rivers with the aim of achieving sustainable development in Africa. This is in addition to assessing the challenges facing the agriculture and energy sectors in light of the problem of global food shortage. In addition, the Conference aims at underscoring the importance of accelerated investments for bringing about food and energy security in all African states, and at specifying the necessary funding mechanisms to achieve such objective in the medium and long term, when the population of the continent will have reached 2 billion. In doing so, the Conference will take into consideration the impact of climate change, and will focus on specific programmes with cost estimates, both for undertaking feasibility studies and for their actual implementation.

This Conference takes place amidst a water crisis in most African states, with the increase of demand on water and the accrued severity of droughts and desertification due to climate change worldwide and substantial progress in the various areas of development with direct impact on water and increased losses in water. The issue of water is particularly important, not only as concerns its management, costs or exploitation mechanisms, but because it is so inextricably linked to the availability of food. This makes it an alarming issue of great concern, especially given the major increase in population and in rural-urban migration and the increasing risks arising from environmental degradation, and in particular water, soil and arable land pollution and the decrease in their areas, as well as their implications on the availability of food.

As you all know, Africa is facing a real problem of increased demand for food and the limited area of irrigated land in the continent, no more than 7 percent of arable land, coupled with a steady decline in agricultural investment. The FAO estimates that the demand for food will triple during the period from 2000 to 2050 due to population growth and the rise in living standards. This problem is exacerbated by climate change, which will result in a decline in food production in several African states by about 50 percent by 2020, threatening the already fragile food security in the continent.

Climate change also has negative impacts on the availability of water resources, arable land, forests and biodiversity. Such impacts are expected to increase in severity in the future threatening the food security of the whole continent by increasing water stress. It is expected that those persons living under water stress will reach between 27 and 250 million by 2020 due to the decline in river water flow and land degradation. This will have an impact on rainfed agriculture and livestock breeding, therefore affecting 180 million people in Africa, and causing an increase in migration, let alone its negative impacts on the energy sector.

Water is considered to be the main resource that determines the level of sustainable development, and the balance between the requirements and the available amounts, especially since rainfall varies widely across the different regions of the continent.

Africa has great potential for expanding the use of water resources for agriculture. It possesses enormous, and as yet untapped, potential in terms of renewable and non-renewable energy. Moreover, Africa s hydraulic energy capacity is considered to be the appropriate option to cover future needs, especially in the Nile and Congo basins, as it represents only 5 percent of the energy available in the continent which is currently being developed and exploited. The current limited energy supplies are a factor restricting the expansion of agriculture and food production, particularly given that Africa s energy needs are expected to double by 2030. The rise in the prices of energy and food constitutes an incentive to developing alternative energy sources, hydraulic in particular, in order to double the area of irrigated land in Africa.

This Conference also takes place in the shadow of the greatest achievement that Africa has made in the new millennium, namely the establishment of the great African Union, such a historic achievement that crowned the efforts of the Libyan Leader towards unity. The African leaders responded to these efforts convinced that the best alliance for Africa is that amongst its countries, and that Africa can enjoy no progress without unity and the integration of efforts in the realms of development and progress in order for the continent to occupy its due place in the present era.

The cooperation between the Jamahiriya and a number of African states has increased significantly: the Jamahiriya undertook the drilling of a number of productive wells in several African states, in addition to projects for soil and water research and advocating the use of the waters of major rivers to fill the water deficit gap and extend agricultural areas. Moreover, the Jamahiriya has made contributions to assist in combating desertification and desert locust, and in providing agricultural machinery such as tractors. The cooperation with African states also included holding periodic meetings through joint committees, with input from specialized regional and international organizations, and the establishment of joint bodies with the neighbouring countries that share with Libya major groundwater basins, with a view to the efficient management and the good use of such basins. I hereby call for putting into effect the initiative of the Leader of the Libyan Revolution encouraging the African states to establish higher African organizations to supervise the provision and making good use of water resources in the continent, and likewise to encourage the production of food through organizations for the production and improvement of seeds and for the development of livestock and fishery wealth.

The particular nature of the availability and distribution of water resources, whether surface or groundwater, in terms of quantity and sources, as well as the steady decline of the per capita water share, places the issue of sustainable management of such resources, both in quantity and quality, at the top of the priorities of organizations concerned with water issues. The impact of climate change on the availability and the ways of using water are among the topmost factors that need special attention, given the serious imbalance that may accrue from them due to the misuse of water, especially in agriculture. Accordingly, this calls for establishing a fruitful cooperation between the African states to control and redistribute the available resources, and to adopt modern scientific practices for optimizing the sustainable management of water resources, reversing the food shortage trend suffered by most African peoples, and providing the means of dignified living in Africa and reducing immigration from the continent.

As you are all aware, the First of September Revolution and its Leader Colonel Muammar el Gheddafi have attached great importance to the issue of water. As such, substantial investments were made to overcome the problem of water shortage, which included transporting freshwater for thousands of kilometres through giant pipelines from the depths of the desert to cities and coastal plains in the greatest project of its kind, namely the Great Man-Made River. This project aims at doubling production, achieving food security and providing the drinking water that coastal cities need and were still lacking not too long ago, despite the establishment of many desalination plants and water well fields. Such a gigantic epoch-making project will provide a temporary solution for the water shortage problem along the coastal areas north of Libya. Yet, as the Leader of the Revolution noted, it is not a final solution but a final attempt to save life in North Africa, and hence it is imperative to synergize efforts and intensify the search for economical alternatives in order to provide the water required continuously. Foremost among such alternatives is inter-basin water transfer. The attempt to divert water from the Oubangi River in order to save Lake Chad is undoubtedly a good example of integration between the African states.

Seriousness and effective participation in drafting the recommendations of this Conference are of utmost importance to serve the interests of the African states and their peoples. It is also incumbent upon us to work towards implementing the recommendations of previous summits and meetings in relation to investment in agriculture and energy and specify a clear methodology for their implementation.

I do not want to keep you long. It just seems to me appropriate on such a distinguished occasion to repeat the words of the Leader of the Great First of September Revolution in one of his statements on Africa: The great continent of Africa is the land of unlimited potential, wealth and bounty. Africa is the unlost paradise, the earthly paradise, the world s heaven. Great Africa is a paradise that extends 30 million square kilometres of pineapple, oil palm, cocoa, coconut, bananas, mangoes and all the fruit of the world. The rivers of the great continent of Africa extend for 20 thousand kilometres with running, flowing water. Imagine such a great length of fresh and sweet waters running uninterruptedly. Imagine 20 thousand kilometres of uncorrupted water, of copious and abundant water, of water springs. This is a blessing that God has given to Africa in His mercy to the black race. God has blessed Africa with spreading shade and gushing waters. God has blessed and dignified the black race and to them gave the great continent of Africa, a continent that is unequalled in bounty, potential, capabilities and wealth.

Allow me to extend my utmost thanks and gratitude to the Food and Agriculture Organization of the United Nations for its effective contribution in organizing this Conference under its auspices and for its earnest calls for holding it in the Libyan Arab Jamahiriya. I would also like to extend my thanks to all the international organizations and financial institutions that sponsored this Conference. My utmost thanks go as well to everyone who participated in the preparations for the Conference.

I would also like to extend my thanks to this great number of officials from the water, agriculture and energy sectors from the different African states, who had to endure the difficulties of travel over here in the hope of achieving important results, recommendations and decisions that would serve the interests of the African peoples and realize their hopes of a dignified living.

This Conference would not have succeeded were it not for the continuous and arduous efforts of the different committees in preparing and organizing it.

And last but not least, let me extend my thanks to the various media that gave this event the attention it deserves.

I wish you all a good stay in the Libyan Arab Jamahiriya, and ask God to bless our efforts with success.

Thank you. And peace be upon you all.

Statement of the Commissioner for Rural Economy and Agriculture at the African Union Commission H.E. Rhoda Peace Tumusiime, African Union

Sirte Libyan Arab Jamahiriya, 15-17 December 2008

I feel honored to be here and to participate in this important Conference at this critical time of sharply fluctuating food prices and global financial crisis that have adversely affected many of our countries. I would like to first of all register appreciation for the warm welcome and hospitality extended to myself and members of my delegation since our arrival in this beautiful city of Sirte, in the Great Socialist People s Libyan Arab Jamahiriya. I would in particular like to thank the Government of Libya and the Food and Agriculture Organization of the United Nations (FAO), for the partnership with the African Union Commission and all the special efforts and hard work involved in convening this important conference. Truly, this conference is taking place in a complex and difficult time, when water scarcity, food insecurity, and unsustainable agriculture and energy production - all these, in the context of climate change and financial crisis, can cause social, economic and political instability.

The African Union Commission remains at the service of all African countries in advancement of the continental agenda on all social, economic and political issues of common interest. The Department of Rural Economy and Agriculture which I head at the Commission covers environment and climate change in addition to agriculture, livestock, fisheries, land, water and forestry, among others. We, therefore, take great interest in this Conference. We are optimistic that the recommendations and decisions from this conference will renew our commitment and concerted resolve to seize opportunities for sustainable development across Africa.

It is a known fact that water is a limited resource that must be carefully managed for the benefit of humanity and our environment. The overall purpose is to ensure food security for all African populations today and future generations while safeguarding environmental sustainability. However, with the global food crises and the growing population continent-wide, more food is required for the 200 million people malnourished across Africa and the one billion more people expected by 2050.

Africa s share of global freshwater resources, at 10 percent, closely matches its share of world population at 12 percent. However, more than 20 percent of the African countries are considered water-poor. The problem stems from the uneven distribution of rainfall, and from the fact that, for the African continent as a whole, 85 percent of water withdrawals are directed towards agriculture and this percentage is even higher in the arid and semi-arid part of Africa. However, increasing demands for limited freshwater resources, without putting in place the right incentives for agricultural production, may be a serious hindrance to meeting the future demand for food. Sixty percent of food production is from non-irrigated agriculture. A sizeable part of irrigation potential is already used in North Africa (where water is the limiting factor), but a large part also remains unused in sub-Saharan Africa. Water for irrigation is a high priority for economic development and stability. However, few countries in Africa can afford the financial investment in efficient irrigation systems

Over-exploitation of water and forest resources mainly for agriculture and other uses has, on the other hand, contributed to environmental disasters. In addition, global warming and climate change have generated drought and floods. Pests and diseases have undermined agricultural production. Rising food prices; shortage of energy; political and civil strife have affected many parts of the continent.

You will agree with me that African countries have never lacked agricultural policies whether at national, regional and/or international levels. Indeed, several countries are currently engaged in long-term planning and strategy formulation for sustainable agricultural development. The major problem, however, has been the low level of implementation of these policies and strategies. We are feeling the impact today. Food consumption exceeded domestic production by 50 percent in the drought-prone mid-1980s and more than 30 percent in the mid-1990s. Africa s dependence on cereal imports is expected to continue to grow, with a widening net trade deficit. Food production capacity and productivity is further weakened due to widespread HIV/AIDS in Africa.

However, if the Comprehensive Africa Agricultural Development Programme (CAADP) adopted at the AU Summit in Maputo, Mozambique in 2003 had been implemented across the continent, increased budgetary allocations, at least 10 percent, would have led to the desired agricultural growth of minimum 6 percent annually and we would be in a much better situation than we are today.

With growing awareness of food production challenges and climate change concerns in Africa, reforms need to be brought about to provide incentives in the agriculture sector, revitalizing productivity and attracting new investments. A number of countries have already embarked on this and are commended to stay the course and others urged to follow suit. In addition, reforms to support effective management of water resources and agriculture systems have began and are encouraged to continue. These include managing water demand, enhancing productivity of water for agriculture, and increasing storage, harvesting, and reuse of water. Less conventional approaches are also adopted continent wide, including lower cost desalination and the development of more salt-tolerant crop species.

Institutional and other reforms are also directed at more sustainable water use. Awareness raising and information systems for water and soil conservation, protection of water resources, better irrigation practices, and adaptation to the effects of climate change are widespread at all

levels, community to regional. It is extremely important to use the scientific knowledge you have to map out water availability in terms of how much each member state receives from rain, what is in the underground and its relations with population growth, urban placement, irrigation and industry. This is the way to go.

Climate, water resources, biophysical and socio-economic systems are interconnected in complex ways, so a change in any one of these induces a change in another. Anthropogenic climate change adds a major pressure to African nations that are already confronting the issue of sustainable water use. Water and its availability and quality will be the main pressures on, and issues for, societies and the environment under climate change; hence it is necessary to improve our understanding of the problems involved.

Significant changes in climatic conditions will affect food security through their impacts on all components of global, national and local food systems. Climate change is likely to make access to food more difficult for the vulnerable people and other low-income consumers, whether because of reduced production, loss of employment opportunities as farm and non-farm production patterns shift, or lower purchasing power due to rising market prices for food.

In addition, the rising cost of energy and the need to reduce consumption of fossil fuels have given rise to a new calculus - that of food miles - which should be kept as low as possible in order to reduce emissions. The combination of all of these factors could result in a reversion to more local responsibility for food security in the future.

Although the debate about biofuel/food security trade-offs has so far focused mainly on how to manage competing demands on scarce productive resources, it is equally important to focus on energy saving and efficient energy use that will contribute to reduced demand for energy, including bio-energy. However, the need to secure stable and affordable energy supplies remains a priority as does the need to improve energy efficiency and renewable energy. Similarly, it is necessary to make a realistic balance on all fronts to ensure that Africa s population has access to affordable food, energy and water.

There exist opportunities for increasing water productivity in both rainfed and irrigated agriculture and on increasing the availability of affordable, environmentally acceptable water that generates maximum socio-economic returns. Similarly, harnessing new water supplies, expanding storage capacity, empowering communities and user groups, ensuring access to food, reforming water management institutions, qualified, skilled people are needed to develop and run these institutions, making needed investments.

Investments should develop water resources to enable community-based irrigation, modernize existing irrigation and drainage systems, and replace and augment storage capacity in reservoirs and groundwater basins particularly in water-scarce countries. Groundwater recharge programmes should be initiated to help restore groundwater tables. In addition, environmental regulations and parallel investments in municipal and industrial waste treatment are needed to improve the quality of river water, reducing dilution requirements and increasing supplies.

The prepared National Investment Briefs (NIBs) of the African countries, that estimated investment needs in water for agriculture and energy, based on investment projections at both country

and river basin levels, need a clear action-oriented vision and partnership agreements that might lead to adoption of concrete mechanisms for making such investment a reality, and this is our responsibility!

Having looked at the various challenges before us and the opportunities available, I would like to take this opportunity to commend the collective actions counteracting the different challenges faced by our continent. The AU Commission with partners is working on actions that will calm markets with market-oriented regulation of speculation, shared public grain stocks, strengthened food import financing, and reliable food aid; promote investment in social protection involving cash transfers, pension and employment programmes, and preventive health and nutrition programmes; and scale up investments for sustained agricultural growth.

Within the framework of the Comprehensive Africa Agriculture Development Program (CAADP), the Commission is currently working, through the NEPAD Secretariat and with development partners, on a number of initiatives that aim to mitigate the effects of high food prices and also improve agricultural production, productivity and food security. These include: the African Common Market for Food Products; the Pan-African Land Policy Initiative; the Framework for African Food Security and the Pan-African Nutrition Initiative; the promotion of African farmers organizations; the early warning systems; as well as improving rural infrastructure and trade-related capacities for market access.

As a result of the consultation process, which started in early 2000, the African Union passed a resolution during its Eighth Summit in January 2007, endorsing the Climate for Development Program (ClimDevAfrica). The African Development Bank (AfDB), the African Union Commission (AUC) and the United Nations Economic Commission for Africa (UNECA), within the framework of a Joint Secretariat (JS) arrangement subsequently embarked on a process of defining and mobilising funds for the ClimDevAfrica Program, for a timely implementation. The ClimDevAfrica as designed provides a strategic framework for the first phase of a long term, multi-sector, multi-stakeholder, demand-driven process of adaptation to climate variability and change for the most sensitive developmental sectors in Africa, including water, agriculture and energy, under the leadership of the JS.

In addition, the African Union, through RECs, is implementing another project called African Monitoring of the Environment for Sustainable Development (AMESD) whereby the European Union (EU) provided 21 million. This programme aims at boosting the capacity of AU Member States Meteorological Stations to be able to download from the European Meteorological Satellite (EUMETSAT) to inform sound policies by increasing the information management capacity of African regional and national institutions mandated with responsibilities in environment and climate-related sectors.

The African Union is also developing the Great Green Wall initiative for the Sahara-Sahel region from Senegal to Djibouti so as to put in place environmental conservation measures including afforestation, to forestall the advancement of desertification.

Institutionalizing the Ministerial Special Technical Committees like the African Ministerial Conference on the Environment (AMCEN) on environment and AMCOW on water, among others, into the African Union as directed by the AU Summit is a crucial step to enhance our concentrated efforts towards sustainable natural resources development in Africa. This process is almost

complete and is expected to be adopted by the 2009 January Summit and will pave the way to closer collaboration on sectoral issues.

A number of partnerships and initiatives, with the appropriate financing instruments, are emerging from the current debate at both the continental and international levels. In this respect, I believe it is vital to adopt harmonized approaches to orchestrate the move of Africa towards a well-aligned agriculture sector, sound food security strategies, skillful human resources in the Ministries of water, agriculture, and energy and for clear future directions for African agriculture.

To conclude, I would like to say that for agriculture to feed the at least 1.8 billion people in Africa in 2050, water allocated to agriculture must be used more efficiently and new water resources developed. In order to meet our water needs, our organizations and institutions will have to choose water use and development priorities, and carefully consider the difficult trade-offs between water for agriculture and water for the environment. Moreover, new approaches for financing water related projects should be explored, tested and adopted.

I would also like to reaffirm the AU Commission s commitment to enhancing collaboration with regional and international communities to achieve our continent s common goals.

I wish you fruitful deliberations.

I thank you for your kind attention.

Statement of the Chair of the African Ministers Council on Water (AMCOW) H.E. Bruno Jean Richard Itoua

Sirte Libyan Arab Jamahiriya, 15-17 December 2008

1. The Lake Chad situation needs to be upgraded to urgent world catastrophe and disaster. It is desirable that an international committee be established for the promotion of Lake Chad.

2. We welcome the initiative of the Supreme Guide of the Libyan Revolution which follows the recommendations of the last Summit of Heads of State and Government in Egypt and addressed the Lake Chad situation.

3. AMCOW prepared that Summit and supports all actions and advocacy in favour of Lake Chad. To that end, it can call on its various partners: EU, G8, United Nations agencies (UN-Water Africa, United Nations Environment Programme (UNEP), etc.). It can draw upon documentation that can be prepared and introduced by the Vice-Presidency of AMCOW Central Africa, currently held by Chad.

4. On behalf of the water donor countries (the Democratic Republic of the Congo (DRC), Congo and Central African Republic (CAR)) and at the highest level (i.e. Heads of State), Economic Community of Central States (ECCAS) has agreed in principle to the launching of a feasibility study on the transfer of water from the Oubangui to Lake Chad, with certain recommendations:

i. that the Commission Internationale du Bassin Congo-Obangui-Sangha (International Commission on the Congo-Obangui-Sangha Basin) (CICOS) is mandated to talk on behalf of the water donor countries and therefore ECCAS;
ii. that the environmental impact study be launched simultaneously and as part of the study of project impact on the water donor basin; and
iii. that an urgent plan be launched to conserve water resources for both Lake Chad and for the Oubangui and the Congo.

5. Two actions are needed during the lead time for the transfer project:
   a. an urgent plan to resolve the negative effects, with measures for adaptation, integrated and sustainable management, change in behaviour and technologies; and
   b. analysis of developments with the rapid introduction of:
      i. an observatory;
      ii. modelling; and
      iii. prevention (adaptation, preservation,).

6. It is important to consider the fragile state of the donor basin and sub-basins (Congo and Oubangui) and the interrelationship that the transfer will inevitably create. Hence the need to accelerate good management of the Congo basin and to take all necessary measures for the two basins, to avoid creating a subsequent catastrophe from efforts to deal with the present catastrophe.

   Remember: the Congo Basin is:
   - the world s second lung!
   - Africa s foremost water and forest basin which needs to be preserved not only for Africa but also for the world.

7. Conclusion: There is an urgent need to save Lake Chad and the Supreme Guide should continue to lead the advocacy campaign for Lake Chad.

Statement of the Director of the Agriculture and Agro-Industry Department of the African Development Bank Mr Aly Abou-Sabaa

Sirte Libyan Arab Jamahiriya, 15-17 December 2008

The African Development Bank Group is very honoured to have been associated with this high level conference on the theme Water for agriculture and energy: the challenges of climate change . On behalf of the African Development Bank Group, I wish to thank the Government of the Libyan Arab Jamahiriya and the FAO for their concerted efforts to bring this important event into reality.

The support of the Libyan Jamahiriya and its Leader, Colonel Muammar el Gheddafi, underscores the considerable support the continent continues to receive especially on issues related to water and energy development.

May I also thank Dr Jacques Diouf, the Director-General of FAO for the constructive way in which his institution has worked, with the AfDB and others, on this event.

This is a truly continental effort towards addressing the critical challenges posed by the harnessing and management of water resources for agriculture and energy in Africa.

Water resources development has always been at the core of the AfDB strategic focus. In 2000, AfDB developed an Integrated Water Resources Management (IWRM) policy, which drew from its experience in this sector. This policy inspired several major initiatives with the most important being the Rural Water Supply and Sanitation Initiative (RWSSI) and the African Water Facility (AWF). The Bank has also been involved, in collaboration with FAO, in the operationalization of NEPAD s Pillar 1 (Land and water management) of the Comprehensive Africa Agriculture Development Programme (CAADP) of NEPAD.

As emphasized by earlier speakers, many countries faced with soaring import bills for oil and food had no choice but to adopt measures which are not always fiscally sustainable. The ADB is prepared and will be providing support to ensure that our regional member countries maintain progress. The Bank has already restructured some US$200 million worth of our agricultural portfolio, in order to provide a rapid reactive mechanism for resources required to accelerate agricultural production in the short term, purchase of fertilizers and inputs. We are very much aware that in a rain-dependent agriculture, such food issues may and will arise in the future, which is why we are calling for increased joint investments in water for agriculture and energy. The Bank is currently busy elaborating a business plan to further develop the water storage in Africa to increase water storage by 1 percent over the next six years. This effort along with other needed inputs including the reduction of post harvest losses, establishment of the African Fertilizers Financing Mechanism will contribute to increasing agricultural production in Africa and contribute to mitigate the impacts of climate change. In terms of its own contribution, the Bank is in the process of investing US$1 billion in the agriculture sector bringing its portfolio to US$4.8 billion before the end of 2010.

Climate change has become a major impediment to development in Africa, threatening the achievement of the Millennium Development Goals. Its impacts on water are severe, with strong negative implications for household water access, energy and agricultural production. The latest IPCC report projects that up to 250 million additional people in the continent could be exposed to increased water stress by 2020. Declining rainfall could severely exacerbate food insecurity, with production expected to halve by 2020. The projected rise in temperature will lead to a decrease in water flows, further constraining hydroelectric energy production. During meetings on climate change which took place last week in Warsaw and Poznan, it was emphasized that the current financial crisis should not derail global efforts to deal with climate change issues and difficult decisions associated with the negotiation process. It is important that Africa has a unified view and position early next year to contribute meaningfully to the process.

The ADB Group has geared up and retooled to play a significantly greater role as part of the solution. The Bank recognizes that river basins are important geographical units for considering the management of water resources to meet agricultural and energy needs in the face of a

changing climate with added emphasis on clean energy. Besides implementing climate risk due diligence in Bank operations, the Bank is supporting the implementation of the Niger Action Plan for the Niger River Basin, which includes major storage infrastructure components. The Bank is also supporting the Lake Chad Basin Commission to define the appropriate solutions in the drive to reverse the near disappearance of this important lake. Furthermore, the Bank is also supporting the riparian countries of the Congo River basin to establish a river basin organization for integrated water resources management. A number of other important interventions include: the Bank support to the Congo Basin Forest Fund (CBFF) and ClimDev-Africa.

With regard to the use of water resources for power generation, Africa is endowed with an important hydroelectric potential. Unfortunately this potential remains largely untapped. Less than 5 percent of economically exploitable hydroelectric energy is mobilized.

The Bank is playing a catalytic role in financing multinational energy related projects. Over the last two years the Bank has contributed substantial resources for hydropower and associated interconnection projects in Africa. The Bank Group also envisages participating in funding of future hydropower projects and associated works such as: Gibe 3 Hydropower Project in Ethiopia; OMVG Energy Project in West Africa; and Rusumo Fall hydropower project in Eastern Africa with estimated resources to the sector in excess of US$3 billion. The Bank is also assisting the river basin organizations (Nile Basin Initiative, Gambia River Basin Development Organization, Niger River Basin Authority), Regional Economic Communities as well as individual countries. It is worth mentioning the approval by the Bank this year of a grant of US$14 million for the financing of the study on the development of the Inga hydropower site and associated interconnection. This study is one of the ten flagship projects of the Short Term Action Plan of the NEPAD prepared by the Bank at the request of NEPAD.

This morning and over the next two days, Africa s leading water specialists will be revisiting these broad issues surrounding the appropriate use of water for agriculture and energy. Perhaps nowhere in the developing world are these issues more pertinent than on our continent today. This is why the Bank is organizing a Parallel Event devoted to the augmentation of the Continent s per capita water storage as a strategic intervention that will enhance opportunities for food production and power generation while at the same time responding to the challenges of climate change. The Bank is committed to helping its regional member countries to increase their water storage capacity by at least 8.5 billion m^3 over the period 2008-2013.

The private sector arm of the Bank is also gearing up to scale up its support to agriculture as well as energy production.

I am very confident that this Conference will identify clear ways of progress in boosting food security and energy for socio-economic development for Africa.

I wish you the best of success in your deliberations.

Thank you.

Statement of the President of the Islamic Development Bank Mr Mohamad Ali

Sirte Libyan Arab Jamahiriya, 15-17 December 2008

The hosting of this meeting by the Libyan Arab Jamahiriya is clear evidence of the great attention that the leadership of the First of September gives to joint African action, to supporting economic and social development and to the reduction of poverty in this continent that owes you a debt of gratitude.

I am sure I will be speaking for all the participants when I extend heartfelt thanks and gratitude through you to the Leader of the First of September Revolution and to the dear people of Libya, for the care we are enjoying in your midst. Also, I cannot but praise the Leader s decision for choosing you for the opening of the Conference, and to commend the excellent preparations to ensure its success, God willing, and to note the warm reception and generous hospitality afforded to everyone. This is not strange coming from the Libyan Arab Jamahiriya, as it has always lent generous support to joint African action, and has bestowed great care upon the Islamic Development Bank.

Profound thanks are due to the FAO for organizing this important Conference, which reaffirms the vital role that the Organization plays and the special attention it gives to the issues affecting the Dark Continent. I would also like to thank His Excellency, Dr Jacques Diouf, for giving the Islamic Development Bank the opportunity to take part in such an important event.

Everyone hopes for the success of the Leader s strategic vision for the continent and for raising the international stature of Africa. The economic performance of Libya in recent years gives significant indications of leading growth in the continent. Likewise, the feverish activity of reconstruction and development that is currently taking place in an atmosphere of economic openness is an important indicator of attracting investment, that will link the Jamahiriya s present with its great past to be a wide bridge for the exchange of culture, knowledge and trade between Africa and the rest of the world.

You have done well by choosing the subject and the timing of this highly attended Conference, as half the population of the continent are drowned in poverty, and lost in the labyrinth of want and malnutrition. The holding of this conference indicates that you wish them to see on the horizon a glimpse of hope for a dignified life, a hope that they direly need.

Indeed, you have done well by dedicating the first theme of your Conference to alerting to the danger that will threaten the poor in Africa and the world in general because of the food crisis. Consecutive crises roll back hundreds of millions of people, and push back tens of millions of Africans into the claws of poverty and indigence.

The IDB answered the call to attend this meeting because we felt in such an invitation a sincere desire to help Africans face a number of urgent and important issues in a systematic manner, and because we found a strong determination by the organizers to examine and deal with certain issues that had been subject for decades to neglect and shortsightedness, causing the loss of millions of lives.

This august congregation is evidence that by your call for facing the challenges collectively and your insights into the heart of matters, you can rightly read history and help the coming generations avoid facing the tragedies of the recent past caused by hunger and disease and their ilk.

Only recently, some member states of the Bank have been trying to convince leaders of international financial institutions with this or that dam project, but their arguments fell on deaf ears that would not hear the reasons for making rewarding investment in electricity and water. At that time, the Islamic Development Bank and sister institutions in the Steering Group were keen to listen to their voice, and give it the attention it deserved. Hence it was the Song Loulou dam in Cameroon, which came as the auspicious start of all the Bank s operations. It was followed by the great Manantali and Djama dams on the Senegal River, and others followed. The Steering Group, which included the IDB, the Arab Funds and the OPEC Fund, did well to have stood firmly behind the member states of the Senegal River Basin Organization in support of building those two dams despite the objections of other financial institutions at the time. Having worked on erecting dams on the rivers of the continent, the IDB is glad that today the approach based on taking care of water is receiving increased attention.

After the times of turning a deaf ear, we find that the poor, who paid the price of decades of neglecting water and agriculture infrastructure, are looking forward today to the results of a serious consideration of investment in agricultural water facilities in Africa. They hope that the Conference will provide answers to a number of questions that have preyed on the mind of those states. These have been long denied funding by major financial institutions, and want to be reassured by a smooth flow of resources in the medium and long terms in order to support agricultural development and food security.

This assembly provides ample opportunity for examining and reflecting on the results of the choices made in the recent past, when long-term investments in agriculture were tightly restricted and the mere consideration of its principal method was considered a mortal sin.

It is unfortunate that, at this stage in particular, no sooner had the food crisis made clear the lessons of the past that the financial crisis followed, which gave a pretext for some to decrease their aid for the reduction of poverty in Africa. This is despite the fact that they are able to garner hundreds of billions in a short time to save the banks of the rich, leaving those for whom food is a matter of life or death to the sway of the crises.

We have no excuse today not to respond widely to the necessity of doubling food production in African countries, whether through government support to development or through direct foreign investment. And, in this latter, there are virtually inexhaustible sources of profit. We are aware of how meagre the funds required for such investments are, compared to the financial support farmers receive in some advanced countries, let alone the sums spent on purchasing arms and instruments of war that cause nothing but poverty and hunger.

The Islamic Development Bank will contribute as much as possible, and with a sense of responsibility, along with the Steering Group, towards meeting such vital demands. The IDB is calling today for forging an investment partnership between countries which God has endowed with natural resources (water and soil), and those with the know-how and advanced experience in the techniques of agriculture, and those with markets and capital.

The IDB believes that the time is more suitable now than it ever was or will ever be for the success of such a partnership. The IDB will, as a matter of priority, allocate resources under the Jeddah Declaration initiative to support around twenty of the least developed member states in Africa.

However, we should not feel complacent when this, or any other, conference calls for accelerating investment in the agricultural sector in African countries and for placing this sector at the heart of the development agenda to halve the number of hungry by 2015.

We have to move to a higher level a level where plans are devised to face the challenges, and where attention is focused on building actual capacities in order to achieve our goal.

We have to use a new language the language of achievement and implementation, no matter how much know-how, skills and good practices this takes. All efforts should come together with a view to providing whatever is necessary for production: installations, facilities, roads or ways to market products. Governments in sub-Saharan Africa, a region that depends heavily on agriculture for achieving overall growth, have no excuse not to allocate 10 percent of public expenditure on that sector.

The most important actions that the world could do to show its earnest desire to reach a permanent solution for the problem of hunger are to encourage social justice within the present world order; to reject wars, occupation and humiliation; and to stop generating, nurturing and fomenting conflicts. What have the people of Darfur done to deserve their plight when water becomes scarce and herding becomes a contest, when weapons speak and well drilling machines fall silent? What have the Somalis done?

Then what are we doing about Lake Chad when the forces of nature are taking it away from us before our very eyes?

Let us all work together to support the capacities of scientific research, to streamline resource management in agriculture, to provide financial lines to agricultural projects, to organize conferences to encourage business people to invest, and to forge partnerships that would allow agriculture to flourish and pave the way to cut free from the claws of poverty. Let us indeed work towards such great deeds!

Let me end by extending in your name, once again, our heartfelt thanks and gratitude for the hospitality and warm welcome afforded to all participants. Finally I pray to God to guide us all towards what is good for Africa, her progress and welfare.

Statement of the Director of Food Security and Sustainable Development at the UN Economic Commission for Africa Mr Josu Dion

Sirte Libyan Arab Jamahiriya, 15-17 December 2008

I bring you warm greetings from Mr Abdoulie Janneh, United Nations Under-Secretary General and Executive Secretary of the UN Economic Commission for Africa, who had planned to be here in person but regrets not being able to do so because of a last minute major constraint. He sends his appreciation for the holding of this important conference and reiterates ECA s full commitment to supporting the implementation of its outcomes.

This Conference is indeed crucial as it brings us to address a critical nexus for Africa s sustainable development, namely, the Water-Agriculture-Energy nexus. This nexus is critical in that one could argue that moving agriculture in Africa depends doubly on water: water directly for increasing and stabilizing productivity and production at the farm level, and water for energy to move the food and agriculture system up the value chain ladder, especially through agro-industry development.

The Conference is also timely as it aims to provide a more action-oriented follow-up to a series of African Ministerial Conferences and Heads of State and Government Summits on those critical sustainable development challenges at a time when the continent is grappling with the hardships of an intricate set of global-level crises, including the food crisis, energy crisis, financial crisis and climate change. If most of these crises may be seen as new at the global level, none of them is really new for Africa.

The recent soaring food prices have only compounded further an already dire state of structural food insecurity throughout Africa. Even before the global food crisis, extreme poverty and chronic hunger affected more than 40 and 25 percent respectively of the total population of the region. Also, this has happened despite increasing commercial imports of food and food aid. FAO estimates tell us that the global food crisis has contributed to adding 24 million to the number of hunger-stricken Africans.

The same goes for energy. With more than 14 percent of the world s population, Africa accounts for only 3 percent of world modern energy consumption. The continent has the lowest electrification rate of all major world regions. Only 25 percent of the population in sub-Saharan Africa, and less than 20 percent of the rural population of the continent, have currently access to electricity. Moreover, it is projected that, in a business-as-usual scenario, half of the population of Africa will still be without electricity by 2030.

Coupled with high energy costs, increasing food import bills and the costs of the related coping fiscal measures further curtail the capacity of African countries to save, mobilize and invest their own resources to achieve the Millennium Development Goals (MDGs) in general, and the poverty and hunger MDG in particular.

Without decisive and sound adaptation actions, we know that climate change will seriously add to this gloomy picture. It will severely constrain agriculture in Africa, by contracting the area suitable for farming, shortening crop-growing periods and reducing yields from rainfed agriculture. It would also increase energy constraints through a combination of reduced water flows to hydropower dams and worsening depletion of biomass energy resources and, therefore, further impede industrial development, especially agro-industry development in Africa.

This dim picture of the state and fate of agriculture and energy is strongly rooted in achievements so far and future commitments towards harnessing and developing Africa s considerable water resources for agriculture and energy. In this regard, we all agree that the record so far is way below what is both needed and possible. With only 4 percent of the continent s available water resources being currently exploited, less than 10 percent of agricultural land is irrigated, and only 7 percent of the hydropower potential of the region is tapped. There is clearly ample room for action here.

For sure, high-level political commitments to developing Africa s water resources, agriculture and energy resources have recently been made and repeated; for instance, Maputo in 2003, here in Sirte in 2004, Johannesburg in 2005, Abuja in 2006 and Sharm El Sheikh in 2008. Yet, there is much to do in following up and translating those commitments into effective actions. Very eloquent in this regard is the finding of a recent report by the African Union Commission and the NEPAD Agriculture Unit that, in 2007, only seven countries had met the Maputo commitment to allocating, by 2008, at least 10 percent of national budgetary resources for agricultural and rural development.

Stretched very thinly in pursuit of all MDGs and sustainable development imperatives, it is understandable that budgetary resources of African countries are subject to extremely difficult allocation exercises. Yet it should be stressed that timely investment in water resources to unleash the full potential of the agriculture and energy sectors would go a long way in accelerating broad-based economic growth and employment and, therefore, providing African people with a sound pathway out of poverty and food insecurity.

This is an area where regional cooperation and integration could help a lot to address the challenge. Indeed, as adopted at the Abuja Food Security Summit, federating and articulating efforts around the systematic development of regionally integrated value chain of strategic food and agricultural commodities would add great value to the implementation of NEPAD s Comprehensive Africa Agriculture Programme (CAADP). Likewise, public-private partnership efforts at developing Africa s shared water and energy resources naturally lend themselves to improved regional cooperation and integration. Devising and implementing effective mechanisms and actions to realize the full potential of regional integration therefore deserve particular attention in the way forward.

To complement Africa s own efforts at mobilizing and investing greater domestic resources in water for agriculture and energy, it is imperative that development partners also make it a priority to deliver on their commitments to the continent. In this regard, deeds unfortunately lag far behind words.

As you are aware, ECA is committed to contributing the fullest possible support to Africa s quest for sustainable development. Water, agriculture and energy have been constant priorities in this regard. Currently, we are engaged in partnerships, especially with FAO and UNIDO, to help African countries and their Regional Economic Communities develop and implement the technological, infrastructure, institutional and policy requirements of a regional approach to developing the value chains of strategic food and agricultural commodities.

To help address the challenge of climate change we have, in partnership with the African Union Commission and the African Development Bank, developed and engaged in implementing a comprehensive Climate for Development in Africa (ClimDev-Africa) Programme. This Programme sets out to scale up the capacities of key African institutions and stakeholders to improve climate-related data and observation, information services, policies and risk-management practices in climate-sensitive sectors, with major focus on water, agriculture and energy. To deliver on the policy component and the management of ClimDev-Africa, ECA has also embarked on establishing an African Climate Policy Centre (ACPC) to assist African countries mainstream climate change concerns in their development policies and frameworks and guide the related investment process.

To conclude, allow me to stress once again that the focus of this High-level Conference on action-oriented outcomes towards decisive progress in water development for agriculture and energy in Africa is both crucial and timely. We at ECA look forward to fully supporting the implementation of these outcomes.

Thank you.

Statement of the Representative of Farmer Organizations Network of Peasant Farmers and Agricultural Producers Organizations of West Africa (ROPPA) Mr Cheikh Mouhamady Cissoko

Sirte Libyan Arab Jamahiriya, 15-17 December 2008

After the Forum on Land in Porto Allegre, here we are gathered in Africa to discuss the continent s water resources.

I should like to thank FAO, the African Union and Libya for including the African Peasants Forum in this important meeting. Peasant farmers still predominate in Africa, south of the Sahara, and are consumers of water for their personal needs (drinking, hygiene and cleanliness) and to produce food.

This vital resource comes directly from captured rainfall or is recovered from ground and surface waters. The abundance of water has given us a popular credo water management is the responsibility of God or the Ancestors or some crises are punishments for our errors ... .

Scientific information increasingly available to African institutions and our researchers tells us that:

1. Rainfall is becoming more erratic and sparse (see annual precipitation irregularities (%) on earth from 1900 to 2005: Courtesy Amadou, Th. Gaye, 2008 Projected Patterns of Precipitation Changes, same authors - Indice Pluviomt rique au Sahel 1905-2005 (Agrigmet data) Courtesy: Abdou Ali and Thierry Lebel).

2. Rainfall impacts on water resources and is a key cause of erosion (Courtesy: 2006 Annual Rainfall Index).

3. Africa s water resources from river basins will be insufficient towards 2025 (see Sharma *et al*, 1996).

4. Several sub-Saharan countries could lose their watercourses unless we take preventive action, as in the case of Lake Chad Atlas of our Changing Environment, UNEP Grid Arendal.

5. Our wise men and elders speak of the imminence of threats and periodically refer to falling water levels and the clear association that exists between rainfall, quality and quantity of arable land and availability of forest resources.

Doubts and concerns are palpable in our villages and communities and among researchers and decision-makers.

The trend is not ending and African peasant organizations note with bitterness and great anxiety that:

- the reduced flow of our major watercourses could continue;
- accelerating siltation is eliminating thousands of hectares of lowlands, backwaters and rivers each decade;
- inland wetlands are endangered;
- water tables are plummeting;
- water quality is deteriorating; and
- access to productive natural resources will be the greatest challenge in managing the risk of conflict among a population of over 1.5 billion in 30 years time.

All of this leads us to conclude that our dear Africa seriously risks being very exposed to variability and change of climate, especially because of our limited capacity to adapt and anticipate.

Is that therefore the end of our adventure? By no means. We can act and react.

I believe that the commitment of the Heads of State to mobilize for the benefit of our water resources and energy production are two programmes that will oblige investment and a close look at our waterways.

Fish farming and irrigation are two measures to better manage and protect resources; and the development of rice and maize cultivation requires the protection of our lowlands.

These are three out of many options, but I believe the key to the success of whatever we do is to inform and mobilize the people, to support research, action and multidisciplinary analysis, to foster the indicators of creation of wealth, to encourage clean energy and to carefully plan the resources needed to marshal Africans into meeting the challenges and the opportunities of their time and their future.

The peasant farmers organizations of Central Africa, East Africa, Southern Africa and West Africa, intent on building a continent-wide organization of peasant farmers, extend a greeting to the peasant farmers of Libya and the Maghreb, commend FAO on its actions of intervention and exchange, thank the African Union and the Economic Commission for Africa for their mobilization and encourage the Heads of State to shape the course of history by deciding what can be done and what should be done.

Thank you for your attention.

Annex 2. Adopted Agenda and Timetable

Monday 15 December

09:30 13:00 hrs
Plenary

Opening of the Conference

Election of the Chair and Vice-Chairs and appointment of the Rapporteur (1)

Adoption of the Agenda and Timetable (2)

Establishment of the Drafting Committee for Conference Declaration and other arrangements (3)

- Address by the Host Country
- Address by the Director-General of FAO
- Address by the African Union
- Address by the African Ministers Council of Water
- Address by the African Development Bank
- Address by the Economic Commission for Africa
- Address by the Islamic Development Bank
- Address by Representative of Farmers Organizations
- Statements of Heads of Delegations

Lunch break

14:30 18:30 hrs
Plenary

Statements by Heads of Delegations

14:30 16:30 hrs
Parallel Event

AfDB: Strategic Approach on Water for Energy and Agriculture

16:30 18:30 hrs
Parallel Event

1. CEN-SAD: Food Crisis in the States of CEN-SAD: Emergency Actions and Sustainable Perspectives
2. AgWA: A New Partnership for Agricultural Water in Africa

20:00 22:00 hrs

Conference Official Dinner

Tuesday 16 December

10:00 12:30 hrs
Committee of the Whole (Session 1)

Prospects for food and energy demands by 2015 and projections for 2030-2050 (4.1)

10:00-12:30 hrs
Drafting Committee
Review of the draft text of Declaration

Lunch break

14:30 16:30 hrs
Committee of the Whole (Session 2)
Defining investment envelopes for water control in Africa (4.2)

16:30 18:30 hrs
Committee of the Whole (Session 3)
Financing mechanisms and implementation strategies for water control in Africa (4.3)

14:30 17:30 hrs
Drafting Committee
Review of the draft text of Declaration

Wednesday 17 December

09:30 11:30 hrs
Round table Discussions
Saving Lake Chad (5.1)

11:30 13:00 hrs
Round table Discussions
Partnership for Financing Water for Agriculture and Energy in Africa (5.2)

11:30 13:00 hrs
Parallel Event
ADEA: Technology Transfer in the Water and Energy Sectors in Africa

Lunch break

15:00 16:00 hrs
Adoption of the Report and Final Declaration (6)

16:00 16:30 hrs
Closing Ceremony

16:30 17:30 hrs
Press Conference

Annex 3. Composition of the Drafting Committee

Chair-Libyan Arab Jamahiriya:	Mr Ali RAHUMA
Algeria:	Mr Omar BOUGUERA Directeur de l hydraulique agricole, Ministr e des ressources en eau
Congo:	Mr Charles NGANGOUE Prs ident, AMCOW-TAC
Guinee:	Mr N Famara CONTE Directeur National du Gn ie Rural, Minist re de l agriculture
Kenya:	Mr Daniel Kdwoli BARASA General Manager, National Irrgaiton Board
Lesotho:	Mr Mohale SEKOTO Principal Secretary, Ministry of Agriculture and Food Security Mr Bataung LELEKA Principal Secretary, Ministry of Natural Resources
Morocco:	Mr El Mahdi ARRIFI Ingni eur Principal, Administration du Gn ie Rural, Ministr e de l Agriculture et de la Pc he Maritime
Mozambique:	Mr Delario SENGO Head of International Rivers Office
Tanzania:	Mr Mbogo Paul FUTAKAMBA Director of Irrigation, Ministry of Water and Irrigation
Zimbabwe:	Mr Conrade ZANRI Deputy Director, Minister for Agriculture

Annex 4. The reports of the parallel events

a) AfDB: Strategic approach on water for energy and agriculture

The panel of this parallel event was chaired by Dr Aly Abu Sabaa, Director of Agriculture and Agro-Industry (AfDB) with the participation of Madame Rhoda Peace Timusiime, Commissioner for Rural Economy and Agriculture of the African Union; Dr Bruno Itoua, Chairman of AMCOW (Minister of Energy and Hydraulics, Republic of the Congo); and Dr Alex Bleriot Momha, Lake Chad Basin Commission.

Three presentations were made by the Experts of the AfDB respectively on: (i) the Bank s strategy on water and energy sectors; (ii) the support to planned and on-going projects on hydro-power development in Africa; (iii) and the multipurpose use of water. The presentations underlined the following key issues:

- The AfDB is establishing strategic interventions over the next three to six years to mobilize US$10-11 billion in infrastructure including water for agriculture and energy of which 15-20 percent will go through existing regional frameworks including NEPAD.

- The AfDB has mainstreamed climate change impacts assessment as a requirement for the funding of projects on infrastructures.
- The strategy adopted in the Medium Term (2008-2012) is to promote growth in agriculture as an efficient means to reduce poverty in rural areas.
- Increasing of water storage capacity by 1 percent over the next six years within the Water Development Plan and operationalization of the Africa Fertilizers Mechanism are part of the priority areas of the Bank s intervention.
- A number of priority countries in the domain of Water for Agriculture for an envelope of 2 225 billion were identified for support.
- The AfDB is playing a catalyctic role to attract other investors including Public, and Private Partnerships in resource mobilization for hydropower development in Africa. The Inga hydropower dam planned in DR Congo to provide energy for neighbouring regions was presented as an illustration of the Bank s support to the development of power pools.
- The AfDB is currently planning US$4 billion worth for the Hydro Electric Power (HEP) programme to provide around 20 percent of project funding. States could borrow but they must have energy development as a national priority.
- Successful projects should have many purposes and division of both costs and benefits should be considered from the start. The design should include control and jurisdiction aspects (sovereignty issues, shareholding, etc.).

The discussions stressed the need for urgent actions to address the crucial rural needs in energy and inputs for the agricultural sector. The issue of ownership and countries own budgetary investments based on defined priorities in the domain of water, energy and agriculture were underlined as well as the need to take into account the changing financial environment with the intervention of new players such as China, Brazil and India who are interested in the agricultural sector.

b) Food crisis in the states of CEN-SAD: emergency actions and sustainable perspectives

Spurred by member states, the African Union and their partners, several initiatives are underway to stem the sense of insecurity due to rising food prices. These initiatives, taken at all levels, aim at providing emergency assistance to farmers and the establishment of agricultural investment policies in both the medium and long term.

The objective of this event is to mobilize more actors to better coordinate efforts and identity actions to improve the effectiveness of interventions to vulnerable populations. The actions taken so far to attain this were presented by different agencies, as described below.

- The PowerPoint presentation made by Community of Sahel-Saharan States (CEN-SAD) summarized the activities undertaken to address the food crisis. Agricultural problems in Africa are of a structural nature, rather than conjunctural nature. There is need for data for indicators and the need to strengthen capacity.
- The FAO Initiative on Soaring Food Prices (ISFP) has two phases: 1) Emergency assistance; and 2) Stabilization of the situation by reducing the vulnerability and augment the resilience, while not only looking at the agricultural production itself but also at issues such as roads, markets, etc.

- AfDB has been: 1) providing seeds and fertilizer; 2) planning to increase water storage by 1 percent in the coming years; 3) implementing a programme aimed at improving cereal production, starting with rice (New Rice for Africa (NERICA)); 4) providing resources to improve project management through training in the different ministries; and 5) giving more priority to projects that are involved in agricultural production.
- AU-NEPAD emphasized the need to refocus on agriculture, to harmonize donor interventions to strengthen the capacity and reduce the knowledge gap within farmers organizations and NGOs.

It was recommended that:

- AU and CEN-SAD should arrange for experience sharing on water control between sub-Saharan Africa and North African countries where a lot of good experience has been gained. AfDB was asked to assist with the preparation of a coordinated technical assistance programme. Attention should be paid to comparative advantages of each sub-region. In this respect, the collaboration between CEN-SAD and the West African Economic and Monetary Union (UEMOA) was mentioned.
- The importance of sub-regional integration should be stressed as well as collaboration on river basin level, electrification and food trade.
- The subsidy programme being implemented in Malawi to help farmers access agricultural inputs has generated much interest and many lessons can be learned from it. The Moroccan experience of modern agriculture and social agriculture can also be emulated.
- The political instability, economic and legislative instability were considered as major constraints to sustainable agricultural development and political will was called upon for the creation of the conducive political, legislative and economic environment.

c) AgWA: a new partnership for agricultural water in Africa

The report on the AgWA partnership was presented by the consultant. There has been recently increasing recognition of the importance of agricultural water for economic growth, poverty reduction and food security. Both national governments and international development agencies are refocusing their activities on agricultural water and seeking new ways to bring it into the mainstream of political and development action. A major step in this direcion was taken in Tunis during the first African Water Week in March 2008 with the formation of a new partnership for agricultural water in Africa (AgWA).

AgWA aims to re-engage development partners and political decision-makers in water for agriculture. It is an instrument for mobilizing political will for scaling up investments in water for agriculture. The principal components of AgWA include:

- advocacy to disseminate positive and coherent messages about agricultural water.
- promoting resource mobilization foe pipeline development and investments.
- harmonizing partner programmes and approaches on a country by country basis.
- knowledge exchange and learning.

While some partners have submitted their potential contributions to AgWA (AfDB, FAO, International Commission on Irrigation and Drainage (ICID), IWMI, World Bank, NEPAD and IFAD), others are still to provide the requested information. Participation remains open. It was agreed that the Secreatariat of AgWA would be hosted by AfDB and would become operational as soon

as possible. The next meeting of AgWA will be held on the occasion of an international event such as the World Water Forum V.

d) ADEA: technology transfer in the water and energy sectors in Africa

Around 50 persons attended the event that took place on the very last day of the Conference. Six African Ministers joined the discussion and, in particular, His Excellency Bruno Jean Richard Itoua, Chair of AMCOW.

During the conference, the African Development Bank pointed out the weak absorption capacity of countries concerning investment (in particular the lack of human capacities). Mr Itoua said: Consequently, one challenge is now to help the African private sector to emerge to bridge the gap ,

The ADEA association (based in France) has been established to facilitate the mobilization of European small and medium enterprises and industries (SME/SMI) in Africa. Around fifty companies are members of ADEA, helping the local private sector in order to promote local permanent collaboration. Three enterprises of the ADEA cluster made presentations on their own experience:

- The Compagnie Nationale du Rhne (CNR) which is specialized in river management (navigation, hydropower generation and irrigation). CNR focuses on the Rh ne river basin but has been working on the transfer of knowledge to the Senegal river basin.
- Michaud Export: This company works on the development of small-scale rural electrification (small systems range between 20 to 500 W with limited distribution). Congo, Guinee, Madagascar and Mali have adopted these systems (the so-called Aladin).
- Sylene: This company focuses on the automation for water supply and irrigation systems. They expanded their experience to Mali (with 100 percent Malian technicians).

Three main questions were raised during the parallel event:

(i) Can we request the private sector from the North to have long-term engagement with specific objectives to transfer technologies to the South?
(ii) How can we promote the intervention of SME/SMI?
(iii) Are the existing funding mechanisms adapted to these SME/SMI?

The parallel event was concluded with an official invitation from the Director-General of FAO to attend the next EURAFRIC Forum in October 2009 in Lyon, France.

Appendix:
The Conference adopted Declaration

WE, the Ministers and Heads of the African States Delegations, meeting at the Conference on Water for Agriculture and Energy in Africa: the Challenges of Climate Change in Sirte, Great Socialist People s Libyan Arab Jamahiriya, from 15 to 17 December 2008;

Inspired by the Leader of the Great Revolution s vision for a strong Africa capable of facing global challenges in a world of great aggregation;

Reaffirming our commitment to the principles and objectives stipulated in the Constitutive Act of the African Union and its programme NEPAD, aimed at promoting cooperation and integration between our countries in all fields with a view to raising the living standards of our peoples and guarantee the well-being of our future generations;

Reaffirming our commitment to the African Water Vision 2025 and to the achievement of the Millennium Development Goals, specifically those related to water and to the eradication of poverty and hunger;

Recalling the commitment of Heads of State and government contained in the Maputo Declaration of 2003 on Agriculture and Food Security in Africa, and in the Sirte Declaration of 2004 on the challenges of implementing integrated and sustainable development on agriculture and water in Africa;

Recalling the African Union Declaration on Climate Change and Development in Africa of 2007;

Recalling the 2008 Ministerial Declaration and outcomes of the first Africa Water Week convened by the African Ministerial Council on Water (AMCOW) and hosted by the African Development Bank in Tunis;

Recalling the Paris Declaration of 2005 on International Aids;

Recalling the 2008 Declaration of the High-Level Conference on World Food Security: the Challenges of Climate Change and Bioenergy ;

Recalling the 2008 Eleventh African Union Summit on Meeting the Millennium Development Goals on Water and Sanitation ;

Recalling the African Development Bank s initiative to increase water storage in Africa by 1 percent over a six-year period in addition to reducing post-harvesting losses by 3 percent over the same period;

Recognizing that water is, and will remain, a key resource to economic, social and environmental development as well as to hunger and poverty eradication of Africa, and that water, sanitation and energy are prerequisites for the development of Africa s human capital;

Recognizing the vulnerability of African economies and agricultural production systems to climate variability and climate change, and the challenges caused by enviromental degradation;

Recognizing that the challenges faced by the continent concerning food security, achieving MDGs, increased energy demand, and combating climate change impact is greater than resources available to each individual country, and therefore require that the countries move jointly at sub-regional, regional and continental level;

Recognizing the important role played by family farms in agricultural production and natural resources management;

Concerned by the progressive decline of the continent s agricultural productivity, increased negative impact of food import on commercial trade balance, vulnerability to food price shocks and low response capacities;

Concerned by the level of food insecurity and the implications of high and volatile food prices on the situation of the poor in Africa;

Concerned by the low level of the use of water and land potential in Africa;

Concerned by the current situation in Lake Chad, the resulting negative implications, and urgent need to intervene in order to avert human and environmental disaster;

Aware that the African agriculture has been under-funded for several decades and that water control projects for agriculture and energy have not been sufficiently developed;

Aware that accelerated investments in support to agricultural water development are needed to ensure agricultural growth, hunger and poverty eradication, foster socio-economic development, and increase employment;

Aware that enhanced agricultural productivity depends not only on improved water management, both in rainfed and irrigated agriculture, but also on the access and optimum use of other farm inputs, availability of services, access to markets and fair and stable prices for farm products;

Noting the progress made by the African Union and by establishment of its programme NEPAD, the on-going process of Africa s economic integration and the need for building mechanisms of cooperation and partnership in the agriculture and energy sectors in the struggle to free the Continent from the scourge of under-development and continued marginalization in a global world economy;

Acknowledging the continuous support of the regional and international partners to the water, agriculture and energy sectors in Africa, and urging development partners to engage further in supporting agricultural water development in Africa;

Recognizing that further efforts need to be made to develop an enabling environment conducive to accelerated investments in the water sector;

Welcoming the proposal by FAO to convene a World Summit of Heads of State and Government on Food Security in 2009, with the objective to secure broad consensus on the rapid and definitive eradication of hunger from the planet by ensuring greater coherence in the governance of world food security and by finding US$ 30 billion per year to invest in water and rural infrastructures and increase agricultural productivity in the developing world;

Determined to prioritize implementation of integrated water, agriculture and energy programmes to enhance sustainable development in Africa;

WE COMMIT OURSELVES TO:

Adopt sound policies and associated institutional reforms in support to water development at the national, sub-regional, regional and continental levels in order to fully exploit the potentialities of both the agriculture and energy sectors;

Support NEPAD in accelerating the implementation of pillar I of its Comprehensive Africa Agricultural Development Program (CAADP) and carry out the new Agriculture Water Partnership (Agwa) to expedite the attainment of CAADP objectives toward the expansion of the area under sustainable land management and reliable water control;

Call upon states to accelerate the fulfilment of the commitments made in Maputo in 2003 on the allocation of 10 percent of our national budgets to boost agricultural production;

Adopt a comprehensive policy towards enhanced agricultural productivity that takes into account water, farm inputs, technical capacity, tenure, markets and a fair and conducive institutional environment in support to small farmers;

Call upon AMCOW to promote an integrated water resource management approach in the preparation of water resources policies and plans;

Adopt a pragmatic, demand-driven, participatory approach and stepwise framework for investment in water development in support to agriculture and energy which considers appropriate water control, improvement of existing water infrastructure and the development of large river basins;

Sensitize donors and development partners to support Africa in sustainable water development and management in agriculture and energy;

Invite development partners and institutions, like FAO, the African Development Bank, the Islamic Development Bank and others, to strengthen countries capacity in project development in order to accelerate investment in water for agriculture and energy;

Call-on the African Development Bank, Islamic Development Bank and the World Bank as well as the regional development banks in ensuring the financing of, inter alia, development projects in the field of water for agriculture and energy;

Request AMCOW, with the support of UN-Water Africa, to develop clear guidelines on the implementation on inter-basin water projects;

Support the Economic Commission for Africa and the African Regional Economic Organizations in their effort to enhance clean energy production in the continent, particularly in promoting the exploitation of the hydropower potential and in strengthening regional Power Pools;

Encourage bilateral and regional agreements on shared water resources and strengthen existing river and lake water basins organizations to promote sustainable water resources development and management in accordance with international law, including the agreements concluded among riparian States;

Encourage accelerated integration of the continent s power network, the development of water falls to provide electric power, and of small hydropower generation to speed up rural electrification;

Develop coherent policy framework for public-private partnerships that will attract increased private capital into agriculture, water and energy sectors;

Call upon the African Regional Economic Communities to develop and strengthen appropriate regional instruments on integrated water resources management and promote the strengthening of regional Centres of Excellence and networks for agriculture, hydropower generation, water management, climate change, desertification, drought, floods and environmental management;

Establish, with the support of FAO, an information system in the field of agricultural production for food security and the trading of commodities between markets and countries;

Undertake necessary national and regional capacity development efforts as an integral component of each national investment plan which should focus on the optimization of water resources use in support to enhanced food and energy security and poverty alleviation while underpinning the need to protect the environment;

Create high level executive bodies to address the integration of resources at the national and regional levels in Africa;

Foster and strengthen cooperation between National Meteorological and Hydrological Services, Regional Climate Centres, Regional Economic Organizations, the African Center of Meteorological Applications for Development, research centers and other institutions on matters of climate variability and climate change to develop aid decision tools;

Enhance Early Warning Systems at national and regional level and their establishment where they do not exist as well as their coordination at continental level in order to minimize the negative impact of drought, desertification, floods and pests;

Foster research and development in renewable energy and agriculture in Africa to increase resilience and adaptation to climate change;

Harmonize climate change adaptation strategies, national and regional development policies, programmes and activities, with the United Nations Framework Convention on Climate Change and the United Nations Convention to Combat Desertification;

Call upon the Lake Chad Basin Committee member states to double their efforts and appeal to donors and development partners to provide immediate assistance toward saving Lake Chad and its basin from the looming human and environmental disaster;

Call upon the AU Commision to design a road map and a mechanism to monitor and evaluate the implementation of this declaration, in close collaboration with FAO, the African Development Bank, the Economic Commission for Africa, NEPAD and the Libyan Arab Jamahiriya.

2

Conference thematic approach

Introduction

The context

The African continent is facing an escalating food crisis. The recent surge in staple commodity prices will hit many developing countries hard, and this is particularly the case for Africa, which will have to find the financial resources to pay for a commercial food import bill that, on average amounts to US$17 billion annually alone. Over 60 percent of this bill is accounted for by food staples. Moreover, terms of agricultural trade are worsening: agricultural net trade has been declining steadily passing from approximately US$3.3 billion surplus in the 1970s to a dramatic deficit of US$4.4 billion in 2004. At the continental level it is apparent that Africa has not been able to intensify agricultural production and generate intra-continental trade to feed growing cities or buffer the volatility of rainfed production. While Asia benefited from the effect of the Green Revolution that involved the development of irrigation, the use of seeds, fertilizers and pesticides, and the extensive and heavily subsidized rural electrification, the African continent did not embark on any similar trend in agricultural growth. Sub-Saharan Africa, in particular, has seen very low or even stagnant levels of yield growth in its rainfed subsector, and slow development of its irrigation subsector.

The food crisis trap that threatens the African continent is not only the effect of the neglect of the agricultural sector, and the lack of investments in water for agriculture, but also a product of the impact of variability of climate on the agricultural sector. Farming in Africa is largely rainfed and Africa s reliance on agriculture makes it singularly vulnerable to the vagaries of its climate. Rainfall is erratic and natural hazards such as droughts and floods are frequent. Africa has also experienced, over recent decades, growing environmental degradation such as deforestation, desertification, declining soil productivity, loss of biodiversity and depletion of freshwater. The United Nations Intergovernmental Panel on Climate Change (IPCC) predicted that climate change could cause crop yields in some African countries to fall by 50 percent by 2020, seriously threatening the continent s fragile food security.

Combined with the increased volatility of the price of the main agricultural commodities, Africa is facing a parallel increase in the price of energy, used as an input to food production. The upward trend of energy costs and concerns regarding the effects of climate change has reinvigorated the interest in alternative energy. Energy is fundamental to the achievement of each of the eight MDGs. Seventy-seven percent of households in sub-Saharan Africa are without access to electricity, and most rural households still rely on traditional fuels wood, dung, and agricultural residues that are strongly affected by climate variability, significantly compromising their opportunities for economic development and further entrenching poverty. Africa, however, has enormous potential for energy production, particularly hydropower, which will have to be exploited in the face of an economy that is placing increasing stress on water resources and is generating further energy needs.

High food and energy costs, notwithstanding the recent circumstantial drop in prices, provides further justification for the development of alternative sources of energy, in particular hydropower, and the development of a productive agricultural sector, which is expected to increasingly depend on expansion and improvement of irrigated production.

Objectives of the Conference

The principal aim of the Conference was to examine all aspects of water resources in Africa in the context of rapidly increasing demand from the agriculture and energy sectors and climate change. The Conference focussed on investment needs and management problems for the harnessing of water and irrigation at village level, the rehabilitation and expansion of large-scale hydro-agricultural works and the development and implementation of large water infrastructure and river basin projects, with a view to finding concrete solutions for the effective use and management of water and energy resources in support of growth and sustainable development in Africa. More specifically, it assessed the challenges faced by the agricultural and energy sectors in Africa in the framework of the global food crisis, examining how increased investment can achieve well balanced subsectors that would concurrently ensure food and energy security in all countries of the continent.

A key goal was to identify the financial mechanisms and steps required to promote and secure investment in the sector of water for agriculture and energy in Africa. The Conference represented a great opportunity to mobilize financial support within the framework of the Comprehensive Africa Agriculture Development Programme (CAADP) and ensured that investment commitments were made or confirmed by bilateral, regional and international financing institutions. For this purpose, relevant instruments for follow-up and monitoring of the implementation of commitments were defined.

Two time horizons were considered: one based on the CAADP projections for agricultural development investment needs by 2015, under current African population growth trends and food consumption demand, and the second looked at a longer-term perspective, 2030 and 2050, with an African population reaching 2 billion people; where climate change can have a greater impact and influence. Under the two scenarios, the focus was on concrete programmes and the assessment of their financing costs, both in terms of feasibility studies and implementation of works.

Organization of the Conference

The Conference preparation included the production of National Investment Briefs for all the African countries, in which investment needs for water control at the level of villages, extensive irrigation systems and major river basins, both for agriculture and for hydroelectric power have been thoroughly and precisely assessed in the short-, medium- and long-term. These programmes were reviewed during five regional preparatory workshops, which took place between October and November 2008 in which national and regional representatives from the water, agriculture and energy sectors participated.

At the conference, three working sessions were programmed to further discuss findings of the regional workshops and propose recommendations for decision-makers. These sessions attempted to address, in sequence, three main questions, the:

- prospect for food and energy demand by 2015 and the projections for 2030-2050;
- definition of the investment envelope for water for agriculture and energy to meet current and future food and energy demand in Africa; and

- financing mechanisms and implementation strategies for water for agriculture and energy in Africa.

The purpose of this background paper was to provide a framework for debate and guide discussions during the Conference s working sessions. It provided background information in support of the three themes, and suggested a series of key questions for discussion at the working sessions.

Theme 1: Prospects for food and energy demand by 2015 and projections for 2030-2050

Introduction

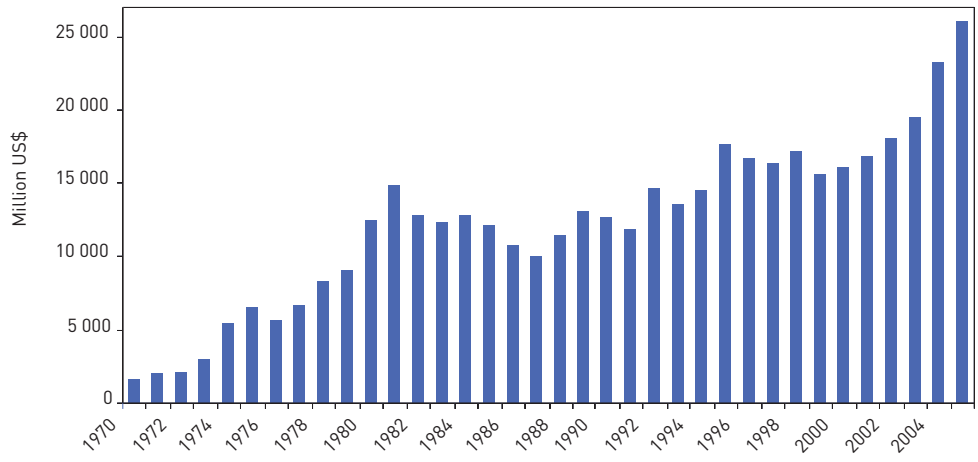
Rapid agricultural growth is urgently needed to face the severe crisis currently escalating in the continent notwithstanding the recent circumstantial drop in prices that has only partially alleviated the problem. The price of cereals has, however, shown variations of more than 100 percent over the last year, and the cereal bill for low income food deficit countries (LIFDCs) in Africa is projected to triple by 2030 under current trends putting heavy pressure on fragile national economies. Additionally, increases in energy demand put a direct burden on the energy bill of many African countries and there is a call for alternative solutions to energy supply. A worrisome implication of the increasing link between energy and food prices is the fluctuation of energy prices that are increasingly translated into food price fluctuations.

While it is apparent, at the continental level, there is unrealized potential for food and bio-energy production, many of the agro-climatic zones favourable for high-yielding irrigated production are constrained by soil and water limits. In any event, looking into the future for water management for agricultural and energy requires a consideration of economic demand. The demand for food is primarily a function of population and income. Relatively accurate estimates of future food demand are available in FAO s perspective studies for 2030 and 2050 (FAO, 2006b). Based on these studies, FAO estimates that food demands in sub-Saharan Africa alone will more than triple between 2000 and 2050 in response to increased population and improved diets.These rising trends in demand have to be set against the inherent spatial and temporal variability and increasing volatility of global food markets, as the last two years have demonstrated (Food Outlook, FAO). If the amplification of this variability under climate change is anticipated, meeting the predictable but rising demands in food and hydropower generation will become even more of a challenge.

While the demand for food is rising, overall production trends in the major cereals are generally flat, but with substantial inter-annual variations, due in large part to agro-climatic conditions that affect a predominantly rainfed production system.

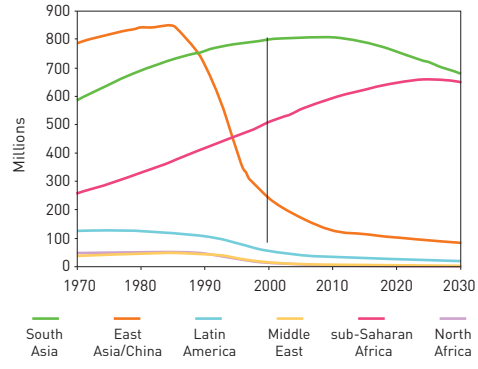
Africa is a net importer of food. Just looking at recent trends in rice imports shows how significant Africa s demand is in relation to global trade. When compared with production trends, despite the stability of irrigated production, imports are still some 60 percent of utilization. Figure 1 shows the increase in food import bills for Africa since 1961.

Figure 1: Food import bill for Africa (FAOSTAT, 2008)



A similarly alarming situation can be found in the energy sector. According to the Infrastructure Consortium for Africa (ICA, 2008), there is a chronic shortage of electricity supply in at least 25 countries in sub-Saharan Africa, and the entire generation capacity of the 48 countries of sub-Saharan Africa is no more than that of Spain. Despite abundant energy resources, the supply of energy in Africa is limited and unreliable, forcing many commercial consumers to invest in back-up energy supplies such as diesel generators. In sub-Saharan Africa, 526 million people live without access to power supply (2002) with the trend growing. In some countries, just 5 percent of the population have access, and in some rural areas only 2 percent. Sub-Saharan Africa is the only region where the absolute number of people without access to electricity is increasing, and it is expected that by 2030, this number will be 660 million (Figure 2). Yet, energy demand in Africa is expected to double, from 500 Mtoe in 2000 to 1 000 Mtoe in 2030. The limited coverage of public electricity grids is a particularly difficult barrier to business and trade promotion in rural areas. It is a major constraint to both diversifying agricultural production and to developing agro-processing facilities to add value to locally produced goods.

Figure 2: Number of people without electricity 1970-2030



Source: International Energy Agency

The main causes of this situation are many, including lack of long-term planning, insufficient investment, poor maintenance, corruption and the conflicts that affect several areas of the region and prevent investments. In addition, African borders limit market size through political and regulatory barriers to trade, hindering the siting of energy generation capacity at lower cost and greener locations, pushing up generation costs and prices, reducing margins and incentives for investment. Removing borders through expansion of international transmission lines, greater trade and stronger regional bodies would expand generating capacity and reduce overall capital and

operating costs. Regional power pools are improving cooperation and trading but progress is slow and they have not yet created the needed open competitive power markets.

The widening gap between food and energy demand and supply

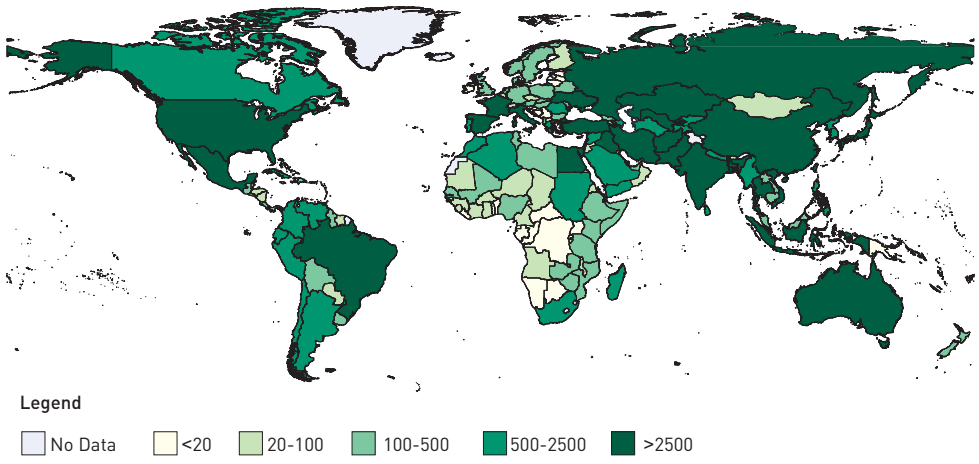
The basic drivers of demand are population and income growth. Demands for food staples and minimum levels of energy provision for heating, cooking, lighting and transport are essentially non-negotiable.

A recent diagnostic of infrastructure carried out by the World Bank (Foster *et al*. 2008) has highlighted the nature of the infrastructure gaps experienced in Africa in relation to water. These gaps have been signalled by NEPAD in relation to implementation of the CAADP and subsequent analysis for irrigation infrastructure (FAO, 2006a). The recent global surge in food commodity and energy prices has highlighted the inherent vulnerability of African economies to global price shocks and the limited capacity of Africa s agricultural base and related infrastructure to respond to market opportunities. The fall in the price of food staples on the international market, starting in July 2008, has only partially and circumstantially alleviated the problem. Whether future demands can be met by domestic production and regional markets in food and power or whether they will continue to be met by imports from outside the continent is a key question.

The priority of food staples needs to be emphasized. The state of food insecurity and poverty in Africa, particularly sub-Saharan Africa, is well established (FAO-SOFI reports) together with the unavoidable need to address agricultural production (NEPAD-CAADP, 2003). The state of the irrigated sub-sector has been comprehensively reviewed with a recent update for Africa (FAO, 2005c). A recent analysis of the implications of demand projections for irrigated production for sub-Saharan Africa (FAO, 2006a) has been undertaken as part of a collaborative programme with the World Bank, African Development Bank, IFAD and IWMI. The key findings are discussed below.

Intensification and diversification are expected to become the major sources of agricultural growth in the region, in which agricultural water will play a major part. The potential is, however, limited in areas with poor market access, particularly in the marginal arid and semi-arid areas. However, to date, sub-Saharan Africa has developed less agricultural water than any other region just 4 percent of the farmed area. Expansion of irrigation has been slow and until recently investments in agricultural water development have declined compared with levels in the 1970s. With the exception of the five North African countries and large areas of rice production in Senegal and Mali, irrigated sugar in South Africa and Swaziland and cotton in Sudan, Africa has seen relatively small areas of fully commercialized irrigated production (Figure 3).

Figure 3: Distribution of irrigation in Africa



Source: FAO, 2006, AQUASTAT

Projections indicate that the largest calorie deficiencies in sub-Saharan Africa will occur in cereal crops, notably coarse grains, rice, wheat and maize (FAO, 2006a). Together with sugar, these staples offer opportunities to scale up production to meet national and regional demand. However, sub-Saharan Africa produces only a fraction of these staples in relation to demand. The regional trends in food import bills continue to rise to unprecedented levels, seriously affecting the balance of trade of most countries in the region. The bulk of these bills are accounted for by staples.

The scale and mix of water control infrastructure has not matched demand. The structural mismatch between styles of production and the character of national and regional demand can be expected to seriously hinder efforts for regional integration. Transport and marketing costs are high and with very little value-added processing, and the scope for developing regional markets is limited.

The technically feasible hydropower potential of Africa is around 1 750 TWh which is about 12 percent of the global capacity. Only 5 percent of this technically feasible potential is exploited. While the demand for electricity in Africa grows at an average annual rate of 3.1 percent, the rapid exploitation of this enormous potential is hampered by dispersed population in the continent and the ever-increasing requirements. Thermal generation accounted for most of the region s total electricity supply in 2005 and is expected to remain the same through 2030. Coal-fired power plants, which were the region s largest source of electricity in 2005, accounting for 47 percent of total generation, are projected to provide a 32 percent share in 2030, as natural-gas-fired generation is expected to strongly expand from 22 percent of the total in 2005 to 50 percent in 2030.

Generation from hydroelectric resources and other marketed renewable energy sources is expected to grow slowly in Africa. As they have in the past, non-marketed renewables are expected to continue providing energy to Africa s rural areas; however, it is often difficult for African nations to find funding or international support for larger commercial projects. With

regard to the economics of hydropower, large hydropower plants (LHP) are characterized by high capital costs and low operational costs. In Africa, where financial resources are scarce, the high up-front costs of hydropower investment are a barrier to the development of this energy source. The intrinsic characteristic of investments in hydropower discloses the opportunities offered by small hydropower in matching supply with demand. Small hydropower (SHP) development is still unsatisfactory throughout Africa but it is anticipated that SHP will be part of the solution to the growing demand for rural electrification programmes on the continent. However, the growing population of Africa will also require the construction of medium and large hydropower plants to cover Africa s growing energy needs. Still, plans for several hydroelectric projects in the region have been advanced recently, and they may help boost supplies of marketed renewable energy in the mid term. Several (although not all) of the announced projects are expected to be completed by 2030, allowing the region s consumption of marketed renewable energy to grow by 2 percent per year from 2009 to 2030.

The regional contrasts

The different endowments in terms of water in the five African regions reflect on the different development of hydropower. Out of the 20.3 GW developed hydropower capacity, about 23 percent is located in North Africa, 25 percent in West Africa and the remaining 52 percent is distributed amongst the remaining regions (Hydropower & Dams, 2001). Countries with installed capacity of more than a 1 000 MW have a total installed capacity of about 13 GW comprising 65 percent of the total hydropower installed capacity of Africa. These countries are Egypt, the Democratic Republic of the Congo, Mozambique, Nigeria, Zambia, Morocco and Ghana (Table 1). The remaining 45 African countries account for 35 percent of the total installed hydro capacity.

Table 1: Countries with major hydropower developments

Country	Subregion	Installed Capacity (MW)
Egypt	North Africa	2 810
DR Congo	Central	2 440
Mozambique	Southern Africa	2 180
Nigeria	West Africa	1 938
Zambia	Southern	1 634
Morocco	North Africa	1 205
Ghana	West Africa	1 072
Total		**13 279**

Source: World Atlas on Hydropower and Dams 2001

Regional discrepancies are evident when considering the distribution of installed hydropower capacity; with Southern Africa accounting for more than 33 percent and North Africa for only 7.7 percent. The largest regional discrepancies, though, emerge when the potential of hydropower generation is considered: as shown in Table 2, the highest hydropower potential both in terms of gross theoretical and technically feasible potential is in Central Africa, particularly the development of large-scale hydropower concentrated around the Congo basin. West Africa represents a small percentage of the total African hydropower potential, since most future development will focus on small hydropower, which is still greatly unexploited, while North Africa generally does not rely on hydropower, apart from Morocco and Egypt (here considered as part of East Africa), and its hydropower potential is almost exhausted.

Table 2: Hydropower potential and installed capacity by region				
Region	Gross Theoretical HP Potential GWh/year	Technically Feasible HP Potential GWh/year	Installed HP Capacity MW	Planned Hydro Capacity MW
North Africa[1]	13 000	4 950	1 549	1 170
East Africa	703 500	97 822	4 537	2 001
West Africa	117 026	95 936	3 969	6 168
Central Africa	1 771 150	921 950	3 448	43 806
Southern Africa	644 207	389 255	6 670	23 389

[1] Excluding Egypt which is considered here as part of East Africa.
Source: World Atlas on Hydropower and Dams 2001

Also the irrigation sector shows significant contrasts between the five North African countries (Morocco, Tunisia, Algeria, Libya and Egypt) and those grouped in sub-Saharan Africa are significant (Table 3). The North African countries have developed land and water resources to the limit and further development of the subsector will hinge on adding value through agro-processing (World Bank, 2006). With the exception of the Republic of South Africa, irrigated production and associated infrastructure in sub-Saharan Africa has lagged far behind, showing negligible growth over the past decade.

Table 3: Regional distribution of irrigation across Africa			
	hectares	Technically Feasible HP Potential in % of total	in % of cultivated land
Northern	6 339 756	47	22.6
Sudano-Sahelian	2619 950	20	6.8
Gulf of Guinea	565 257	4	1.0
Central	132 439	1	0.6
Eastern	616 143	5	2.0

Source: FAO, AQUASTAT, 2005

Why linking energy, agriculture and water strategies is an imperative

Agriculture and energy are two highly interconnected sectors but at present these linkages are not fully taken into account in policy-making. The way energy is produced, distributed and consumed affects the local, regional and global environment. Agriculture is a key sector where the spillovers of energy production and consumption are pronounced. On one side, any further growth in the rural space will necessarily increase demand for energy and will be competing with the industrial and urban centers already at the limit of thermal generation and are under pressure from the impacts of high and still increasing oil prices. On the other side, accelerating access to electricity for the rural poor offers new opportunities for agriculture, including access to a cheap source of energy for water pumping. If access can be improved, and energy needs for agriculture anticipated and met, then a potential roadblock to agricultural growth can be avoided. Rapid growth in agricultural production could then stimulate rural and overall economic development. The objective of food security could come closer to reality, and exports of agriculturally-based products could improve the regional trade balance.

On the positive side, Africa has a vast, largely untapped potential of both renewable and non-renewable energy sources. In particular, Africa s large hydropower potential appears an attractive option for meeting energy needs. Acceleration of hydropower development is already apparent both in the Nile and Congo basins and it will continue to increase, together with the establishment of regional power grids and energy markets. In many cases, hydropower dams are also promoted as being suitable for multi-purpose functions, such as supplying water for irrigation and drinking water.

Getting the right structure of production to match food demand

Beyond the operational and local political considerations, most countries in Africa are looking at a range of rainfed and irrigated production systems. The macro-economic purpose of both systems is and will remain important. It is the right combination and effective management that makes the difference. If lower yielding and extensive rainfed production can reliably meet demand in food staples, then stabilizing rainfed production should be the most economic means of achieving food security. However, low input systems can be high risk under climatic regimes. Hence, if the volatility of rainfed production becomes intolerable, irrigation of staples, whether promoted through economic incentives or structural planning or a combination of both, becomes necessary.

Irrigated production is a small contributor to Africa s overall food production, but plays an important role in wheat, rice, horticulture, sugar and cotton production. Generally, current irrigated production is characterized by low productivity. Irrigated cereal yields are mostly low by global standards having improved only slowly in recent years. However, on a few large, well-managed schemes, yields have reached levels comparable with Asia. Irrigated production of higher value crops with good market access has proved profitable. Where yields are good and investment costs not too high, irrigated rice cultivation is profitable, at least for the local market. Other irrigated cereals have been less profitable, particularly with continuing declining world prices. Irrigated horticulture is fast growing, especially around cities or even within them, and is driving profitable investment in irrigation. Low productivity clearly correlates with unreliable water supplies, poor water management, low input use and difficulty in accessing profitable markets, therefore investments in water control are fundamental to overcoming these barriers to production and ensuring an increased level of food security in the African continent.

Improved agricultural water use in irrigated and rainfed agriculture will have a direct impact on local and regional water demands. Irrigated agriculture will need to be re-thought in order to close gaps in food needs while also making room for transfers to other uses where needed. Such reform will involve a shift in approach from a supply, or input-driven activity, to a much more demand responsive activity. To achieve this goal, irrigation institutions need to adopt a service orientation and improve their performance in different areas, including the adoption of new technologies, modernizing infrastructure, application of improved administrative principles and techniques and promotion of active participation of water users. Irrigation sector institutions need to link their central task of providing irrigation services to agricultural production services and to integrate water resources management at basin level.

Adapting to a future with increased climatic variability

Africa has contributed the least to climate change but is likely to suffer the most. Increased climate variability already affects its water resources, land, forests and biodiversity, and these impacts are likely to worsen over time. According to the Intergovernmental Panel on Climate Change (IPCC), the cost of adaptation in Africa could be as high as 5 10 percent of the continent s GDP. Agricultural production and food security in many African countries are likely to be severely compromised by climate change and climate variability, and projections indicate reduced yields of up to 50 percent in some countries by as early as 2020, with small-scale farmers being the most affected.

These trends, if not blocked, will inevitably further impact the food import bill of many African countries. Such an increase in cereal trade, coupled with the economic and environmental costs of food transportation over long distances on poor infrastructural networks, are likely to cause further increases in food prices. Climate change will affect the African continent in several ways:

1. **Increased water stress:** even small reductions in rainfall could cause large declines in river water. It is estimated that between 75 and 250 million people could be exposed to significant water stress due to climate change by 2020. Water stress is expected to hit harder in already water scarce areas of North and Southern Africa.
2. **More severe land degradation:** the agriculturally unfavourable dry semi-arid areas with severe land degradation, prohibiting the use of rainfed agriculture, will increase by 10 percent, affecting the 180 million people who live and rely on agriculture in such areas for their livelihoods. Moreover, the projections for climate change show that rainfall will be more variable, with an increase in the frequency of extreme events. Heavy storms will negatively affect the soil, leading to a rapid increase in erosion and desertification.
3. **Reduced food security:** recent estimates show that each 1˚C rise in average temperature will reduce dryland farm profits in Africa by nearly 10 percent. The length of growing seasons, the area suitable for agriculture and the yield, are expected to decrease, hence endangering the food security achievement.
4. **Growing competition for natural resources:** several currently populated areas are expected to become less desirable or uninhabitable due to climate changes, opening the way to massive migration. Drought and other climate-related shocks will lead to greater water interdependence and competition for both water resources and farmland.
5. **Negative impacts on the energy sector.** Many African countries rely on biomass and hydropower, energy sources that are sensitive to climate change. Changes in precipitation, in fact, can be felt through variations in runoff, increased siltation and impacts on fuelwood and charcoal production.

The implications for Working Session 1

Working session 1 attempted to tease out some of these issues to focus on the prospect for food and energy demand by 2015 and the projections for 2030-2050, implications for agriculture strategies and the energy sector, and possible impact of climate change. Key questions included:

a. How do countries cope with the prospects of rapid increase in food and energy demand by 2030 and 2050?

b. How do current water infrastructures perform in response to increasing demand? What are the constraints to improved performance of these infrastructures and how could countries respond?
c. What is the relative contribution of rainfed production, small-scale irrigation and large-scale irrigation in terms of food security are they complementary or do they compete for financial resources?
d. How does climate change affect projections for 2030 and 2050, and do current adaptation strategies satisfactorily address climate change related challenges?

Theme 2: Defining the investment envelope

Introduction

It is clear that accelerated investment in infrastructure are needed to break down the internal barriers that hold Africa s productive potential back and to increase the capacity of African farmers to produce and market their products. Numerous studies (World Bank, 2005; World Bank, 2007; UNCTAD, 2008; Commission on Growth and Development, 2008) have demonstrated that infrastructure investment is essential to increasing farmers access to input and output markets, stimulating the rural non-farm economy, building the economic base of rural towns, increasing rural consumer demand and facilitating the integration of rural areas into national and international economies. If it is accepted that agricultural water and rural infrastructure have not been comprehensively coupled with active markets, certainly in sub-Saharan Africa, the synergies that could be expected have not been realized. In addition, these synergies can be expected to spread beyond the immediate farm to market chain into the wider economy.

Growth will be boosted by accelerated investment in agriculture, particularly water and energy infrastructure from small-scale irrigation to larger hydropower facilities. Such investments contribute to agricultural growth and poverty alleviation by permitting intensification and diversification, increased farm outputs and incomes; increasing agricultural wage employment; and reducing local food prices, thus improving real net incomes in rural areas.

Investment in agriculture has, however, experienced a continuous decline since the 1970s. The drop-off in investment in agricultural water was mainly driven by the perception of the decline in rate of return, compared to alternative investments in other sectors but the recent surge in food prices and degradation of the food security situation show the limits of such short-sighted strategies. Indeed, the fact that the return on capital invested in agriculture rarely matches that in industry and urban services does not capture the multiplier and social benefits from rural investment, beyond the direct impacts on food security.

The consequences of low and declining investment are manifest in the comparative state of Africa s agricultural infrastructure. The world area under irrigation amounts to about 20 percent of the arable land area, while in Africa only 7 percent of arable area is irrigated (4 percent in sub-Saharan Africa). Moreover, there is a correlation between Africa s under-capitalization and its lack of competitiveness on global markets. This insufficient attention to agricultural infrastruc-

ture and the rural economy in general manifest in falling investment in water control, mechanization, fertilizer and other inputs which has had serious consequences for Africa where, in most countries, the agricultural output per capita keeps falling. Part of the solution will be investments in agricultural water and in the commercialization of production, but equally important is providing support to effect transitions from inherently vulnerable subsistence agriculture to more commercially oriented farming.

While public investments are needed to support growth, it is important to recognize that a substantial share of investment in agriculture is private: farmers across the continent invest a large share of their resources in their land. Indeed, statistics show that Africa is the only continent where agriculture has a positive net taxation rate on agriculture, while all other continents subsidize their agriculture. The 2008 World Development Report has clearly indicated that public investment in agriculture is badly needed to reverse the current declining trend in investments. The commitment of the 2003 Maputo Summit, to allocate within 5 years 10 percent of the national budget to agriculture, responds to this concern, but while some progress has been registered, the average allocation of all the African Union member countries is still far from reaching the agreed target.

Investing in water for agriculture and energy production is not a trivial exercise. For water management, the two principal initiatives out of NEPAD to put together domestic and the traditional ODA and FDI sources are the Comprehensive Africa Agriculture Development Programme (CAADP) and the Infrastructure Consortium for Africa (ICA). Both are supported by MDG Thematic Working Groups and specific networks such as AgWA and are nationally endorsed initiatives through which multilateral and bilateral support can be channelled with the help of the African Development Bank and the World Bank.

Demand for investment

While attempts to quantify the demand for public investment in water for agriculture and energy in Africa remain a difficult exercise, the available estimates concur in showing that current levels of investment remain much below targets. Projections of future investment in irrigation by 2050, based on FAO s Agriculture towards 2030/2050 indicate that the level of investment in irrigation, which will take place in Africa (excluding South Africa) on the basis of current trends, will be around US$56.4 billion including new build and rehabilitated systems. Such level of investment, however, will not be able to prevent current trends towards increased imports of major staples and therefore constitutes a baseline figure against which efforts towards improved food security should be measured. The NEPAD-CAADP (NEPAD, 2003) had estimated at US$37 billion the total investments needed between 2002 and 2015 in land management and water control in Africa. A similar figure, but for sub-Saharan Africa only, was obtained by the International Food Policy Research Institute (IFPRI) in a recent study on irrigation investment needs (IFPRI, 2008). A recent FAO/IFAD study (FAO, 2008) estimates as high as US$85 billion the total cost of water infrastructure that could be developed in support of rural poverty reduction in sub-Saharan Africa. In terms of energy needs, ICA estimates that to achieve 35 percent electricity access by 2015, sub-Saharan Africa (excluding South Africa) would require a total estimated cost of US$47.8 billion each year (shared almost equally between investment and operations) equivalent to 6.7 percent of sub-Saharan Africa s GDP, which is more than double the current spending on power (although only a fraction of these investments would be for hydropower).

The preparatory work to this Conference allowed new estimates to be produced for investment needs at national, regional and, finally, continent level. Concrete projects and programmes for water for agriculture and energy at different stages of implementation, (recently implemented, ongoing and pipeline), have been compiled for each African state and aggregated at continent level. Compiled project portfolios have been reviewed and validated by governments representatives on the occasion of the five regional workshops held prior to the Conference.

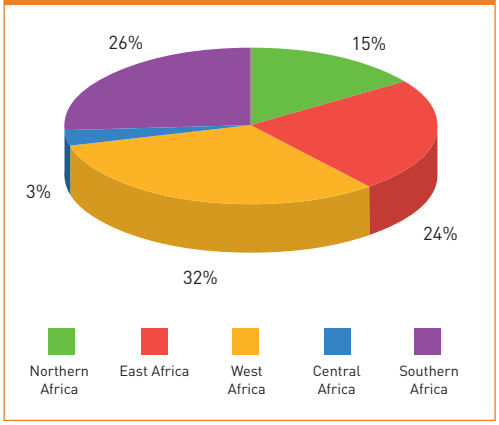
This exercise has shown that the cumulative amount of investment for ongoing and pipeline projects in water for agriculture and energy on the continent, excluding major hydraulic storage works, is US$64.6 billion (Table 4). The highest proportion of the cost is allocated to large-scale projects, including large-scale irrigation schemes development and hydropower projects. Similarly, 56 percent of the total investment envelope is expected to be exhausted in the medium term, showing a need to enhance planning for investments in the long term to ensure sustained and permanent growth in the agriculture and energy sector to meet food and energy security goals.

Table 4: Estimated investment envelope for Africa (in million US$)

Time Frame/Size of Project	Small scale water control	Rehabilitation of irrigation	Large Scale	Total
Short-term	2 385	778	7 818	**10 981**
Medium-term	7 041	3 509	28 207	**38 758**
Long-term	1 491	1 329	12 042	**14 862**
Total	**10 917**	**5 616**	**48 067**	**64 600**

The exercise demonstrated West Africa accounts for 32 percent of the continental investment envelope. Southern Africa, East Africa and North Africa have a share of 26, 24, and 15 percent respectively of the African envelope, while the residual of 3 percent is the share of Central Africa, indicating that more effort should be made in the region to undertake project formulation and feasibility studies in the water sector, particularly considering the as yet unexploited enormous hydropower potential (See Figure 4).

Figure 4: Regional contribution to the African investment envelope



Defining investment targets

Defining investment targets is rarely a clean exercise in planning, and not all countries have established plans and processes for their implementation. A statement of macro policy targets; with respect to food and energy security, poverty alleviation and growth, should be clear from the outset. Given the instrumental role of water in food security, the linkage with Poverty Reduction Strategy Papers (PRSPs) needs to be explicit and direct financial support to vulnerable groups should be clarified when an economic case for investment cannot be made.

It is important to appreciate the initial starting conditions. The state of the existing assets, their institutions and the policy context will influence further development. A comprehensive typology of current and future investment targets needs to be established and, if public money is to be used, a transparent inventory of public and private assets that use publicly administered water resources for productive use be created.

The state of existing institutions that allocate water, govern its use and operate and maintain infrastructure the software is of fundamental importance. Projections of investment requirements must include an evaluation of public and private capacities to absorb an increase in financial support and improve their performance in delivering regulatory and operational services. The functioning of public regulation, local government services, water user associations, catchment boards and public turnkey operations for bulk infrastructure are equally important. The value of new assets cannot be realized without them.

The link between national and regional initiatives

Attempts to compile the briefs for planned investments in water for agriculture and energy at the regional level have revealed a broad range of investment initiatives and a high degree of variability between neighbouring countries. This may well be an indication of inherent physical and political diversity, but it may also indicate where opportunities exist for trade, benefit sharing and the development of joint markets. There are three concrete fields in which regional integration is needed and can help enhance the viability of investments in water for agriculture and energy on the continent: river basin management, agricultural markets and electricity grids.

River basin management, as transport and trade corridors presents such opportunities and is well recognized as such (Sadoff and Grey, 2005). Most countries in Africa share transboundary rivers with their neighbours. As water resources develop, the need arises for better integration of national plans within a river basin management framework. Inter-basin transfers, when justified, require regional cooperation mechanisms. The development of regional markets for agricultural commodities can go a long way in improving the continent s capacity to feed itself while reducing the cost of food. Improved interconnectedness between countries, in terms of electricity provision through regional power grids, would translate into scale economies and subsequent reduction in the cost of electricity.

Prioritizing and phasing investments

The original CAADP document (NEPAD, 2003) recognized that the scale and phasing of water control and rural infrastructure were related, namely: (a) water control: short-term (water harvesting and micro irrigation), medium-term (rehabilitation of irrigation infrastructures) and long-term (continuation of medium-term initiatives and water basin management programmes and transfers); and (b) infrastructure development: rural infrastructure, storage facilities, markets, slaughterhouses, ports, etc. The short, medium and long-term priorities, as identified in the AfDB/FAO CAADP update, are expected to remain relevant, certainly for most of sub-Saharan Africa. For sub-Saharan Africa, what is now being selected as a programmatic focus is the rapid commercialization of key strategic crops at scales that are commensurate with the volume of regional demand, as identified by FAO (2006).

Given any set of policy directions, the development of a project or programme pipeline to be effective will need to be prioritized and graded. Not everything can be done at once and methods for screening both supply driven and demand driven initiatives according to financial, economic, social and environmental criteria will need to be applied. Further, since initiatives will generally be chasing scarce financial resources, some means of phasing investment to match finance availability needs to be anticipated. None of this has to amount to a master-plan approach, but can be done in an iterative and consultative fashion in consideration of realistic natural and human resource limits. The purpose of prioritization and phasing is to build in some measure of equity, certainly with respect to public expenditure and regional balance, and to avoid dilution of investment where only periods of concentrated investment such as building dams during dry seasons will bring results.

To this extent the CAADP approach to scale and phasing of investments remains relevant, but at the national level the generation of nationally owned recurrent and capital expenditure plans need to be adept at defining priorities and matching these with the various finance sources. It is suggested that an investment framework approach can help resolve confusion and duplication in water related investments.

Towards an investment framework approach

Simply stated, an investment framework is a method for combining sectoral typologies (such as irrigation schemes or power generation facilities), development objectives and time horizons in a way that facilitates strategic planning and the establishment of cost envelopes, and which can be applied at any hierarchical level within a sector and at any level of detail. As such, investment frameworks can be thought of as providing the space within which investment decision-making is both responsive to local needs and priorities and subject to cross-sectoral regulation, including natural resource management and environmental impact.

An investment framework translates specific policy measures in terms of programmes, projects and budgets, considering institutional, regulatory and legal as well as infrastructural measures, all of which can be clustered in terms of civil administrative or hydrological entities. For the investment framework to be effective it must define, in general terms, what needs to be done to achieve the objective in question. Guided or (where appropriate) constrained by the framework, decision-makers, beneficiaries and the development partners can then identify, select, prepare, finance and implement specific interventions that respond to those needs in a policy compliant fashion. Such an investment framework therefore has a regulatory aspect, and helps focus investments on the achievement of stated goals.

Irrespective of the sources of finance and the coherence of specific sector support, in the spirit of the Paris Declaration, it is important for individual countries to be clear about investment needs in water for agriculture and energy to address food security, poverty alleviation and to promote growth. An investment framework is necessary to make a sound quantification of overall finance needs in relation to specific policy targets. Over time such frameworks can be used to monitor the rate and balance of investment to determine whether a better structured sector or subsector is evolving and whether policy targets need to be modified or changed. This does not preclude the formulation of detailed projects but it does recommend that individual projects are recognized

and evaluated within the investment framework along with more programmatic demand led investments that may have shorter investment cycles. Such frameworks can also set the basis for reciprocation between governments and donors ensuring that the investment envelopes are both mutually credible and eligible.

The implications for Working Session 2

Working Session 2 will examine current investment portfolios, based in part on the results of the regional workshops, and discuss them in relation to stated development targets. Key questions may include:

a. Are current trends and investment projections in water for agriculture and energy in line with expected demand for food and energy?
b. How are priorities defined and applied to existing project portfolios? How do they match the need for efficiency and equity and how can public and private investments be better prioritized and programmed?
c. Do approaches to planning vary according to the nature of investment target (for example, poverty reduction or expanded commercial production)?
d. How can the demands for low intensity but highly distributed investments be calculated (as opposed to high intensity public infrastructure such as dams and conveyance canals) and how can their impact be assessed in terms of poverty reduction and economic growth?

Theme 3: Financing mechanisms and implementation strategies

Introduction

The purpose of the Sirte Conference is to examine ways to open up the policy and investment space for water for agriculture and energy in securing food and energy supplies in the face of increased competition for natural resources and climate change. The current and projected gaps between demand and domestic supply of food and energy production will not be closed if current trends and investment responses continue. The use of pro-active investment frameworks is needed to set out the investment requirements in water infrastructure and management and monitor the impact of investments. Such frameworks are seen as one way of integrating the interests of the diverse economic sectors at the national level and matching these with capital and recurrent government budget allocations of and the eligibility requirements of development banks and bilateral donors. The frameworks also allow explicit recognition of private investment from individual farmers, Foreign direct investment (FDI) and other sources. Crucially, on a continent dependant upon shared water resources, the frameworks can offer a transparent means of appraising joint investment opportunities. The hope is that investments can be geared towards sustainable development of water resources, recognizing comparative advantage and identifying shared benefits.

It is stressed that policy alignment, public and private institutional capacity, and an enabling environment that can attract and implement much larger proportions of investment in agriculture and energy production are prerequisites. If investment targets can be identified and prioritized with a sufficient degree of precision, then this aspiration has to be set against the fact that African agriculture and related infrastructure is under-capitalized in relation to its economic importance. Equally, penetration of energy services into the rural economy has lagged and the opportunities to boost agricultural productivity through mechanization and processing are not sufficiently distributed.

The evidence from analysis of domestic finance, Official development assistance (ODA) and FDI shows a declining trend over the past 30 years. However, there are signs of new sources of financing through non traditional donors and foundations like the Alliance for a Green Revolution in Africa (AGRA) and the Gates Foundation, and agricultural joint ventures with countries keen to secure food and industrial crop supplies. The role of countries such as Brazil, India and China is becoming more prominent (World Bank, 2008b) along with the interest of some of the Gulf countries.

Projects/programmes?

Choices between project-based and programme-based planning need not be mutually exclusive. Investments in agricultural water are always going to implicate other economic sectors and involve water allocation and environmental trade-offs. For this reason, it may be wise to adopt a programmatic approach, rather than re-negotiate water allocations on a project by project basis.

In recent years, political and fiscal devolution has shifted much of the decision-making and financial responsibilities for providing services to local levels of government. This has raised two major questions. First, does this level of government have the capacity to undertake the planning and construction of the physical infrastructure and its management at the level of service demanded by customers? Second, given the limited available public finance and foreign exchange risks associated with some loan arrangements, how can this level of government fund the needed investments? There is growing recognition that mobilizing capital from local financial markets to tap domestic savings is essential to financing viable infrastructure services. Equally, the need to improve the capacity of this level of government to develop and use asset management plans and to optimize the choice of funding mechanisms for new investments, rehabilitation and maintenance is crucial to the successful provision of rural infrastructure.

In the past project design and implementation has been largely supply driven and publicly financed. Recent participatory approaches are producing more responsive, demand driven results. Key areas for improvement are to ensure that viability and profitability are targeted throughout, that users are genuinely empowered, and to improve overall management and supervision processes in adding value.

Financing mechanisms opportunities in local and regional development

The role of public funding in the provision of water and energy services has been dominant and will remain important. However, alternative approaches including forms of decentralization have evolved. Decentralization is a means of developing effective, responsive, demand-led services and, in particular, making government services more locally accountable. It could enhance the development impact of agricultural water investments, but achieving a balanced mix of local small-scale and larger investments presents a complex political, technical and administrative challenge demanding strong management capacity at both local and central levels. For instance, in Tanzania s Agriculture Sector Development Programme, the creation of a district level investment fund, to be blended or combined with a national irrigation development fund, is seen as one way to reconcile local needs with larger-scale national priorities. The use of public funds to develop access and power supplies to large blocks of agricultural land for commercial development is another approach that has been used by other countries such as Zambia and Namibia.

The role of private funding: where government revenues are not strong enough to generate capital expenditure programmes, and cope with operation and maintenance, public-private finance initiatives are starting to play prominent roles where long-term returns to capital can be assured. Even privately-funded investment such as Kenana Sugar in Sudan has shown that long-term planning and implementation in particular crop sectors can succeed where scale and quality of production can be assured.

The role of International Financial institutions (IFIs) (mainly the World Bank, AfDB, IFAD and subregional banks) will remain fundamental in supporting macro-economic approaches, alongside traditional bilateral and emergent donors. Country Water Resource Assistance Strategies (CWRAS) were designed as a means of integrating World Bank assistance for all the water-related subsectors within an integrated water resource management approach. As such, it is a prime instrument for linking irrigation sector strategy and investment needs to the PRSP and the overall country assistance strategies (CAS) and could ensure that agricultural water is adequately represented in CWRAS, the PRSP and the CAS.

Finally, global and regional programmes in finance initiatives are showing signs of convergence: the two main umbrella programmes that implicate water management, and are applicable to agriculture and energy, are the NEPAD-CAADP and the G8-led Infrastructure Consortium for Africa (ICA). One tool that will be used to provide support to the CAADP processes is the Multi-donor Trust Fund (MDTF) being established at the World Bank with support from several development partners (USAID, DFID, the EC and others) to support the CAADP processes at country and Regional Economic Communities (RECs) levels.

Strategies to accelerate investment flows toward priority targets

The great need for infrastructure has motivated regional economic organizations to push for an ambitious programme of private participation. However, beginning to solve Africa s infrastructure investment problems will need greater financial commitments from governments and donors along with a progressive policy and institutional reform agenda as part of an enabling investment

environment. In agriculture, three principal areas of policy and investment intervention can be identified:

- At micro level, individual farmers and households need to be assured stable engagement with land and water resources. Systems of land tenure and water use rights need to be flexible to promote the realization of comparative advantage in food staples and cash crops. However, they need to be matched by access to rural credit and finance that suits specific agricultural systems and are not just linked to annual repayment or harvest production, but allow longer-term finance of farm inputs. Such initiatives will have to be complemented by the dissemination of technology and good practices in water control and agricultural productivity.
- At irrigation scheme level, a focus on rehabilitation that includes modernization and management transfer, offers tangible scope for extracting the full value out of sunk costs and reducing pressure on public funds. Such programmes are essential before longer-term investments in new-build can be evaluated.
- At macro level, government policy and investments need to be aligned to allow local markets for agricultural produce to become more effective in meeting local demands. This will require investment in the key public goods such as roads and storage but will also involve a more progressive role for large-scale private investment. Creating these conditions while also guaranteeing allocation of sovereign resources through negotiation of shared water resources, for instance, are key considerations.

In terms of prioritization and phasing of investment, the following can be anticipated:

(a) Short-term: focus on small-scale water control in (water harvesting and micro irrigation).
(b) Medium-term: focus on rehabilitation of irrigation schemes and new build of medium sized schemes.
(c) Long-term: continuation of medium-term initiatives and the inclusion of larger scale water basin water management programmes and transfers.

At the international level, any attempt to accelerate investment for food and energy security must remain coherent with the principles of the Paris Declaration on Aid Effectiveness and the Accra Agenda for Action, and therefore build on available funding mechanisms. Examples exist of vertical funds to address specific issues at regional level. IFAD, for instance, is discussing its eighth replenishment seeking a substantial increase in resources to support smallholder agricultural development. An African Fertilizer Financing Mechanism, hosted by ADB, designed to lower unit costs of fertilizer throughout Africa, was recently established but is not yet adequately funded. The question as to whether such vertical funds should be promoted, or existing financing mechanisms should be scaled up to accommodate the additional financing is worth considering.

The implications for Working Session 3

Working Session 3 discussed financing and implementation approaches in relation to national and regional priorities for acceleration of investment programmes in water for agriculture and energy in Africa. Key questions including:

a. What types of financing mechanisms will suit short-medium-and long term investments?
b. What is the potential for public/private partnership in investment and management of water infrastructure for agriculture and for energy? Are there differences between the two

sectors? What conditions must be met to promote private investments?

c. What implementation strategies are needed at regional, national and local levels to ensure the viability of proposed investments? In particular, what institutional, policy and capacity-building reforms are needed to boost and secure return from investments in water for food and energy security?
d. What is the scope for vertical funds in support of water for food and energy security, and relation with existing funding mechanisms (ICA)?
e. What is the scope for enhanced regional integration in response to increased food and energy demand on the continent?

Conclusions

The overall economic and agricultural growth performance has improved among African countries over the last ten years. Despite this positive growth trend and Africa s potential, the continent is lagging behind in terms of energy and agricultural productivity, with serious implications for development and trade balance, making Africa more vulnerable to rising/fluctuating food and energy prices. On the other side, Africa has a vast potential of water resources for agricultural expansion and renewable energy production that could be exploited.

Agricultural and energy underperformance in Africa is directly linked with under-investment in both sectors. Although the agriculture sector is the main engine for the economy in most of the African countries, it has consistently received less than 10 percent of the national budget in most countries, yet its contribution to gross domestic output is between 20 and 50 percent for most African countries. In the case of Africa, agricultural spending, as compared to total government spending, declined by a third in this period. Moreover, development aid for agriculture dropped from 18 percent in 1979 to just 2.9 percent in 2006. From 1993 to 2003, international aid for irrigation and drainage and for hydropower also declined substantially. Based on publicly available data on foreign aid to African agriculture by Organization for Economic Co-operation and Development (OECD) countries, the share of total overseas development assistance to the sector is shown to have steadily declined (bilateral and multilateral combined) from a high of about 26 percent in the late 1980s to under 5 percent by 2005. All top six bilateral donors to the region have also witnessed declining shares of aid resources allocated directly to agriculture. Therefore, the positive growth trend will be sustained and boosted by accelerated investment in agriculture, particularly water and energy infrastructure, from small-scale irrigation to larger hydropower facilities.

Substantial progress has been made in terms of national, regional and international commitments. In 2002, NEPAD s Comprehensive African Agriculture Development Programme (CAADP) offered a framework for investment in agriculture in Africa, with special emphasis on land management and water control. At the UN Conference on Financing for Development, at Monterrey in 2002, governments and agencies committed themselves to increasing their aid by 25 percent, which would raise an extra US$12 or so billion a year. In Maputo, in 2003, the Heads of State and Governments of the African Union committed to allocating at least 10 percent of their national budgetary resources for agriculture and rural development. In 2004, the Sirte Declaration

focused on ways to implement integrated and sustainable development of agriculture and water in Africa. In 2005, the Report of the Commission for Africa titled Our Common Interest highlighted the need for investment in water and energy infrastructure. In the context of soaring food prices and after the High Level Conference held in Rome in June 2008, several countries and organizations announced their contributions to help overcome this crisis totalling US$10.8 billion which, added to the funds pledged at the beginning of the year 2008, gives a sum of US$22.26 billion.

Unfortunately, progress remains too slow. Estimates indicate that about a dozen countries have reached or exceeded half of the Maputo budget target, but only a handful have achieved it. Achieving such growth rates not only calls for high levels of expenditures but also greater efficiency in planning and executing these expenditures. On a positive note, the climate for official aid is now better than for some years, and with the new commitments made, one can look forward to a reversal of the recent downward trend.

What is necessary for African countries to do is to learn from the successes/failures of the last ten years and undertake the necessary policy and investment measures to accelerate and broaden the growth process. Greater impulse should be given not only to create new commitments to investment in water for agriculture and energy in Africa, and renew those already agreed upon years before, but also to establish effective measures to bring these commitments into a timely-set implementation. Just as African countries have to make greater progress towards meeting the Maputo budget target, development partners will need to increase investment in the sector to help broaden and accelerate the recent economic and agricultural growth recovery process. Food security and poverty reduction cannot be accomplished without substantial donor support for agricultural water development and management.

The Sirte 2008 Conference brought together the Governments of all the African Countries, international development organizations, bilateral and multilateral donors, representatives of the civil society and research organizations. All these institutions are pooling their knowledge and efforts to increase investments in water development for agriculture and energy in Africa.

The Conference, with its clear action-oriented vision, went beyond stocktaking of the major issues regarding water for agriculture and energy and the impacts of climate change. It indeed, offered reasonable estimates of investment needs for water for agriculture and energy in each African country and at regional level, assessing concrete projects and programmes in the short, medium and long term. The Conference served as a formidable platform to boost investments in water, promoting a strong and univocal re-commitment by the Governments of Africa and development partners to engage in a long-term investment programme for water development in support of agriculture and energy and facilitated Partnership Agreements for food and energy security in Africa. A declaration and plan of action for the short, medium and long term followed the decisions made and concrete mechanisms were adopted to guarantee an adequate follow-up of the agreed action plan.

The success of the Sirte 2008 Conference and the accomplishment of its ambitious objective to boost financing for water for agriculture and energy in Africa rely on the approach adopted both in the preparatory and in the follow-up process. The Conference, with its focused, outcome-oriented Action Plan offers the potential to accelerate progress in the African continent, based on five key strategic elements:

1. **First**, the country based model remains at the center of the efforts to boost development outcomes through the enhancement of water control in Africa. The innovative approach adopted by the Conference will, however, integrate the country based view into a wider river basin approach, identifying the scope for synergic actions at both levels.
2. **Second**, the process is characterized by a markedly country-driven, bottom-up approach. The National Investment Briefs, prepared in close collaborations with the National Governments, will guide dialogue and thinking for country strategies and the efforts will concentrate on areas that respond to emerging demand from countries. The investment needs estimated, based on concrete projects and programmes, will be prioritized accordingly with the National time-bound targets to achieve results.
3. **Third**, the effort will be directed to increasing and sustaining the flow of funds towards water management while enhancing the quality of the interventions. This will be achieved through the formulation of overall water management policies and action plans, based on joint options analysis and country/regional priorities.
4. **Fourth**, the harmonization of partner programmes and approaches is critical to capturing synergies, taking advantage of complementarities, avoiding duplication of efforts and, ultimately, enhancing development impact and sustainability of investments. Therefore, the Conference approach will permit the alignment of policy dialogue (amongst groups of donors) and of project implementation arrangements with the objective of developing a programme approach and co-financing for water for agriculture and energy.
5. **Fifth**, as a response to the poor performance of investment operations often shown by the agricultural and energy subsectors, several countries have started implementing innovative operations that aim to address some of the past weaknesses. However, limited information sharing at regional and national levels restricts knowledge, adoption and scaling up of successful innovations and best practices. Thus, the Conference will concretely strengthen national and regional Information and Development associations and networks and enhance the quality of information transfer concerning the management of water resources.

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3

Regional views for investment

Water for agriculture and energy in Africa: The challenges of climate change

Report of the ministerial conference - 15-17 December 2008 - Sirte, Libyan Arab Jamahiriya

Introduction

The ministerial Conference on Water for Agriculture and Energy in Africa: the Challenges of Climate Change was an opportunity to discuss water development projects within the framework of the Comprehensive Africa Agriculture Development Programme (CAADP) and to mobilize the required financial resources. It specifically focused on concrete programmes and the assessment of their financing costs, both in terms of feasibility studies and implementation of works. The Conference preparation included the production of National Investment Briefs for all the African countries, in which estimated investment needs for agriculture and energy were given. The preparatory work for this Conference allowed the production of new estimates for investment needs at national, regional and continental levels. Concrete projects and programmes for water for agriculture and energy at different stages of implementation (recently implemented, ongoing and pipeline) have been compiled for each African State and aggregated at continent level. The compiled project portfolios have been reviewed and validated by government representatives on the occasion of the five Regional Workshops held prior to the Conference, in which national and regional representatives from the water, agriculture and energy sectors participated.

The objective of these workshops was primarily to help the compilation and validation of project portfolios and their review, as well as the estimation of investment envelopes for water in the agricultural and energy sectors at country and regional levels. More specifically, the workshops aimed to:

- define the investment needs with regard to water for agriculture and energy at country level;
- define priorities of investment in water control;
- share knowledge on national strategies for water, energy and agriculture and investment plans; and
- promote regional integration, particularly concerning large hydropower projects and integrated water resources management in transboundary river basins, and to harmonize actions on a regional scale.

Challenges

An overview of the challenges that Africa as a whole faces, is presented and should serve as a framework for action.

These challenges are summarized below.

- an increasing population projected to reach 2 billion in 2050;
- extreme poverty which, although especially persistent in the rural areas, is shifting towards the urban areas where rural-urban migration increases the need for affordable food for poor people that no longer produce it themselves;
- undernourishment is pervasive in the continent with malnutrition particularly diffuse among infants and children; 24 percent of the population suffer from chronic hunger; and
- many countries on the continent have economies based on agriculture with, on average, more than 50 percent as value added to their GDP (AQUASTAT, 2008). Despite having essen-

tially agriculture-based economies, the agricultural trade balances are often negative;

- climate change poses a significant threat to the continent with more droughts and floods and changes in ecosystems taking place. Building capacities in climate change prediction, promoting mitigation and adaptation technologies is already seen as a must for enhanced agricultural development;
- poor governance and poor management of available water and land resources, which cause productivity to fall below full potential. Irrigation potential is largely untapped. Rainfed agriculture still prevails and is now being affected at various degrees by climate change;
- the continent suffers from limited access to electricity: 77 percent of households in sub-Saharan Africa are without access to electricity, and most rural households still rely on traditional fuels wood, dung and agricultural residues that are strongly affected by the climate variability; and
- despite the enormous hydropower potential of about 1 750 TWh, and the opportunity to ensure energy security through hydropower generation, only 5 percent of the potential is currently tapped.

Water resources for agriculture and energy in the context of climate change

The regional distribution of the African countries adopted for the purpose of the Regional Workshops and for the Conference is shown on Table and Annex 1.

Table 1: Regional distribution

Central Africa	West Africa	East Africa	North Africa	Southern Africa
Cameroon	Benin	Burundi	Algeria	Angola
Central African Republic	Burkina Faso	Djibouti	Libyan Arab	Botswana
	Cape Verde	Egypt	Jamahiriya	Comoros
Chad	Gambia	Eritrea	Morocco	Lesotho
Congo	Ghana	Ethiopia	Tunisia	Madagascar
Equatorial Guinea	Guinea	Kenya		Malawi
Gabon	Guinea Bissau	Rwanda		Mauritius
Democratic Republic of Congo	Ct e d Ivoire	Somalia		Mozambique
	Liberia	Sudan		Namibia
Sao Tome and Principe	Mali	Uganda		Seychelles
	Mauritania			South Africa
	Niger			Swaziland
	Nigeria			United Republic of Tanzania
	Senegal			Zambia
	Sierra Leone			Zimbabwe
	Togo			

Poverty is common and sometimes extreme in Africa (a summary of the results is provided in Table 2). Thirty-four of the 49 least developed countries (LDCs) are African and 315 million people,

or 36 percent of the total population, survive on less than US$1/day. The sum of national GDPs of all African countries in 2007 amounted to approximately US$1 200 000 million, or barely 10 percent of the GDP of the United States of America in the same year. It corresponds on average to a per capita GDP of US$4 800. in North Africa, US$4000 in Central Africa, US$2 600 in Southern Africa, US$700 in West Africa and US$600 in East Africa. The differences amongst countries are marked, with the per capita GDP ranging from US$190 in Liberia to US$8 564 in Seychelles. The human development index (range = 0-1) varies from 0.336 in Sierra Leone to 0.843 in Seychelles (ranked as 50th out of a total of 177 countries globally), while the 22 countries with the lowest HDI are African (UNDP, 2007).

In 2007, the added value of the primary sector (agriculture) contributed, on average, 24 percent to the GDP in Africa, ranging from 18 percent in Southern Africa to 30 percent in East Africa. Some countries, show a very high reliance on agriculture with a contribution to the GDP of the sector higher than 65 percent, e.g. Somalia and Liberia. More than half of the economically active people are engaged in the farming sector, with the only exception of North Africa (21 percent). At the country level, where 90 percent of the total labour force is engaged in the primary sector, Burundi and Rwanda are the two countries with the most limited cultivable area per inhabitant on the continent (less than 0.2 ha/person). Conversely, Namibia and Gabon, with the largest cultivable area per person (12.4 and 11.2 ha/person respectively), have less than 40 percent of their economically active people working in the primary sector. With 5 percent of economically active people engaged in agriculture and cultivating about 23 ha per active agricultural worker, the Libyan Arab Jamahiriya is the country with the lowest percentage of economically active people in this sector.

Table 2: Regional indicators

Variable	Unit	North Africa	Central Africa	Southern Africa	West Africa	East Africa
Total area	1 000 ha	475 144	536 598	751 954	614 321	626 560
Population - current	1 000 inhabitants	80 287	93 702	186 409	263 631	280 777
Population - predicted	1 000 000 inhabitants	160	689	1 000	228	374
Rural population as % of total population	%	32.51	52.13	63.62	58.90	67.30
Gross domestic product (GDP)*	million US$	301, 913	66 764	416 323	249 417	243 087
Value added in agriculture	% of GDP	18.21	21.34	17.92	32.88	29.44
Number of undernourished persons**	million inhabitants	3.20	49.20	53.40	37.20	69.30
Poverty headcount (share of population) - rural **	%	19.23	58.45	64.05	55.52	50.17
Poverty headcount (share of population) - urban **	%	7.60	42.55	43.73	32.71	29.67
Water resources: total renewable (actual)	(10^9 m^3/yr)	46	2 858	1 032	1 315	385
Total dam capacity	(10^9 m^3)	25	16	316	256	185
Irrigation potential	1 000 ha	2 774	10 346	13 172	9 159	11 343
Area equipped for irrigation: total	1 000 ha	2 918	83	3 436	1 069	5940
Agricultural water managed area: total	1 000 ha	2 918	211	3 944	2 148	6 173
Agricultural managed water as a % of cultivated area	%	13.18	3.83	8.57	6.68	25.64

* World Bank, 2007

** FAOSTAT, Food Security Statistics, 2006

Source: AQUASTAT, 2008

Annual precipitation in Africa is estimated at 20 360 km^3, which constitutes an average for the continent of 678 mm. Disparities between countries and regions are very important. The driest

country is Egypt with 51 mm/year on average, followed closely by the Libyan Arab Jamahiriya (56 mm/year) and Algeria (89 mm/year), with Morocco (346 mm/year) and Tunisia (207 mm/year) as the most advantaged countries in the northern region. This is the driest region on the continent with an average of 96 mm/year.

Renewable water resources for the whole of Africa amount to about 3 930 km^3, or less than 9 percent of global renewable resources. The central region is the best endowed, with 48 percent of Africa s resources for only 18 percent of its area. On the other hand, the northern region is the most disadvantaged with less than 1 percent of the renewable water resources. The Democratic Republic of the Congo has 900 km^3 of internal renewable water resources, 23 percent of the total for Africa, while the Libyan Arab Jamahiriya has only 0.01 percent of these resources.

The irrigation potential of the continent is estimated at more than 42.5 million ha, considering irrigation potential by basin and renewable water resources. One-third of this potential is concentrated in two very humid countries, Angola and the Democratic Republic of the Congo with a potential of 3.7 and 7 million ha respectively. Most of the regions in Africa are highly dependent on rainfed conditions, as shown below.

- Central Africa is the region that shows the highest dependency on rainfed agriculture and, with the exception of S o Tom , Chad and, to a lesser degree, Cameroon, the regional irrigation potential is largely underexploited. Only 212 000 ha, or just over 2 percent of the 10 000 000 ha of potentially irrigable land are under water management.
- Central Africa About 50 percent of the 11.3 million ha of irrigable land in the East African region is equipped; however it ranges between the 77 percent of Egypt to only 2 percent in Rwanda and Eritrea. Note that only two countries, Egypt and Djibouti, completely rely on irrigated agriculture, while in other countries such as Uganda, Ethiopia and Kenya, water control is still not significantly developed.
- Instead North Africa appears to be an exception to the previously indicated trend with very large areas of land, in terms of irrigation potential, under water management regimes, ranging from just over 75 percent in Tunisia to around 90 percent in Morocco. In the case of the Libyan Arab Jamahiriya, because the country exploits its fossil fuel deposits, the controlled areas far exceed the irrigation potential based on renewable freshwater resources, and the potential exploitation rate is around 1 175 percent.
- West Africa suffers from chronic water shortages because of uneven rainfall distribution, low levels of water mobilization (less than 2 percent) and poor water management. Only 10 percent of the potentially irrigable lands are equipped for irrigation, with the agricultural water managed area ranging from 28.8 percent of the cultivated area in Sierra Leone to less than 1 percent in Benin, Ghana and Togo.
- Less than 7.5 percent of the Southern African region s vast irrigation potential has been equipped. Only in a few countries (Madagascar, Mauritius and Swaziland) more than 20 percent of the cultivated area is equipped for irrigation, while in countries with great potential such as Zambia or Mozambique less than 5 percent of the cultivated land is equipped.

The technically feasible hydropower potential of Africa is around 1 750 TWh which is about 12 percent of the global capacity. Only 5 percent of this technically feasible potential is exploited. The demand for electricity in Africa grows at an average annual rate of 3.1 percent, while the rapid exploitation of this enormous potential is hampered by dispersed population and ever-increasing demand for electricity.

Climate change is already recognized as an important factor impacting the agricultural and energy sectors in Africa. Increased climate variability already affects its water resources, land, forests and biodiversity, and these impacts are likely to worsen over time. According to the Intergovernmental Panel on Climate Change (IPCC), the cost of adaptation in Africa could be as high as 5 10 percent of the continent s GDP. Agricultural production and food security in many African countries are likely to be severely compromised by climate change and climate variability, and projections indicate reduced yields of up to 50 percent in some countries by as early as 2020, with small-scale farmers being the most affected.

Some countries have already experienced an increase in frequency, extent, and magnitude of droughts and floods. Also, coastal areas and island states will increasingly be affected by sea level rise while, in a wide range of countries, erosion of natural resources resulting from climate change will increasingly burden traditional agriculture and pastoral livelihoods. Furthermore, throughout the Sahara Belt climate change is expected to further reduce food production, due to declining rainfall and increased variability, with a fall in crop yields of up to 70 percent in the most vulnerable areas. Climate change has also impacted on hydropower generation: soil erosion, in fact, has directly affected the total storage volume of many of the reservoirs in Africa, as exemplified by the case of the Koka dam in Ethiopia, resulting in a reduced power generation capacity and in a reduction of the benefits obtained from irrigated agriculture.

Investment programmatic framework and envelope

The Regional Workshops have stressed the need to move from a project-based approach to a programmatic and integrated overview for the water and energy sectors. The important contribution that irrigation can make to food security has to be recognized, especially given that rainfed agriculture, which currently accounts for the bulk of agricultural production, is highly vulnerable to climate change. If lower yielding and extensive rainfed production can reliably meet demand in food staples, then stabilizing rainfed production, particularly small scale, should be the most economic means of achieving food security. But, if the volatility of rainfed production becomes intolerable, irrigation of staples whether promoted through economic incentives or structural planning or a combination of both becomes necessary. This makes it urgently necessary to encourage complementary irrigated agriculture (off-season production, etc.) by both small-scale and large-scale irrigation, which more than ever now are closely geared to local and regional demands and conditions.

With the foregoing in mind, the programmatic framework for investment can be synthetically presented as follows:

- Actions undertaken can be based on the individual National Investment Briefs but must be seen within the context of a shared regional vision, and eventually an overall African one.
- The objectives of the investment plan should aim to address poverty alleviation through food security and upgrading health services, agricultural development supported by hydraulic and energy infrastructure, the promotion and scaling up of renewable and alternative energies, and the protection of ecosystems and the environment.

- While priorities necessarily vary from country-to-country, conjunctive use of water resources must be a key consideration in all efforts. Likewise, all water projects should address the viability of power generation components, and reflect a river basin perspective. Thus, an integrated water resources management approach shall be an embedded component of the investment plan.
- A capacity development component should be inherent to every element of the investment plan. Indeed, the needs are broad: i) enhancing institutional and managerial capacity for the absorption of investment funds at both country and regional level; ii) upgrading capacity to deal with climate issues, such as variability and impact of change, mitigation and adaptation for both rainfed and irrigated conditions, predictions and early warning systems, etc.; and iii) support for adoption and implementation of climate change adaptation action plans at national and regional levels; already under various degrees of preparation.
- As shown in the preparatory work of the Conference, the cumulative amount of investments for ongoing and pipeline projects in water for agriculture and energy on the continent reaches about US$64.6 billion. The investment framework specifies the size of irrigation infrastructure (small-scale irrigation, rehabilitation of irrigation, large hydraulic projects) and distinguishes between projects and programmes in the short (< 4 years), medium (between 4 and 8 years) and long term (> 8 years). The highest proportion of the cost is noticeably allocated to large-scale projects including large-scale irrigation schemes development and hydropower projects. Similarly, 56 percent of the total investment envelope is expected to be exhausted in the medium term, showing a clear need to enhance the planning for investments in the long term to ensure sustained and permanent growth in the agriculture and energy sector to meet the food and energy security goals.

Table 3: Investment Envelope (million US$)

Time frame/size of project	Small scale water control	Rehabilitation of irrigation	Large scale	Total
Short-term	2 385	778	7 818	10 981
Medium-term	7 041	3 509	28 207	38 758
Long-term	1 491	1 329	12 042	14 862
Total	**10 917**	**5 616**	**48 067**	**64 600**

- As demonstrated by the results of the preparatory work for the Conference, Western Africa, with the great hydropower potential to be exploited, accounts for 32 percent of the continental investment envelope. Southern Africa, East Africa and North Africa have a share of 26, 24, and 15 percent respectively, while the residual 3 percent is for Central Africa, indicating that more effort should be made in the region to undertake project formulation and feasibility studies in the water sector, particularly considering the enormous hydropower potential not yet exploited.

Table 4: Regional distribution of the investment envelope

Time frame/size of project	North Africa %	East Africa %	West Africa %	Central Africa %	Southern Africa %
Short-term	16%	10%	35%	11%	28%
Medium-term	12%	29%	29%	2%	28%
Long-term	23%	19%	37%	1%	20%
Total	**15%**	**24%**	**32%**	**3%**	**26%**

Institutional environment

It is necessary to harmonize sectoral policies (water, agriculture, energy and economic development, among others). The approach entails very close sub regional cooperation and countries will therefore need to align and integrate their agriculture and energy policies accordingly. Thus, this makes it appropriate for the countries to embark on high-level institutionalized regional cooperation.

Regional cooperation and integration will play a vital part in the joint management of water resources, the development of agricultural product markets and energy. This would make it possible to create free-trade areas and introduce the mechanism needed to encourage trade and the exchange of experiences. In practical terms, supplementary human and financial resources must be marshaled more than ever, and conflict prevention and management mechanisms must be put in place. Likewise, regional standards for irrigation must also be developed and promoted.

The countries possess different and complementary areas of expertise, and exchanging them would be mutually beneficial. Establishing regional centers specializing in research and training, and collectively mobilizing financing will make it possible to make up for the knowledge deficits at the lowest cost. Scientific and technical cooperation, and the harmonization of rules and procedures, will also be promoted to encourage trade. Unfortunately, national institutions are often weak and are unable to produce robust field-based projects. Therefore, an investment-friendly framework must be created for the construction of economically profitable and socially and environmentally justifiable infrastructure, and the quality of investment feasibility studies must be improved.

The Regional Workshops have recognized that an Integrated Water Resources Management (IWRM) approach needs to be put into practice, both with regard to inter-sectoral management and the management of the large transboundary basins. For this, the African countries proposed establishing a subregional structure to coordinate the various IWRM plans. Promoting multipurpose works and a framework for concerted action and coordination between water users should also make it possible to control the competition between energy and irrigation needs.

Therefore, in summary, a successful institutional environment for the implementation of the investment plan will require, in addition to its promotion, the facilitation to ensure that a number of conditions are met: i) to have a favourable institutional framework with a strong emphasis on governance; ii) to seek and secure effective involvement of regional bodies to balance the issue of sovereignty and ensure equitable access to resources (water and energy); iii) to ensure wide market access, both agriculture and energy-related; iv) to include a strategy for better land care (soil and water conservation, watershed and river basin management, including agro-pastoral and forestry considerations); and v) to strengthen the capabilities for intervention, with emerging and proven water technologies playing a lead role.

Finally, countries recognize that in general there is a lack of information, which prevents them from making informed decisions. Therefore, countries stress that the obligation to collect data in order to have reliable databases at national level and implement monitoring and evaluation should be governed by law.

Implementation strategies and financing mechanisms

Investment programmes must be designed taking into account the food, energy security and climate change adjustments; but they also need to include economic development, health care, education and environmental objectives in general. Factors such as population density, the vulnerability of the population to climate variations, the types of agricultural producers and the options available for both public and private intervention in the matter of energy and agriculture need consideration.

Any attempt to accelerate investment for food and energy security must remain coherent with the principles of the Paris Declaration on Aid Effectiveness and the Accra Agenda for Action, and therefore build on available funding mechanisms. Examples exist of vertical funds to address specific issues at regional level. The question, as to whether such vertical funds should be promoted or existing financing mechanisms should be scaled up to accommodate the additional financing, is worth considering.

A priority for all countries in Africa is to effectively allocate their own resources as part of the investment envelopes in order to signal the seriousness of their commitment to donors and partners; such action should be a key element of any investment implementation strategy. In addition, sub regional pool funds to support agriculture and energy components need to be designed and incorporated as part of a broad investment plan financing mechanism. More innovative approaches, such as taking advantage of carbon trade and funding opportunities or specific renewable energies-related incentive funds, among others, need to be seized to support hydropower in Africa.

The five Regional Workshops stressed the following:

- Approaching the implementation of the overall African Investment Plan based on the respective Regional Plans through the development of a shared vision that has both regional and continental bodies playing, overseeing and coordinating roles that create synergy, trust and provide confidence towards fair and balanced interventions.
- The emphasis on the Investment Implementation Plan must reach into the realm of food security and poverty alleviation while underpinning the need to protect the environment. The Plan must be directed towards the optimization of water resources utilization for which human and institutional capacity building is essential.
- The need for massive Regional Capacity Development efforts, aggregating eventually at the continent level, should be seen as an integral component of the Investment Plan and cut across disciplines and projects.
- In general, each country will be strongly committed to develop and emphasize water technology options and packages that provide, *in primis*, a clear added value to their own conditions, but always adopting a synergic approach to implement optimal solutions on a national, regional and continental scale.
- Concrete opportunities should be provided for an increasing role of the private sector, in itself or through private-public partnerships, for both water for agriculture and energy.

- A clear and transparent monitoring and evaluation mechanism at regional level, as well as national data collection mechanisms and databases, is required to convey a sense of fairness in prioritizing activities and to provide guidance of when and where further interventions should be forthcoming.

With regard to energy security, work must begin on framing appropriate policies and strategies, stressing: i) the diversification of energy sources; ii) the development of renewable energy sources with particular focus on the exploitation of the currently untapped small and large hydropower potential; iii) the interconnection of networks as a factor for regional integration; and iv) the role of micro-power plants to facilitate rural electrification and for the decongestion of the large networks.

Conclusions

African governments, financing institutions and other development partners would need to undertake firm commitments to initiate and guarantee the financing of projects to improve food security and energy security (accompaniment measures).

Recently, substantial progress has been made in terms of national, regional and international commitments. In 2002, NEPAD s Comprehensive African Agriculture Development Programme (CAADP) offered a framework for investment in agriculture in Africa, with special emphasis on water control. In Maputo, in 2003, the Heads of State and Governments of the African Union committed themselves to allocating at least 10 percent of their national budgetary resources for agriculture and rural development. In 2004, the Sirte Declaration focused on ways to implement integrated and sustainable development of agriculture and water in Africa. In 2005, the Report of the Commission for Africa titled Our Common Interest highlighted the need for investment in water and energy infrastructure.

So far, based on available information, only five countries have achieved the Maputo budget allocation target. Estimates indicate that about a dozen countries have reached or exceeded half of the Maputo budget target. The African regions have the necessary experience and expertise, and encouragement and incentives must be provided to share it (South-South Cooperation). The same applies to cooperation between the African Regional Economic Communities. The recommendations made at the earlier international fora have not yet been implemented. The causes of this situation must be analysed in order to ensure that the Sirte 2008 Conference reaches concrete and operational plans of action.

Successful implementation of the proposed African water sector investment plans clearly requires a major new round of commitment not only from the various development partners; but also the private sector as investors, operators and users of water sector infrastructure. Moreover, the success of the national and regional investment plans will be ensured only by focusing more on funding structural investments in water management for the highly interconnected sectors of agriculture and energy, without neglecting the importance of emergency measures, which necessarily act in synergy with long-term investments. Governments should clearly set out their priori-

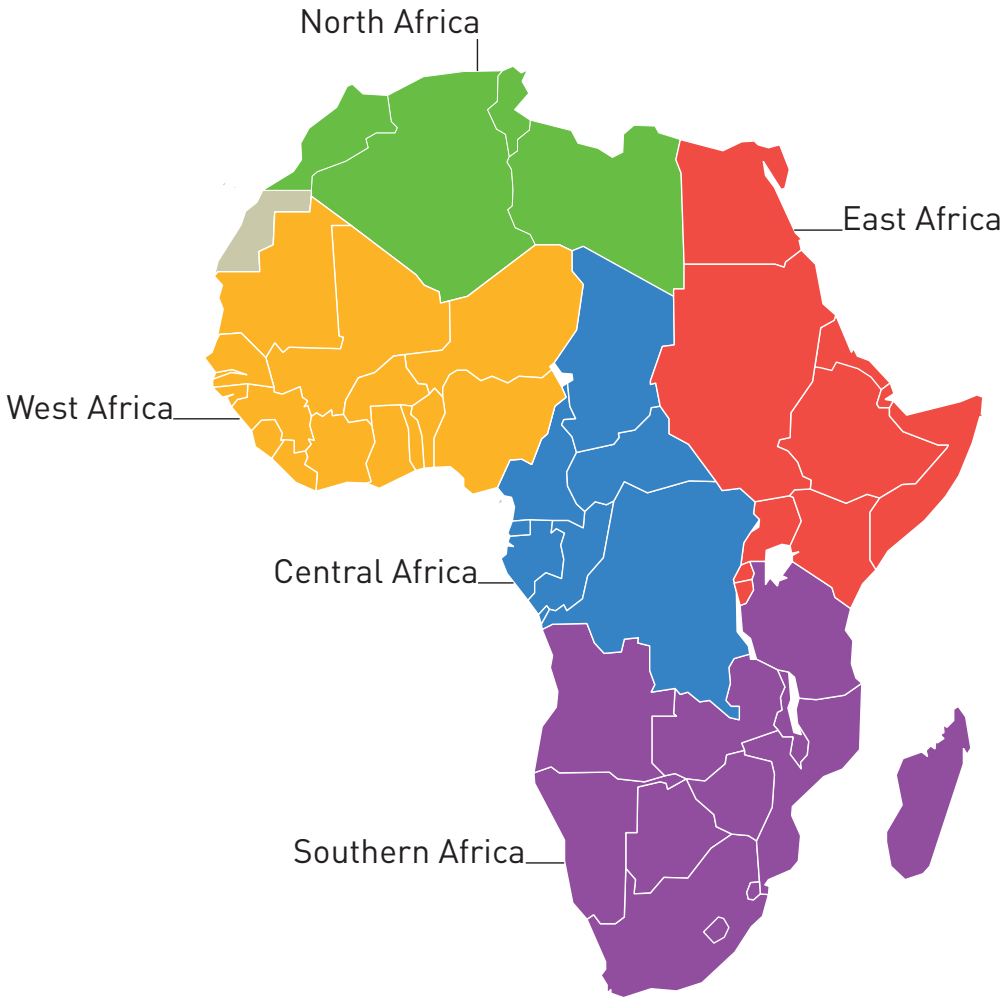
ties and take them into account when framing their investment programmes. Each government needs to promote and develop suitable policy and strategy documents for developing the water for the agriculture and energy sectors that are in line with the respective investment envelopes. The policies defined to implement the national investment programme should be incorporated into wider and holistic regional initiatives, particularly in the context of regional power pools and river basin organizations.

External investment, both public and private, should be promoted in countries with plentiful water and land resources still awaiting exploitation, particularly those that cannot afford to finance water mobilization infrastructure. A measure of this kind would help to increase food production, and would benefit both sides investors and proprietors alike. The development partners should support countries in post-conflict situations to help finance their priority projects.

There is a strong need for expanded irrigation while enhancing water control in rainfed agriculture which represents the bulk of farming activities in the continent; but care should be taken to embed climate change adaptation measures from the outset. Governments should develop climate change adjustment action plans. Similarly, in areas where the opportunity costs of water can be expected to increase, care must be taken to ensure that farmers and extension services are able to adapt to aptly valued farming systems. It should be noted that irrigation expansion will, in most cases, require storage. This suggests opportunities for multi-purpose dams at various scales, from community up to basin level. This in turn calls for greater inter-sectoral planning and cooperation than may have been the case to date.

There is a clear need to raise existing levels of expenditures on agriculture and food security, which are far below NEPAD-CAADP initial projections, while massively increasing investments in hydropower and introducing a new focus on general water resources management, especially where there are transboundary issues. Mechanisms (political, fiscal and economic) must be put in place to create a framework to encourage private investment in agriculture and hydroelectricity and to forge private-public partnerships in this area.

Annex 1: Regional Distribution



Annex 2: Africa and the World

Variable	Unit	Africa	World	Africa as % of the world
Total area	1 000 ha	3 004 084	13 442 788	22
Cultivated area	1 000 ha	210 697	1,540 708	14
in percentage of total area	%	7	11	
per inhabitant	ha	0.24	0.24	
per economic active person engaged in agriculture	ha	1.03	1.16	
Total population 2004	Inhabitants	868 094 000	6 377 646 000	14
Population growth 2003-2004	%/year	2.2	1.2	
Population density	Inhabitants/km^2	29	47	
Rural population as percentage of total population	%	61	51	
Economically active population engaged in agriculture	%	56	21	
Precipitation	mm/year	678	818	18
Renewable water resources	km^3/year	3 931	43 744	9
per inhabitant	m^3/year	4 521	6 859	
Irrigation	ha	13 444 875	277 285 000	5
in percentage of cultivated area	%	6	18	

Source: Irrigation in Africa in figures, AQUASTAT, 2005

Annex 3: Investment envelopes

North Africa				
Time frame/size of project	**Small-scale water control**	**Rehabilitation of irrigation**	**Large-scale**	**Total**
Short-term	555	163	1 059	**1 777**
Medium-term	1 803	820	2 216	**4 839**
Long-term	481	200	2 711	**3 392**
Total	**2 839**	**1 183**	**5 985**	**10 007**

East Africa				
Time frame/size of project	**Small-scale water control**	**Rehabilitation of irrigation**	**Large-scale**	**Total**
Short-term	299	153	599	**1 051**
Medium-term	1 117	596	9 605	**11 318**
Long-term	94	105	2 680	**2 878**
Total	**1 510**	**854**	**12 883**	**15 247**

West Africa				
Time frame/size of project	Small-scale water control	Rehabilitation of irrigation	Large-scale	Total
Short-term	710	134	3 025	**3 869**
Medium-term	1 794	684	8 648	**11 126**
Long-term	458	333	4 718	**5 509**
Total	2 962	1 150	**16 391**	**20 504**

Central Africa				
Time frame/size of project	Small-scale water control	Rehabilitation of irrigation	Large-scale	Total
Short-term	159	83	991	**1 234**
Medium-term	167	63	526	**756**
Long-term	9	1	162	**171**
Total	**335**	**148**	**1 679**	**2 161**

Southern Africa				
Time frame/size of project	Small-scale water control	Rehabilitation of irrigation	Large-scale	Total
Short-term	661.95	244.29	2 144.47	**3 050.70**
Medium-term	2 160.57	1 345.93	7 212.63	**10 719.13**
Long-term	449.36	691.23	1 771.11	**2 911.69**
Total	**3 271.88**	**2 281.45**	**1 1128.21**	**16 681.53**

4

Irrigation projections for 2030-2050

Water for agriculture and energy in Africa: The challenges of climate change

Report of the ministerial conference - 15-17 December 2008 - Sirte, Libyan Arab Jamahiriya

The baseline

This paper presents the results of an analysis of irrigated agriculture in Africa on the basis of agricultural trends data compiled by FAO as part of its World Agriculture: towards 2030/2050 programme (FAO, 2006a), referred to here as AT2030/2050. The AT2030/2050 study presents a perspective on future agricultural supply and utilization on the basis of national demand and production of the main agricultural products in each country. It is driven by two key variables, population and income. Because the AT2030/2050 analysis is undertaken for 93 developing countries, South Africa is not a part of the detailed projection analysis for individual crops but has been incorporated to prepare the final estimates of irrigated areas and associated costs.

This analysis updates the work presented for sub-Saharan Africa (FAO, 2006a) and has been developed from two principal sources:

- the agricultural trends data generated for *World Agriculture: towards 2015/2030 an FAO Perspective* (FAO, 2003); and
- FAO s AQUASTAT database, which specifies irrigated areas at national level in geographic regions over which there is a degree of physical and climatological homogeneity

Current data for agricultural water management was taken from AQUASTAT and is summarized in Table 1:

Table 1: AQUASTAT Irrigated Areas, 2008

	Areas equipped for irrigation		Non-equipped cultivated wetlands and inland valley bottoms		Non-equipped flood recession cropping area		Total area under water management	
Region	Area (ha)	% of total	Area (ha)	% of total	Area (ha)	% of total	Area (ha)	% of all Africa
Central	122 739	28	1 000	0	322 500	72	446 239	3
Eastern	616 143	73	233 195	27	-	0	849 338	6
Gulf of Guinea	542 699	39	167 238	12	681 914	49	1 391 851	9
Islands	1 132 123	99	-	0	9 750	1	1 141 873	7
North Africa	6 339 756	100	-	0	-	0	6 339 756	41
South Africa	1 498 000	100	-	0	-	0	1 498 000	10
Southern	565 427	75	181 900	24	8 510	1	755 837	5
Sudano-Sahelian	2 639 728	88	96 724	3	257 984	9	2 994 436	19
Total	**13 456 615**	**87**	**680 057**	**4**	**1 280 658**	**8**	**15 417 330**	**100**

Table 1 indicates that the whole of sub-Saharan Africa (all regions except North Africa and islands) has a total area equipped for irrigation of 5 874 267 ha.

However, in order to establish consistency with the regional groupings adopted for the Sirte 2008 Conference it was necessary to cluster country data from both AT2030/2050 as indicated in Table 2. Countries shaded are those for which AT2030/2050 data do not exist. Given the importance of South Africa in regional statistics, the current 1.5 million ha of area equipped for irrigation has been added to the projection analysis and expanded at a growth rate of 0.5 percent per year given the limited land and water availability in the country.

Table 2: Africa regional groupings for the Sirte Conference			
Region	**Countries**		
Central Africa	Cameroun	Congo Democratic Republic	Sao Tome and Principe
	Central African Republic	Equatorial Guinea	Tchad
	Congo	Gabon	
West Africa	Benin	Guinea	Nigeria
	Burkina Faso	Guinea Bissau	Senegal
	Cape Verde	Liberia	Sierra Leone
	Cote D Ivoire	Mali	Togo
	Gambia	Mauritania	
	Ghana	Niger	
East Africa	Burundi	Ethiopia	Sudan
	Djibouti	Kenya	Uganda
	Egypt	Rwanda	
	Eritrea	Somalia	
North Africa	Algeria	Morocco	
	Libya	Tunisia	
Southern Africa	Angola	Mauritius	Kingdom of Swaziland
	Botswana	Tanzania	Tanzania
	Comoros	Mozambique	Zambia
	Lesotho	Namibia	Zimbabwe
	Madagascar	Seychelles	
	Malawi	South Africa	

Projections

Irrigated areas

For every country, the AT2030/2050 projections assume that a food supply utilization account can be closed and demand for calories is met by domestic production and through imports from world markets for all major crop types. Assumptions are made for individual crop yields and cropping intensities to the extent that the areas for rainfed and irrigated production can be projected. These projections assume that current growth trends are maintained and are therefore policy neutral as they make no assumptions about policy changes, constraint removal or trade regimes. The only constraint is that the supply utilization accounts have to close and that physical limits of land and water are respected. The 2030/2050 projections indicate that from a 2000 baseline of 12 816 million ha, an annual growth rate of some 0.9 percent is maintained. This is in line with actual growth rates recorded for the period 1992-2000 (FAO, 2005). The increases in the areas equipped for irrigation are shown in Table 3.

Table 3: Projections of areas equipped for irrigation by region					
Region	**Projection Year**				
	2000	**2030**	**2050**	**Increase 2000-2030**	**Increase 2000-2050**
	(1 000 ha)			**%**	
Central	84	98	113	14.3	25.7
West	923	1 197	1 502	22.9	38.5
East	5 807	7 403	8 057	21.6	27.9
North	2 721	3 251	3 546	16.3	23.3
Southern	3 281	3 740	4 244	12.3	22.7
All Africa	12 816	15 689	17 462	18.3	26.6

Associated costs

Assumptions on unit costs have been compiled from the FAO AQUASTAT database and applied across an investment typology similar to that used for the CAADP estimates prepared in 2003 (NEPAD, 2002). These unit costs, at 2008 prices, are presented below in Table 4.

Table 4: Cost estimates and distributions of different types of agricultural water management

	Local cost (Mostly labour)	Non local cost (Capital) %	Central Africa	West Africa	East Africa	North Africa	Southern Africa
Type of investment	Unit Costs ($Us/ha)						
Large-scale irrigation development	25	75	10 000	12 500	12 500	6 000	9 000
Large-scale irrigation rehabilitation	25	75	3 000	4 000	4 000	2 000	3 000
Small-scale irrigation development	50	50	3 000	3 500	3 500	2 000	2 500
Wetland development: inland valley bottoms etc.	65	35	600	600	600	600	600
Water harvesting, soil and water conservation	70	30	300	300	300	300	300
Land improvement	100		100	100	100	100	100
	Distributions (% of total area)						
Large-scale irrigation development			2.36	1.71	2.16	19.41	3.12
Large-scale irrigation rehabilitation			5.87	8.19	8.63	22.84	7.26
Small-scale irrigation development			9.64	5.33	6.41	9.41	7.98
Wetland development: inland valley bottoms, etc.			16.57	10.90	11.62	0.00	6.62
Water harvesting, soil and water conservation			9.98	23.14	22.69	7.01	23.44
Land improvement			55.59	50.73	48.48	41.34	51.58

The overall investment estimates (at 2008 costs) required to bring the additional AT2030/2050 projected irrigated areas into production and maintain them through at least one cycle of rehabilitation are calculated at approximately US$56 billion for the whole African continent. The assumptions are that current trends in irrigated and rainfed production are maintained and that the entire 2000 baseline is rehabilitated during 2000-2030, split between large and small scale, and that 50 percent of the entire resulting 2030 baseline is rehabilitated between 2030 and 2050. (Table 5)

Table 5: Cost estimate assumptions based on 2008 costs				
Region		Costs (US$1 000)		
		Increment to 2030	Increment to 2050	
Central	New	64 218	62 117	
	Rehabilitation	109 907	64 586	
West	New	1 462 255	1 626 089	
	Rehabilitation	1 572 039	1 019 980	
East	New	8 983 289	3 680 455	
	Rehabilitation	10 454 881	6 664 767	
North	New	2 033 651	1 132 057	
	Rehabilitation	3 480 668	2 079 276	
Southern	New	2 046 172	2 244 321	
	Rehabilitation	4 868 327	2 775 192	
All Africa	New build	14 589 586	8 745 039	23 334 625
	Rehabilitation	20 485 822	12 603 801	33 089 623
Total		**35 075 408**	**21 348 840**	**56 424 248**

Analysis

Irrigated areas

As a guide, physical water scarcity becomes apparent when withdrawals begin to exceed 40 percent of the annually renewable resource (ARR 40%). With the exception of North Africa and several of the drier Sahelian countries, the projected growth is within available land and water limits, although expansion of irrigated areas in already committed river basins and aquifers needs to be avoided or alternative sources of water supply sought.

However, high volumes of water can be seasonal, meaning that they cannot be used without storage. Given the increasing demand for energy, it is likely that some water will be allocated for hydropower generation for which operating rules may be inconsistent with the seasonal demands of irrigation; and from which evaporation losses may be significant. This challenge is particularly relevant in the African context given that much of the irrigation potential is situated upstream of the hydropower potential. Because irrigation is a consumptive use of water, uncontrolled expansion can compromise existing generation capacity or reduce hydropower potential. However, wherever irrigation potential lies downstream of the hydropower potential, and despite evaporation losses from the reservoir surface, the dams may be designed and operated in such a way that downstream irrigation can be expanded.

The nature of the national production data used in AT2030/2050 prevents any meaningful assessment of temporal, or vertical expansion of irrigation (by increasing cropping intensities). Without annual hydrographs and local cropping patterns, it is difficult to be sure about the possibilities of multi-cropping. However, where storage is already in place, or planned, the possibility of multiple cropping is increased.

A comparison between the total potential irrigable areas (AQUASTAT) and those projected in the 2030/2050 data showed that only Madagascar s projections exceeded the available land while remaining within water resource limits. For all other countries the projections are generally consistent with current rates of growth. Further, it is clear that the assumed increases in equipped areas are modest with some 70 percent of all countries equipping 55 percent or less of their potential areas.

Yield gap closure

Closing yield gaps on existing irrigated areas still needs to be seen as the first step towards increased productivity and food security, agriculture based economic growth and market stimulation. To this end, the analysis shows that simply closing prevailing yield gaps could save a total of more than 922 000 ha new build by 2030, and additionally more than 866 000 ha by 2050. It is emphasized, however, that these projections are based on target yields only for a range of selected crops. Yet, the potential benefits of yield gap closure will be clear, even if the actual target yields are not achieved.

Regional trade

Regional trade of surplus production or the allocation of water amongst riparian countries according to specific technical comparative advantage in a particular crop could be a complement to domestic production.

An example of the regional trade of surplus production can be derived from FAO projections to 2015 (FAO, 2003) for the countries of the Eastern Nile Basin (Egypt, Ethiopia and Sudan). These projections included estimated country shortfalls, which have yet to be provided for the AT2030/2050 projections. These are needed for an assessment of regional trade potential. This shows for instance that in this region:

- surplus rice grown in Egypt could be more than enough to satisfy demand in Sudan and Ethiopia;
- surplus sorghum (already irrigated in all three countries) grown in Sudan could fill shortfalls in Ethiopia; and
- Ethiopia s coffee surplus could satisfy demand in Egypt and Sudan.

The deployment of technical comparative advantage can occur if a nearby country can increase its production of a specific commodity with greater natural resource efficiency. Wheat provides an example of how this may work.

Under business-as-usual conditions, the data indicates a total shared deficit for wheat of over 8.5 million tonnes in the Eastern Nile Basin. In 2007 production in this region was as follows:

- Egypt produced 7 379 000 tonnes on 1.139 million ha (6.478 t/ha);
- Sudan produced 642 000 tonnes on 0.250 million ha (2.568 t/ha); and
- Ethiopia produced 3 000 000 tonnes on 1.353 million ha (2.217 t/ha)

This gives a weighted average yield of just over 4 000 tonnes/ha. At this level of yield, regional self-sufficiency would require an additional 2.1 million ha of cultivated land. Although the weighted yield includes rainfed and irrigated production, even Egypt s high yielding irrigated wheat would require over 1.3 million ha of additional land under irrigation. This suggests that prospects for regional trade in wheat under conditions of business-as-usual are limited to nil. A similar calculation confirms that this also holds for maize and sugar. These together with wheat comprise the three biggest deficits in the Nile Basin.

So far, the discussion has focused on trade between countries that are located within the same subregion. FAO s Water Report No 31 (FAO, 2006b) applies a similar analysis to the prospects for trade between regions and finds that if target yields can be achieved by 2030, then for instance:

- barley shortfalls in Central and East Africa could be improved by increased production in West Africa;
- millet shortfalls in West Africa could be improved by increased production from the other regions;
- rice shortfalls in South Africa could be improved by increased production elsewhere in the southern region; and
- sorghum shortfalls in Central Africa could be improved by increased production in East Africa.

In each case, the producing region may have a clear technical comparative advantage for the crop in question, but realization of physical trade could be severely limited by transport infrastructure.

Climate change

Although the various climate change models have yet to show convergence, with respect to rainfall and periods of drought, temperature projections are generally more reliable and will have pronounced implications. Increased evaporation and evapotranspiration with associated soil-moisture deficits will impact rainfed yields. In addition, increased open water evaporation on stored water can be expected to reduce water availability for irrigation and hydropower generation. While ocean-atmosphere coupling is generally reliable and indicates increased precipitation in areas influenced by monsoonal circulation, it is the unreliable land-atmosphere coupling over areas such as the west which give rise to uncertainty over future rainfall trends. Modeling of the emission scenarios, with respect to rainfall, already justify the adoption of some key operational principles when planning new irrigation on the assumption that there would be no regrets since they would contribute to overall resource management in any event.

First, the possibility that schemes could be provided in areas where water resources may be compromised by reduced precipitation and hence runoff. There is therefore a real risk of investing in schemes that fail due to water shortages. This risk can be offset, however, by selecting investments that can be supported at a later stage, by seasonal or trans-annual storage, subject to satisfactory social and environmental impact assessment.

Second, another effect of reduced water resources is increased competition for their use. This could increase their resource price and/or, where storage proves necessary, the added value or

service cost. When this becomes the case, it may become economically inefficient to use scarce, valuable water for additional production.

Third, the need to think ahead and avoid building schemes that will be difficult to retro-fit with more precise water management technology at a later stage.

Finally, it is also necessary to think ahead in areas that are expected to become wetter, with more extreme hydrological events becoming the norm, not just because of climate change itself, but also because of the expected increases in soil moisture, which in turn will both increase and intensify runoff. In such locations it will be necessary to include adequate drainage facilities when new schemes are built, and in all likelihood to retro-fit the same to existing schemes. With this in mind, paradoxically it is necessary to note that good drainage facilities should be provided in the areas expected to become drier. This is in order to increase return flows for re-use downstream.

Conclusions and recommendations

Notwithstanding the assumptions of the AT2030/2050 projections, three principle conclusions can be drawn. First, the projections are conservative in comparison to the natural resources available for the continent as a whole. In most cases, growth can be accommodated within available land and water limits if adequately planned with respect to basins and aquifers where resources are not already stretched. However, the land and water scarcity in both North Africa and South Africa, in particular, are expected to constrain the AT2030/2050 projections significantly.

Second, irrigation development is only one path, among others, towards increased production, regional food security and overall economic growth. Other options include yield gap closure and regional trade, which could be complementary to irrigation development. Regional trade could lead to increased economic growth as a result of the livelihood diversification that is usually associated with increased market size and activity.

Finally, the prospect of climate change will need to be anticipated through more flexible and adaptive water management practices that allows irrigated production to respond to more variable water supply inputs and buffer greater volatility of rainfed production.

Following these conclusions several recommendations emerge.

- Food security can be assessed on a regional or transboundary basis to mobilize comparative advantage in specific staple crops and thereby spread production risk and lower economic costs.
- There is potential for improving the productivity of existing equipped irrigated areas. Where appropriate, this approach should be prioritized before new-build is contemplated. Accordingly, it is recommended that capacity building becomes an essential component of any irrigation based food security and economic growth strategy. Further, such capacity building should not concentrate on the traditional skills of engineering and agronomy, but extend to institutional initiatives that respond to demand and add value, including water pricing, market research and adaptive programme financing.

- Where there is competition between irrigation and hydropower, then multi-objective operating rules can allow expansion of irrigation while maintaining planned generation capacity.
- The private sector should be encouraged to play a larger role in irrigated production and irrigation service delivery. There is a lot that governments can do to increase private sector involvement by establishing policy-backed enabling environments, appropriate incentives and transparent risk sharing mechanisms. Public-private partnerships should be forged to allow the continent to escape hunger and poverty.

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5

Resources and challenges in the context of climate change

Water for agriculture and energy in Africa: The challenges of climate change

Report of the ministerial conference - 15-17 December 2008 - Sirte, Libyan Arab Jamahiriya

Executive summary

Even though the current levels of global food production are sufficient to feed the population of Africa, as well as other parts of the world, 212 million people in Africa suffer from hunger and malnutrition. The recent food crisis, and its consequent social instability, have clearly shown the vulnerability of African countries in the face of food market fluctuations.

Being largely arid or semi-arid, Africa s climate has made agricultural improvement difficult. Anticipated temperature increases in parts of Africa could double the challenges related to food production and further warming is expected to significantly reduce crop productivity. These effects are exacerbated by the fact that agriculture and agro-ecological systems in Africa tend to be less capital and technology intensive. The predicted impacts of climate change across the African regions uniformly suggest the need to pursue large improvements in the agricultural systems.

Agricultural productivity is closely associated with direct and indirect energy inputs, and policies are required to consolidate this relationship for the benefit of farmers. Energy development plans rarely take into consideration the present and future energy needs of agriculture, and most rural electrification programmes are mainly directed towards households. With growing awareness of food production challenges and climate change hazards in Africa, reforms need to be brought about to provide incentives in the agriculture sector, revitalizing productivity and attracting new investments.

This report addresses the challenges faced by users of agricultural water resources in Africa in the context of climate change. These include population pressure; land use, such as erosion/siltation; and its impacts on the hydrological cycle. With the global food crises and the growing population continent-wide, more food must be grown for the 212 million malnourished people across Africa and the one billion more expected by 2050.

Water withdrawals in Africa are mostly directed towards agriculture. Agriculture significantly contributes to African national economies, employment and food supplies. However, Africa s climate has put pressure on agricultural development. Some farmers may grow only one or two kinds of crops and risk starvation if not enough rain falls. The hot, humid climate in much of Africa encourages the spread of pests and diseases that destroy livestock and cause various illnesses in people. Also, many countries in Africa continue to be among the lowest per capita energy consumers in the world, which is necessary for agricultural development.

Climate change and global warming are likely to result in water availability problems in some parts of Africa. Changes in precipitation would make extreme weather events more common, leading to more severe and frequent flooding and to lower dry-season water flows in rivers. While precipitation is expected to decrease by 33 percent in some regions and increase by 22 percent in others, the global mean surface temperature is expected to increase between 1.3 C and 1.7 C by 2050 (IPCC). Sea levels are projected to rise between 15 and 59 cm (IPCC). Further warming is consequently expected to reduce crop productivity adversely.

The main effect of climate change on semi-arid or tropical agro-ecological systems is a significant reduction in crop yield, which may force large regions of marginal agriculture out of production in Africa. Such a reduction in crop yield will place more pressure and higher demand for conversion of lands, extraction of water supply for irrigation, introduction of new exotic plant and animal species, more intensive use of chemical inputs and hence pollution and environmental damage, erosion, etc. which may seriously accelerate biodiversity loss and extinction.

Africa s vulnerability to climate change and its inability to adapt to these changes may be devastating to the agriculture sector, the main source of livelihood for the majority of the population. The utmost concern should be for improved understanding of the potential impact of climate changes on African agriculture and to identify ways and means to adapt and mitigate their detrimental impact.

The challenges faced by water resources and the prevailing food situation are recognized as a serious global issue, and Africa has prepared many initiatives in response to them. Initiatives dealing primarily with water for agriculture in Africa involve efforts in one or more of the following categories: formulating long-term water policies and related strategies; increasing water productivity; promoting water availability; controlling agricultural pollution; reforming institutions and management; enhancing stakeholder participation; raising awareness and developing information systems; developing human resources; supporting action-oriented research; and adopting innovative technology.

Opportunities for facing the challenges do, however, exist. These opportunities are in increasing water productivity in both rainfed and irrigated agriculture and increasing the availability of affordable, environmentally acceptable water that generates maximum socio-economic returns; harnessing new water supplies; expanding storage capacity; empowering communities and user groups; ensuring access to food; reforming water management institutions (qualified and skilled people are needed to develop and run these institutions); and make needed investments.

Investments should develop water resources to enable community-based irrigation, modernize existing irrigation and drainage systems, and replace and augment storage capacity in reservoirs and groundwater basins particularly in water-scarce countries. Groundwater recharge programmes should be initiated to help restore groundwater tables. Also, environmental regulations and parallel investments in municipal and industrial waste treatment are needed to improve the quality of river water, reducing dilution requirements and increasing supplies. To feed the approximately 1.8 billion people in Africa in 2050, water allocated to agriculture must be used more efficiently and new water resources developed.

Shared understanding of the problems and their consequences, solutions, and the interconnections and tradeoffs are crucial if actions are to achieve common objectives. The starting point must be to develop common awareness and understanding among current and future decision-makers in Africa. This must be done in schools, in the media, and in workshops, meetings and conferences, allowing those affected to make decisions. Appropriate actions must be taken on economic policy and trade, investment, infrastructure, institutional reform, research and capacity building.

The priorities for the African countries are to develop consistent, comprehensive water and food policies, promote equitable trade, expand water storage and improve water quality. More water storage at or below the surface is essential to achieving the volume of water required for food production and other purposes. Water storage and harvesting techniques should be further developed to enhance productivity in rainfed agriculture, shifting the focus of irrigation development, making irrigated agriculture more productive, reforming irrigation and drainage institutions, developing information systems and knowledge networks, improving water education, building capacity and increasing research.

Introduction

Water in Africa, as a limited resource, must be carefully managed for the benefit of all people and the environment to ensure food security today and in the future. With the global food crises and the growing population continent-wide, more food must be grown for the 212 million malnourished people across Africa and the one billion more people expected by 2050.

Over-exploitation of water resources, mainly for agriculture has, created environmental disasters. Efforts to provide adequate water resources for Africa will, therefore, face several challenges, including population pressure; problems associated with land use such as erosion and/or siltation; and possible ecological consequences of land-use change on the hydrological cycle.

In addition, since water resources are inextricably linked with climate, global warming is likely to have huge impacts on both irrigated and non-irrigated agriculture. Understanding the characteristics of the African climate will therefore allow for weighing the risks reduced of water availability in some African regions and an increase in others and, hence, allow us to assess the impacts on future food production on the continent.

African climate and anticipated future patterns

Much of Africa has a tropical or desert climate, while it may be warm or hot in other areas; humidity and rainfall vary dramatically from one place to another. The map in Figure 1 shows Africa s climate patterns. The map indicates the average January and July temperatures and the average yearly precipitation (rain, melted snow and other forms of moisture). Africa has the largest tropical area of any continent. The equator runs through the middle of Africa, and about 90 percent of the continent lies within the tropics. In countries south of the equator, the seasons are opposite to those of countries that lie to north. However, temperatures are high around the year almost everywhere in Africa. The variations between summer and winter temperatures are slight. In fact, the difference between daytime and night-time temperatures in most parts of the continent is greater than the difference in the average temperatures between the coldest and warmest months.

Africa s highest temperatures occur in the Sahara and in parts of Somalia. The highest temperature ever recorded was 58˚C in the shade at Al Aziziyah, Libya, on 13 September 1922. At Ibn-Salah, Algeria, and along the north coast of Somalia, July temperatures soar to 46˚C or higher almost every day. Night-time temperatures, however, may drop sharply. The Sahara also has the greatest seasonal range of temperatures in Africa. Winter temperatures in the Sahara average from 10 to 16˚C. Near the equator, temperatures may average 24˚C or more around the year. However, temperatures of more than 38˚C are rare. The coolest regions in Africa are the northwest, the highland areas of the east, and parts of the south. In Johannesburg, South Africa, for example, the average temperature in January, the warmest month, is 20˚C. Frost and snowfall are common in the mountains of Africa.

Changes in the African climate have been assessed at major river basins (shown in Figure 2). Model results derived from three Global Circulation Models (GCMs) (namely, CSIRO2, HADCM3 and PCM) and considering the two extreme cases named A2 and B2 provide the anticipated deviation of rainfall from average (in percent) for the periods 2030, 2050 and 2080. The results show that there will be major changes in precipitation ranging from a reduction of 33 percent to an increase of 22 percent, which will have implications on spatial and temporal distribution of rainfall in Africa.

Table 1 and Table 2 report the future change in precipitation at different river basins in Africa for climate scenarios A2 and B2.

Table 1: Anticipated rainfall deviation from average (%) in major river basins in Africa using 3 GCMs for the A2 climate scenario

		CSIRO2-B2			HADCM3-B2			PCM-B2		
	HIST.	2030	2050	2080	2030	2050	2080	2030	2050	2080
Central African	0	0	1	1	-4	-6	-10	4	7	13
Congo	0	1	2	3	2	3	6	2	3	6
East African Coast	0	7	11	21	3	6	10	2	4	7
Horn of Africa	0	-4	-6	-11	-11	-17	-29	7	11	22
Kalahari	0	-4	-6	-11	-11	-17	-29	7	11	22
Lake Chad	0	-1	-2	-3	7	12	22	4	6	12
Limpopo	0	-7	-11	-21	-3	-5	-10	-1	-2	-3
Madagascar	0	2	3	6	0	0	0	1	1	2
Niger	0	-1	-2	-4	3	5	10	4	6	12
Nile	0	1	1	2	6	10	18	6	11	20

Table 2: Anticipated rainfall deviation from average (percent) in major river basins in Africa using 3 GCMs for the B2 climate scenario

		CSIRO2-B2			HADCM3-B2			PCM-B2		
	HIST.	2030	2050	2080	2030	2050	2080	2030	2050	2080
Central African	0	1	1	2	-4	-6	-8	5	7	11
Congo	0	1	2	2	1	2	3	3	5	7
East African Coast	0	5	7	10	3	5	7	5	7	9
Horn of Africa	0	0	0	1	-17	-23	-33	8	11	16
Kalahari	0	0	0	1	-17	-23	-33	8	11	16
Lake Chad	0	-2	-3	-4	8	12	18	8	11	16
Limpopo	0	-3	-5	-7	-6	-9	-12	-3	-4	-6
Madagascar	0	2	3	4	1	1	2	2	3	4
Niger	0	-1	-2	-3	7	10	14	5	7	10
Nile	0	0	-1	-1	6	9	13	13	19	27

Figure 1: Africa climate patterns

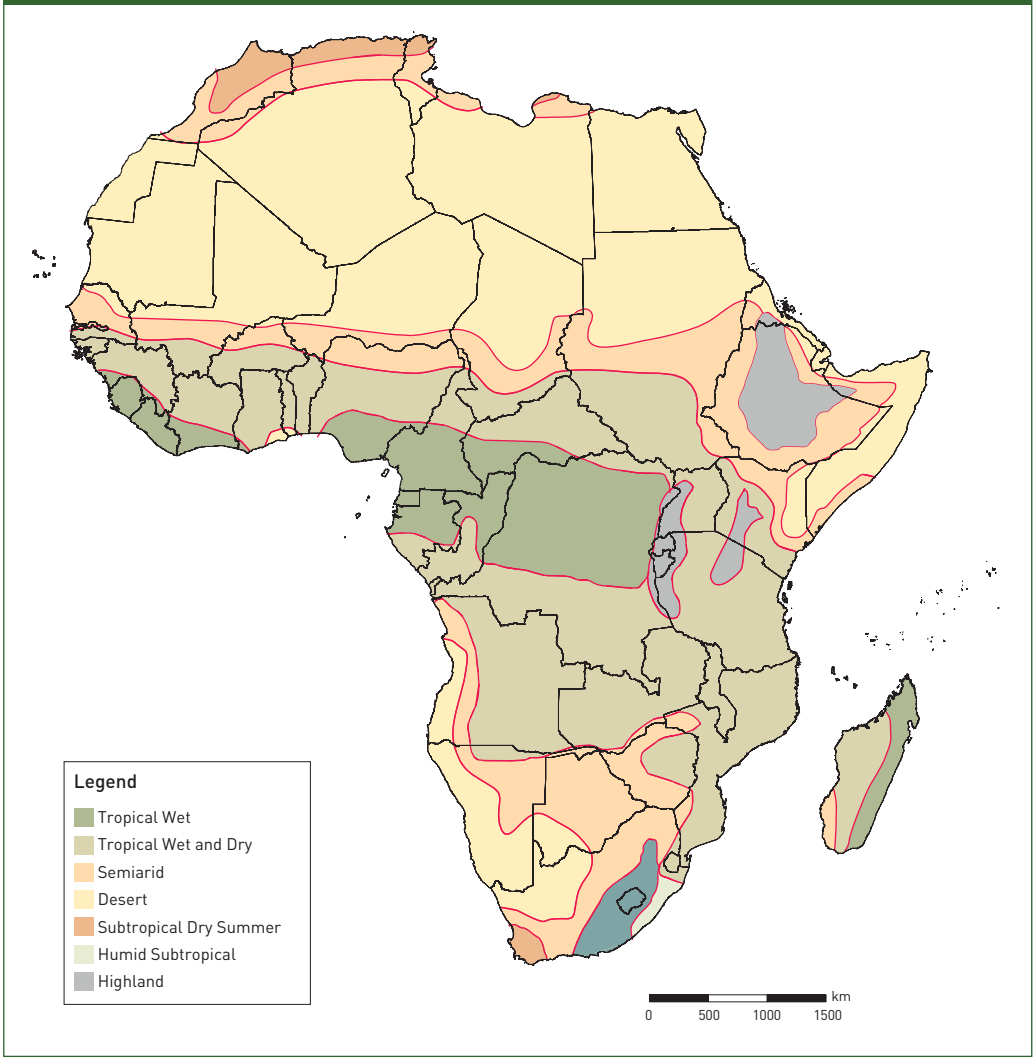


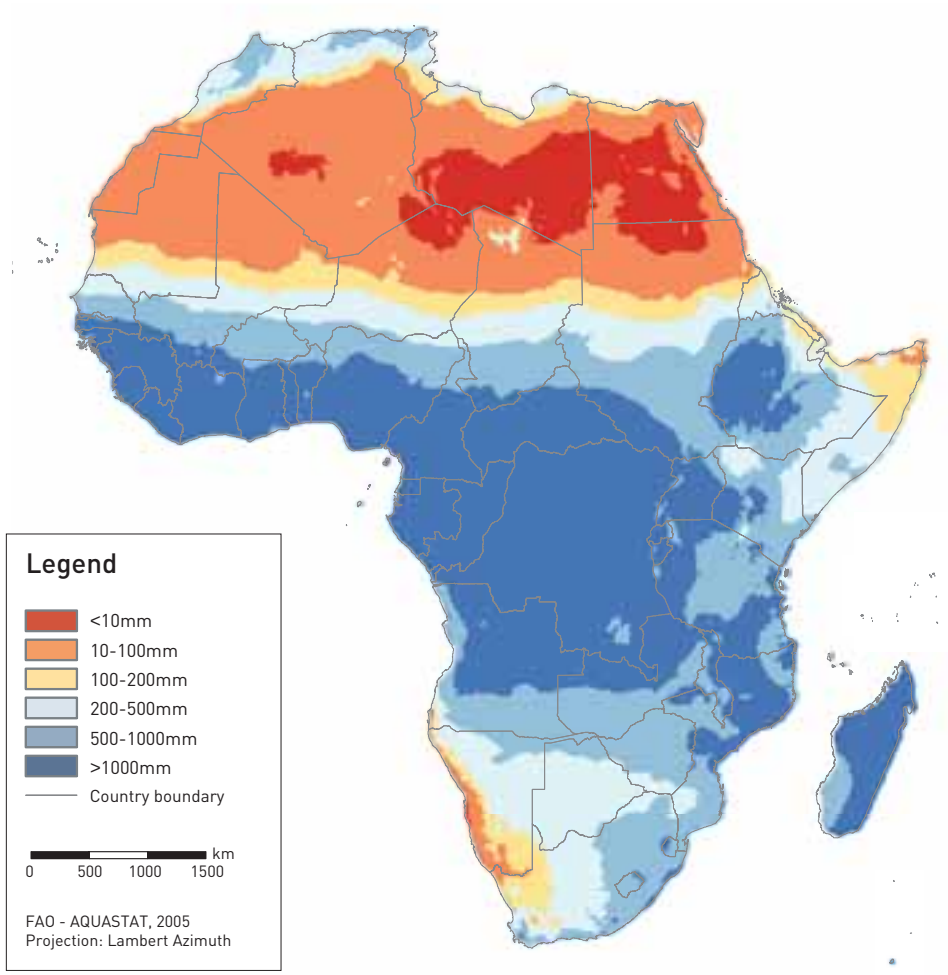
Figure 2: Major river basins in Africa

Water resources in Africa

Africa s share of global freshwater resources, at 10 percent, closely matches its share of world population at 12 percent. The problem stems from the uneven distribution of rainfall (as shown in Figure 3), and from the fact that, for the African continent as a whole, 86 percent of water withdrawals are directed towards agriculture, and this percentage is even higher in the arid and semi-arid part of Africa (FAO AQUASTAT, 2005). In those areas the water withdrawn for agriculture from the hydrologic system may represent a significant part of the water resources.

As can be seen in Table 3, most areas receive either too much rain or too little. In parts of the west coast, for example, annual rainfall averages more than 250 cm. In Monrovia, Liberia, an

Figure 3: Average annual precipitation



Source: New,M., Hulme,M. and Jones, P.D. (1999) Climate Research Unit of the University of East Anglia, UK

average of more than 100 cm of rainfalls during the month of June alone. In contrast, more than half of Africa receives less than 50 cm of rainfall yearly. The Sahara and the Namibia deserts receive an average of less than 25 centimetres a year. In parts of the deserts, rain may not fall for six or seven years in a row. Rain falls throughout the year in the forests of the Congo Basin and the coastal regions of western Africa. However, almost all the rest of Africa has one or two seasons of heavy rainfall separated by dry periods.

In some regions of Africa, the amount of rainfall varies sharply from year to year rather than from season-to-season. Both droughts and floods have increased in frequency and severity over the past 40 years. Over the past fifteen years, Africa has experienced nearly one-third of all water-related disaster events that have occurred worldwide, with nearly 135 million people affected, 80 percent by droughts. Since the late 1960 s, droughts have caused much suffering in Africa. Millions of Africans have died of starvation and related causes. The hardest-hit areas include Ethiopia and the Sahel region on the southern edge of the Sahara.

Table 3: Regional distribution of rainfall and water withdrawals in Africa										
Sub-region	Area	Annual precipitation		Annual internal renewable resources (IRR)			Annual withdrawals for agriculture, community water supply and industry			
	1 000 km^2	mm	million m^3	million m^3	In % of Africa	Per inhabitant (2004)	million m^3	% of Africa	m^3 per inhabitant (2004)	% of IRR
North	5 753	96	549 959	49 495	1	325	93 889	43.7	616	189
Sudano-Sahelian	8 587	311	2 671 364	260 200	4	1 418	54 948	25.7	486	35
Gulf of Guinea	2 119	1,356	2 873 971	951 940	24	4 853	12 395	5.8	63	1.3
Central	5 329	1,425	7 592 517	1 876 180	48	19 845	1 993	0.9	21	0.1
Eastern	2 925	920	2 665 720	280 960	7	1 521	14 215	6.6	77	5
Southern	4 736	659	3 110 159	270 130	7	2 518	21 657	10.0	202	8
Indian Ocean Isl.	592	1,510	895 250	340 951	9	17 042	15 717	7.3	786	4.6
Total	30 041	678	20 358 940	3 929 856	100	4 527	214 814	100	247	5.5

Source: *FAO-AQUASTAT, 2005*

Northern: *Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Tunisia;*

Sudano-Sahelian: *Burkina Faso, Cape Verde, Chad, Djibouti, Eritrea, Gambia, Mali, Mauritania, Niger, Senegal, Somalia, Sudan;*

Gulf of Guinea: *Benin, C te d Ivoire, Ghana, Guinea, Guinea-Bissau, Liberia, Nigeria, Sierra Leone, Togo;*

Central: *Angola, Cameroon, Central African Republic, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Sao Tome and Principe;*

Eastern: *Burundi, Ethiopia, Kenya, Rwanda, Uganda, United Republic of Tanzania;*

Southern: *Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, Zimbabwe;*

Indian Ocean Islands: *Comoros, Madagascar, Mauritius, Seychelles.*

Because of the lack of rainfall in some countries, large numbers of people are dependent on groundwater as their primary source of freshwater, as shown in Table 4.

Table 4: African countries highly dependent on groundwater resources	
Country	Groundwater use (%)
Algeria	60
Libya	95

Source: Table based on UNEP, 2002. Africa Environment Outlook.

Water supply coverage

With only 64 percent of the population having access to improved water supply, Africa has the lowest proportional coverage of any region in the world. The situation is much worse in rural areas, where coverage is only 50 percent compared with 86 percent in urban areas. Yet more than half of the urban dwellers have inadequate provision if the definition is a house connection or yard tap. The continent is home to 27 percent of the world s population that is without access to improved water supply. Table 5 shows the percentage of African population having access to improved water supply facilities and to household connections.

Table 5: Percentage of access to water supply services in Africa			
Year	Access to improved water supply facilities (%)	Access through household connections (%)	Not served (%)
1990	59	17	41
2000	64	24	36

Source: ONU/WWAP, 2003, UN World Water Development Report.

Sanitation

Only 60 percent of the African population has sanitation coverage, with 80 percent and 48 percent in urban and rural areas respectively. In most of the larger cities in Africa, less than 10 percent of their inhabitants have sewer connections; and only 10 to 30 percent of all urban households solid wastes are collected. The continent houses 13 percent of the world s population that is without access to improved sanitation. Table 6 shows the percentage of African population having access to improved sanitation facilities and to household connections to sewer systems.

Table 6: Percentage of access to sanitation services in Africa

Year	Access to improved sanitation facilities (%)	Access through household connections to sewer systems (%)	Not served (%)
1990	59	11	41
2000	60	13	40

Source: UN World Water Development Report.

Irrigation and cropping pattern zones

Sixty percent of food production is from non-irrigated agriculture. The North African countries, where water is the limiting factor, have developed land and water resources to the limit and further development of the subsector will hinge on adding value through agro-processing (World Bank, 2006). Instead, a large part of irrigation potential remains unused in sub-Saharan Africa. Water for irrigation is a high priority for economic development and stability. However, few countries in Africa can afford the financial investment in efficient irrigation systems, and water losses through leaking pipes and evaporation are as high as 50 percent in South Africa alone.

Irrigation cropping pattern zones in Africa are considered to be homogeneous with respect to crop calendar and cropping intensity. The delineation of the irrigation cropping pattern zones was done by compiling information of various types: distribution of irrigated crops, average rainfall trends and patterns, topographic gradients, presence of large river valleys (Nile, Niger, Senegal), presence of extensive wetlands (the Sudd in Sudan), population pressure, technological differences and crop calendar above and below the equator.

Table 7 summarizes the cropping patterns, crop calendar and monthly and yearly cropping intensities divided among different zones in Africa. The figures shown in the table relate to the different crops and, in correspondence to the growing period of the crop, represent the percentage of the irrigated area in that particular zone, assigned to that crop category.

Table 7: Cropping patterns, crop calendar and cropping intensities in Africa													
	cropping intensity (%)												
Main crops	J	F	M	A	M	J	J	A	S	O	N	D	
1. Mediterranean coastal zone													
Vegetables		40	40	40	40	40	40	40	40	40	40		40
Wheat	15	15	15	15	15						15	15	15
Fodder	25	25	25	25						25	25	25	25
Arboriculture	20	20	20	20	20	20	20	20	20	20	20	20	20
Total	60	100	100	100	75	60	60	60	60	85	100	60	100
2. Saharan oases													
Vegetables			30	30	30	30	30	30	30	30	30		30
Wheat	30	30	30	30	30						30	30	30
Fodder	20	20	20	20	20						20	20	20
Arboriculture	20	20	20	20	20	20	20	20	20	20	20	20	20
Total	70	70	100	100	100	50	50	50	50	50	100	70	100
3. Semi-arid to arid savannes in West-East Africa													
Maize/sorghum							90	90	90	90			90
Vegetables	20	20	20	20							20	20	20
Total	20	20	20	20	0	0	90	90	90	90	20	20	110
4. Semi-arid/arid savanna East Africa													
Maize/sorghum				40	40	40	40	40					40
Cotton				30	30	30	30	30	30	30			30
Vegetables	30	30	30							30	30	30	30
Total	30	30	30	70	70	70	70	70	30	60	30	30	100
5. Niger/Senegal rivers													
Rice	100	100	100								100	100	100
Rice						80	80	80	80	80			80
Total	100	100	100	0	0	80	80	80	80	80	100	100	180
6. Gulf of Guinea													
Rice						100	100	100	100	100			100
Rice	50	50									50	50	50
Total	50	50	0	0	0	100	100	100	100	100	50	50	150
7. Southern Sudan													
Rice	100	100	100								100	100	100
Rice				80	80	80	80						80
Total	100	100	100	80	80	80	80	0	0	0	100	100	180
8. Madagascar tropical lowland													
Rice	100	100	100								100	100	100
Rice				30	30	30	30	30					30
Total	100	100	100	30	30	30	30	30	0	0	100	100	130
9. Madagascar highland													
Rice	100	100	100								100	100	100
Vegetables					10	10	10	10	10	10			10
Total	100	100	100	0	10	10	10	10	10	10	100	100	110

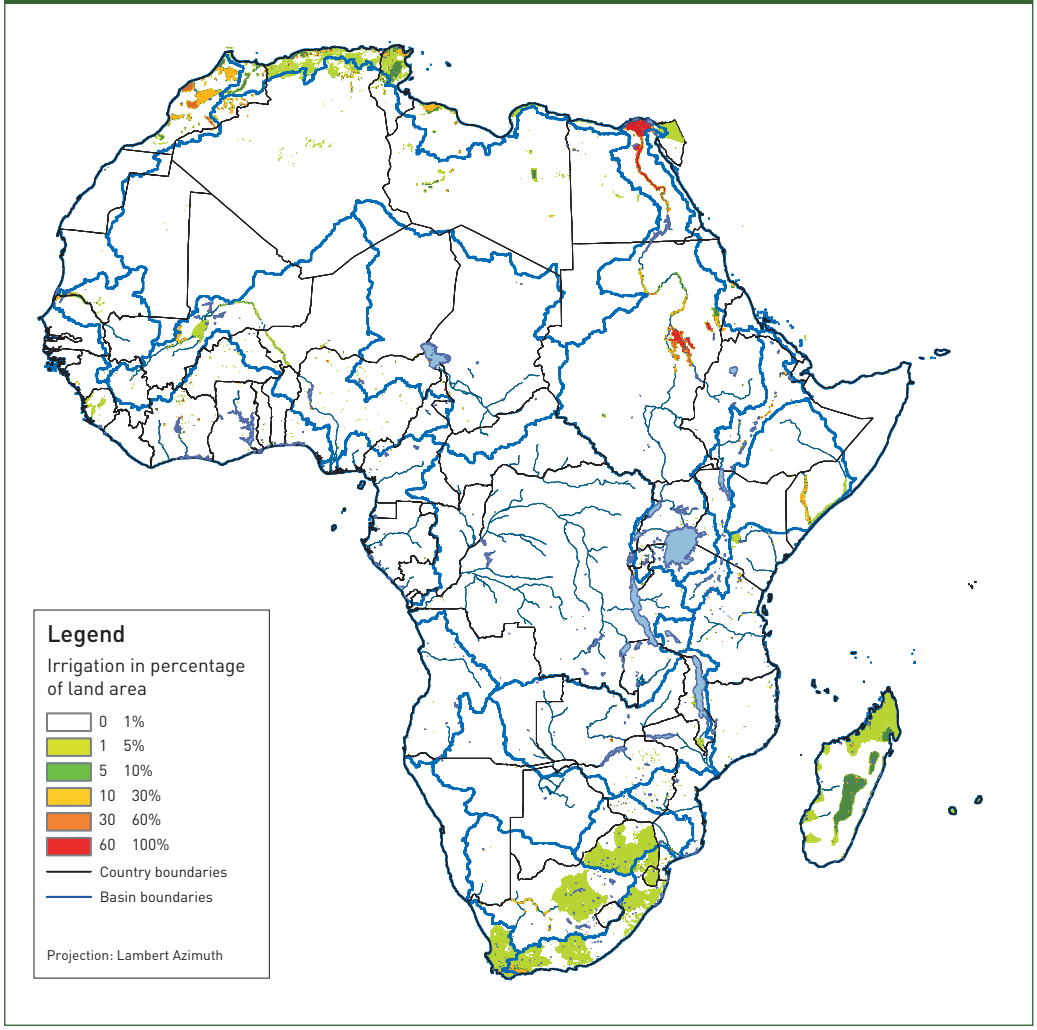
	Cropping intensity (%)												
Main crops	J	F	M	A	M	J	J	A	S	O	N	D	
10. Egyptian Nile and Delta													
Wheat	40	40	40	40	40						40	40	40
Fodder	60	60	60	60						60	60	60	60
Maize					50	50	50	50					50
Rice						30	30	30	30	30			30
Total	100	100	100	100	90	80	80	80	30	90	100	100	180
11. Ethiopian highland													
Maize						40	40	40	40	40	40		40
Vegetables						60	60	60	60	60	60		60
Vegetables	10	10	10	10	10							10	10
Total	10	10	10	10	10	100	100	100	100	100	100	10	110
12. Sudanese Nile area													
Wheat	40	40	40	40							40	40	40
Cotton							50	50	50	50	50	50	50
Sorghum/maize						40	40	40	40	40			40
Sugarcane	10	10	10	10	10	10	10	10	10	10	10	10	10
Total	50	50	50	50	10	50	100	100	100	100	100	100	140
13. Shebelli-Juba river area in Somalia													
Maize				40	40	40	40						40
Maize	30									30	30	30	30
Vegetables				20	20	20	20	20					20
Vegetables	30									30	30	30	30
Rice				15	15	15	15	15					15
Sugarcane	10	10	10	10	10	10	10	10	10	10	10	10	10
Total	70	10	10	85	85	85	85	45	10	70	70	70	145
14. Rwanda - Burundi - Southern Uganda highland													
Vegetables/ Sweet potato	30	30	30	30	30	30	30	30	30	30	30	30	30
Maize/sorghum		25	25	25	25	25							25
Maize/sorghum	15								15	15	15	15	15
Rice		20	20	20	20	20							20
Rice	20								20	20	20	20	20
Total	65	75	75	75	75	75	30	30	65	65	65	65	110
15. Southern Kenya - Northern Tanzania													
Vegetables				40	40	40	40	40	40	40			40
Rice				25	25	25	25	25					25
Cotton					15	15	15	15	15	15			15
Sugarcane	10	10	10	10	10	10	10	10	10	10	10	10	10
Arboriculture	5	5	5	5	5	5	5	5	5	5	5	5	5
Total	15	15	15	80	95	95	95	95	70	70	15	15	95

Cropping intensity (%)													
Main crops	J	F	M	A	M	J	J	A	S	O	N	D	
16. Malawi - Mozambique - Southern Tanzania													
rice	40	40	40								40	40	40
Maize				40	40	40	40	40					40
Vegetables				20	20	20	20	20	20	20	20		20
Sugarcane	10	10	10	10	10	10	10	10	10	10	10	10	10
Total	50	50	50	70	70	70	70	70	30	30	70	50	110
17. West and Central African humid areas above equator													
Rice						60	60	60	60				60
Rice	30	30	30	30	30								30
Vegetables	40	40	40	40								40	40
Sugarcane	10	10	10	10	10	10	10	10	10	10	10	10	10
Total	80	80	80	80	40	70	70	70	70	10	10	50	140
18. Central African humid areas below equator													
Rice	20	20	20	20								20	20
Rice					10	10	10	10	10				10
Vegetables					65	65	65	65	65	65	65		65
Arboriculture	10	10	10	10	10	10	10	10	10	10	10	10	10
Total	30	30	30	30	85	85	85	85	85	75	75	30	105
19. Rivers affluent on Angola - Namibia - Botswana border													
Maize	60	60	60	60								60	60
Vegetables	40	40	40	40	40						40	40	40
Total	100	100	100	100	40	0	0	0	0	0	40	100	100
20. South Africa - Namibia - Botswana desert and steppe													
Sorghum/maize	50	50	50									50	50
Vegetables	30	30	30	30								30	30
Arboriculture	20	20	20	20	20	20	20	20	20	20	20	20	20
Total	100	100	100	50	20	20	20	20	20	20	20	100	100
21. Zimbabwe highland													
Cotton	30	30	30	30	30						30	30	30
Wheat						40	40	40	40	40			40
Vegetables					20	20	20	20	20	20			20
Sugarcane	25	25	25	25	25	25	25	25	25	25	25	25	25
Total	55	55	55	55	75	85	85	85	85	85	55	55	115
22. South Africa - Lesotho Swaziland													
Wheat						35	35	35	35	35	35		35
Maize	25	25	25	25	25							25	25
Pasture/fodder	50	50	50	50	50	50	50	50	50	50	50	50	50
Total	75	75	75	75	75	85	85	85	85	85	85	75	110
23. Awash river area in Ethiopia													
Cotton						25	25	25	25	25	25	25	25
Maize							25	25	25	25	25		25
Sugarcane	30	30	30	30	30	30	30	30	30	30	30	30	30
Arboriculture	5	5	5	5	5	5	5	5	5	5	5	5	5
Total	35	35	35	35	35	60	85	85	85	85	85	60	85

The irrigated areas, shown in Figure 4, correspond to that part of the water managed areas equipped with hydraulic structures: full or partial control irrigation, equipped wetland or valley bottoms and areas equipped for spate irrigation, namely the areas that have modified the natural flow regime of the rivers or groundwater. The data used concern only the equipped irrigated areas which do not necessarily correspond to the actually irrigated area as shown in Figure 4.

On a continental scale, inadequacy of rainfall is not the fundamental issue facing water resources in Africa. The key issues appear to be related to management of the available resources. It is an issue related to the adequacy of the enabling environment under which water resources are managed at local, national and inter-country levels. Issues and challenges should, therefore, be identified and alternative approaches found to provide the water needed to produce the necessary food.

Figure 4: Irrigated areas in Africa



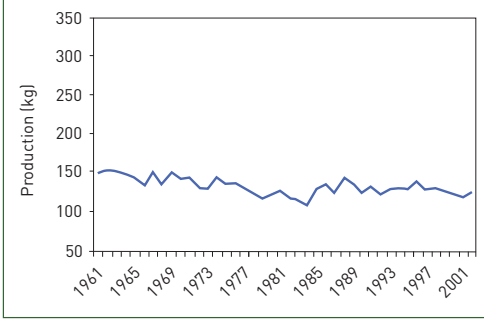
Source: FAO, Aquastat, 2005

Water for food

Africa s climate has made agricultural improvement difficult. In areas with limited and unreliable rainfall, farmers may be uncertain about what crops to plant. Some farmers grow a number of crops with different moisture needs in the hope of having at least one successful harvest. Other farmers may grow only one or two kinds of crops and risk starvation if not enough rain falls. In areas with too much rainfall, heavy downpours wash away nourishing substances from the soil. The hot, humid climate in much of Africa encourages the spread of insects that destroy livestock and cause various diseases in people.

An impending food crisis in Africa is already apparent. There are 2.9 million hunger-related deaths per year and 315 million people in sub-Saharan Africa live on less than US$1 a day. The number of undernourished Africans is rising steeply while the total number of undernourished people worldwide has fallen. At the time of independence, most of sub-Saharan Africa was self-sufficient in food. In less than 40 years, the subcontinent went from being a net exporter of basic food staples to reliance on imports and food aid. In 1966-1970, for example, net exports averaged 1.3 million tonnes per year, three-quarters of which were non-cereals. By the late 1970s, sub-Saharan Africa imported 4.4 million tonnes of staple food per year, a figure that had risen to 10 million tonnes per year by the mid-1980s. Cereal imports increased from 2.5 million tonnes per year in the mid-1960s to more than 15 million tonnes in 2000 and 2001. Since independence, agricultural output per capita remained stagnant and declined in many places. Africa is the only continent where cereal production per capita was less in 2001 than in 1961 (Figure 5). Notwithstanding the seriousness of the situation, it should also be noted that after independence sub-Saharan Africa faced the highest rate of population growth ever recorded. Growth actually took place over the last decades, but it has not been rapid enough.

Figure 5: Cereal production per capita in sub-Saharan Africa



The rise in grain prices on the global market has led to widespread rapid increase in domestic food prices. With their still fragile economies, most African countries were hard hit by this sharp rise in food prices, which triggered food riots in several countries. The multiplication of export bans, quotas and export taxes are exacerbating the problem. The production shift to biofuels and ethanol has also driven up the price of fertilizers, they are now beyond the reach of smallholder farmers. This phenomenon could affect development efforts made by African states. Despite the fact that the severe food crisis that hit the continent in 2005 and early 2006 may have eased, food shortages persist, particularly in East and Southern Africa. There have already been alarming effects in the health sector, with the increasing malnutrition, which may hamper all poverty reduction efforts. Also, the public finance systems in Africa cannot continue bearing the additional burden imposed on them to absorb the shock of this food price increase. An enduring solution is deemed necessary; to devise vigorous and quick initiatives to help African countries cope with this crisis. Such initiatives should be effective in the medium-and long-term, to address this food price crisis.

The prevailing global food crises calls for the revitalization African agriculture and the enhancement of water-use technologies to improve food security, contribute to sustainable and equitable growth and the achievement of the Millennium Development Goals (MDGs) on the continent. Now, more than 20 percent of African countries are considered water-poor.

Although agriculture consumes more freshwater than does any other use, it also significantly contributes to national economies, employment and food supplies. It constitutes approximately 30 percent of Africa s GDP and contributes about 40 percent of the total export value, with 70 percent of the continent s population depending on the sector for their livelihood. Production is subsistence in nature with a high dependence on rain. Thus, in most African countries, it remains an important way for poor people to sustain and improve their livelihoods. Rainfed and irrigated agriculture depend on the secure, adequate quantity and quality of water, either surface or underground. The challenge is, therefore, to optimize the use of currently available water and to make new water available during dry seasons and to reverse the draw down of groundwater tables.

The irrigation potential of the continent is estimated at more than 42.5 million ha, considering irrigation potential by basin and renewable water resources. One-third of this potential is concentrated in two very humid countries: Angola and the Democratic Republic of the Congo. The North African countries have developed land and water resources to the limit. Further development of the subsector will hinge on adding value through agro-processing (World Bank, 2006). With the exception of the Republic of South Africa, irrigated production and associated infrastructure in sub-Saharan Africa has lagged far behind, showing negligible growth over the past decade. Africa s dependence on cereal imports is expected to continue to grow, with a widening net trade deficit.

However, increasing demands for limited freshwater resources, without putting in place the right incentives for agricultural production, may be a serious hindrance to meeting the future demand for food. In Africa as a whole, food consumption exceeded domestic production by 50 percent in the drought-prone mid-1980s and by more than 30 percent in the mid-1990s. Food production capacity and productivity is further weakened due to widespread HIV/AIDS in Africa.

This has raised calls for water-stressed countries to buy the virtual water they need for food as grain on the international market or to get it as foreign aid. Food aid constitutes a major proportion of net food trade in Africa, and in many countries it constitutes more than half of net imports. In Kenya and Tanzania, for instance, food aid constituted two-thirds of food imports during the 1990s.

With some 150 million people at risk, Africa will be facing more challenging times in securing food for its growing population, given that some of the hardest hit countries are either in conflict or emerging from conflict and are seeking to build capacity that will enable them to deal with their multiple challenges. Some of the countries at risk such as Ethiopia, Niger, Somalia and Kenya are facing environmental challenges that could spell further danger to their development efforts.

Energy requirements for sustainable agriculture

Many countries in Africa continue to be amongst the lowest per capita energy consumers in the world. In all sectors, industry, agriculture, transport, household and commercial, a lack of minimum energy inputs has led to continued low productivity and impaired economic growth. It is also clear that in all sectors, energy is but one of the many important inputs for production, conversion, processing and commercialization.

However - and especially in the agricultural sector of most African countries - increased yields and production due to energy and other inputs can lead to important benefits such as improved incomes, new employment opportunities and agro-industrial growth, which will in themselves tend to increase energy requirements. Food security issues, particularly in Africa, have acquired a revived and new emphasis. Thirty countries in sub-Saharan Africa alone, suffered from low or critically low levels of food security in the period between 1991 and 1993. Achieving the aim that all people at all times have access to the food they need for a healthy, active life , will necessarily imply increasing the quality and quantity of energy inputs. Major energy issues that affect agriculture production are summarized below:

Energy and agricultural linkages

Agricultural productivity is closely associated with direct and indirect energy inputs, and policies are required to consolidate this relationship for the benefit of farmers. Energy development plans rarely take into consideration the present and future energy needs of agriculture, and most rural electrification programmes are mainly directed to households.

Large dams and their impacts

Some of the biggest dams are located in Africa. The region includes more than 1,200 dams, more than 60 percent of which are located in South Africa (539) and Zimbabwe (213). More than 50 percent were constructed to facilitate irrigation, only 6 percent for electricity generation. Outside of West Africa, only the richest 20 percent of households have electricity. Table 8 lists the large dams and reservoirs in Africa.

Large dams have had several negative impacts, including displacement of people, increasing erosion and flooding, loss of land, loss of income from downstream fisheries, etc. The development of micro-hydropower facilities is seen as a more sustainable means of managing water resources.

Table 8: Large dams and reservoirs in Africa

Reservoir	Country	Basin
Owen Falls	Uganda, Kenya, United Rep. of Tanzania	Victoria-Nile
Nasser	Egypt	Nile
Kariba	Zambia, Zimbabwe	Zambezi
Volta	Ghana	Volta

The four reservoirs listed above are among the five biggest in the world.
Source: Quoted in the UN World Water Development Report, 2003, Shiklomanov.

Energy prices

Energy price policies seldom regard the economic conditions of rural populations. If rural development is to be achieved, energy inputs must be made available, and this might require special efforts from society as a whole - e.g. subsidizing energy inputs in order to maintain the expected low costs and high quality of agricultural produce, as generally demanded by urban populations.

Social equity

Policies promoting social equity between rural and urban populations and between men and women, particularly in rural areas, are generally non-existent, leading to migration, injustice and social instability. In energy terms, what is needed is a reduction in human drudgery (e.g. water and fuel collection) and better services. Facilitating energy and other inputs required by agriculture represents greater recognition, in both economic and social terms, of the vital role played by Africa s rural people in feeding society.

Land tenure

Policies concerning the ownership of land, and regulations to control its use, have important implications for biomass conversion to energy. Legislation regarding property rights - both of land and of produce, such as biomass from forests - is generally weak in Africa and is considered an important barrier to the healthy development of sustainable bio-energy production and use.

There are, however, some energy issues that constrain agricultural development. These issues are summarized below.

Methodological issues

There is a need for coordination of agriculture, energy, electrification and rural development plans. Also, institutional links and responsibilities need to be strengthened due to the very limited linkages between the various sectors involved in the definition of energy policies for agriculture; in the actual implementation of energy projects for agricultural activities; and in the development of technologies related to the double role of agriculture as an energy consumer and producer. Also, the coordination of planning at the local, regional and national levels, in addition to considering end-use analysis as the basis for planning and projections, has an important role.

Technology development

Efficient energy utilization: there is significant potential for cost-effective energy efficiency improvements in key areas such as tobacco curing, agricultural pump sets and food, beverage, and textile industries, where reductions of up to 50, 20 and 30 percent respectively in energy use could be economical and achievable.

Biomass energy conversion: the potential role of agriculture as a major energy producer will only be tapped if technologies to convert biomass (wood, residues, purposely grown) are developed, tested and economically assessed. Among technologies that seem to offer good possibilities are: gasification, pyrolysis, fermentation (alcohol and biogas) and modern combustion.

Renewable energy sources: although efforts have been pursued in many African countries to develop and utilize energy sources such as solar and wind energy, their potential is far from being realized. Amongst promising solar and wind technologies are: water lifting and pumping using

solar thermal and photovoltaic systems and windmills; and heat and cold production for drying and other processes using solar dryers and thermodynamic systems.

Awareness raising: political awareness and capacity building are of importance to energy efficiency and also in view of linking energy to agricultural production.

Recommendations for sustainable agriculture

Energy requirements for specific objectives: Planners and policy makers need to be able to link energy requirements with specific objectives of agricultural and rural development, such as food security, agro-industry development and sustainable farming practices. This requires data indicating the energy intensiveness of different farming techniques for important food and other crops.

Energy availability to match food security targets: The goal of regional food security could require significantly increasing agricultural energy provisions, particularly if emphasis is placed on improving yield through conventional high-input techniques. Agro-industry could become the fastest growing sector, in terms of energy requirements, with the agricultural sector as the next fastest growth sector.

Energy implications of low-input farming techniques: low-input farming techniques, such as integrated pest management, low-tillage cultivation, use of residues, green manures, and other organic fertilizers, may play an important role in sustainable agricultural development. There are several local success stories and new initiatives in low-input, high-yield agriculture. However, the energy implications of these techniques have yet to be systematically documented. More research is needed to enable clear comparisons with well established high-input methods.

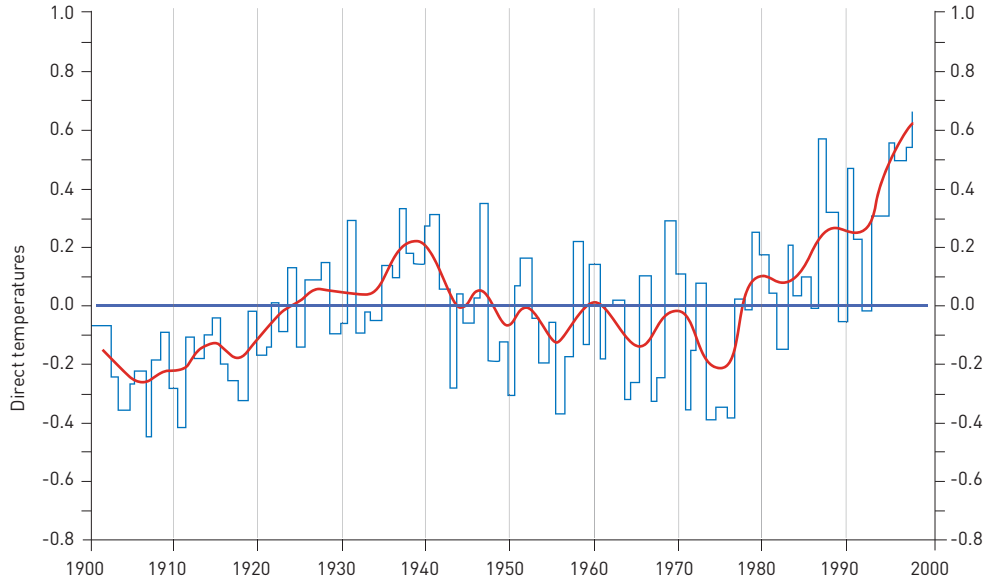
Consideration of the full food chain in assessing energy requirements: in order to promote food security strategies with the necessary energy inputs, policies and methodologies the critical linkages between agricultural production, agriculture-based industries (food, beverages, tobacco and textiles), distribution and commercialization and the rest of the economy should be considered. Agricultural growth is the most important contributor to manufacturing and service activity in sub-Saharan Africa, not only stimulating agro-industries, but the rest of the economy as well. In this context, energy from biomass is an added benefit.

Hazardous agriculture in light of climate change

Climate change and global warming are likely to make precipitation patterns in Africa increasingly variable, reducing water availability in some regions and increasing it in others. The shift would have a huge impact on both irrigated and non-irrigated agriculture. Changes in precipitation would make extreme weather events more common, leading to more severe and frequent flooding and to lower dry-season water flow in rivers. Past investments in water control measures and infrastructure will lose their value if reservoirs are no longer filled and irrigation canals do not run.

Observational records (Figure 6) show that the African continent has been warming through the twentieth century at the rate of about 0.05 C per decade with slightly higher warming in the June-November seasons than in December-May. By the year 2000, the five warmest years in Africa had all occurred since 1988, with 1988 and 1995 being the two warmest years. This rate of warming is not dissimilar to that experienced globally, and the periods of most rapid warming - 1910 to 1930s and the post-1970s - occurred simultaneously in Africa and the rest of the world.

Figure 6: Temperature curves in Africa during the twentieth century

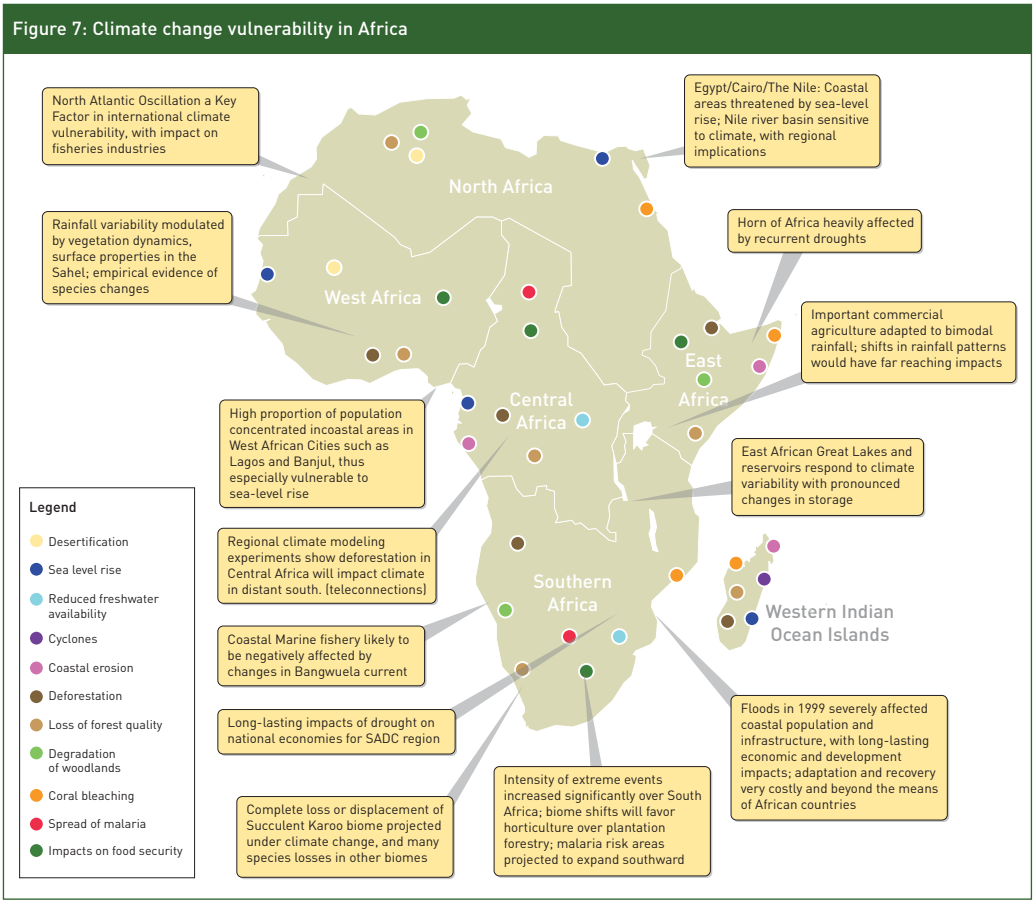


During the twentieth century, the global average surface temperature increased by about 0.6 C and global sea level increased by about 15 to 20 cm. The IPCC AR4 projects that the global average temperature will rise another 1.1 to 5.4 C by 2100, depending on how much the atmospheric concentrations of greenhouse gases increase during this time. This temperature rise will result in continued increases in sea level and overall rainfall, changes in rainfall patterns and timing, and decline in snow cover, land ice and sea ice extent. The expected warming is greatest over the

interior of semi-arid margins of the Sahara and central-southern Africa. It is also expected that temperature rise in Africa will correspond to global temperature rise, and that adverse impacts on agriculture will be spread across the diverse regions of Africa, putting a huge proportion of the African continent at greater risk.

Multiple stresses make most of Africa highly vulnerable to environmental changes. As shown in Figure 7, climate change will increase vulnerability of an already stressed continent. Analysis of the impacts of climate change suggests that agro-ecological systems are the most vulnerable sectors. Agriculture in low latitude developing countries is expected to be especially vulnerable because the climate of many of these countries is already too hot. In many parts of Africa, agro-ecological systems are characterized by recurring droughts, soil degradation and water supply shortages. These effects are exacerbated by the fact that agriculture and agro-ecological systems are especially prominent in the economies of African countries and the systems tend to be less capital and technology intensive.

Figure 7: Climate change vulnerability in Africa



The main effect of climate change on semi-arid or tropical agro-ecological systems is a significant reduction in crop yield, which may well force large regions of marginal agriculture out of production in Africa. Such a reduction in crop yield will also place more pressure and higher demand for conversion of land, extraction of water supply for irrigation, introduction of new exotic plant and animal species, intensive use of chemical inputs and hence pollution and environmental damage, erosion, seriously accelerating biodiversity loss and extinction.

The climate patterns Illustrated in Figure 7, coupled with the current inadequacy of public infrastructure (such as roads, long-term weather forecasts, and agricultural research and extension), suggests a need to ensure climate change adaptation through pursuing massive changes in the agricultural systems of low latitude (mostly developing) countries.

Five main climate change related drivers, namely, temperature, precipitation, rise in sea level, atmospheric carbon dioxide content and incidence of extreme events, may affect the agriculture sector in the following ways:

- Reduce crop yields and agricultural productivity: there is growing evidence that in the tropics and subtropics, where crops have reached their maximum tolerance, crop yields are likely to decrease due to an increase in temperature.
- Increase incidence of pest attacks: an increase in temperature may be conducive to a proliferation of pests that are detrimental to crop production.
- Limit the availability of water: it is expected that the availability of water in most parts of Africa will decrease as a result of climate change. In particular, there will be a severe downward trend in the rainfall in Southern African countries and in the dry areas of countries around the Mediterranean Sea.
- Exacerbate drought periods: an increase in temperature and a change in the climate throughout the continent are predicted to cause recurrent droughts in most of the regions.
- Reduce soil fertility: an increase in temperature is likely to reduce soil moisture, moisture storage capacity and the quality of the soil, which are vital nutrients for agricultural crops.
- Reduce livestock productivity and increase production costs: climate change will affect livestock productivity directly by influencing the balance between heat dissipation and heat production and indirectly through its effect on the availability of feed and fodder.
- Affect availability of human resources: climate change is likely to cause the manifestation of vector and vector-borne diseases, where an increase in temperature and humidity will create the ideal conditions for malaria, sleeping sickness and other infectious diseases that will directly affect the availability of human resources for the agriculture sector.

The impact of these adverse climate changes on agriculture is exacerbated in Africa by the lack of adaptation strategies, which are increasingly limited due to the lack of institutional, economic and financial capacity to support such actions.

Africa s vulnerability to climate change and its inability to adapt to these changes may be devastating to the agriculture sector, the main source of livelihood for the majority of African peoples. The utmost concern should therefore be for a better understanding of the potential impact of the current and projected climate changes on African agriculture and to identify ways and means to adapt and mitigate its detrimental impact.

Attempts to overcome the challenges

Today s water and food situation is recognized as a serious global issue and Africa has prepared many initiatives in response to it. Initiatives dealing primarily with water for agriculture in Africa involve efforts in one or more of the following categories: formulating long-term water policies and related strategies; increasing water productivity; promoting water availability; controlling agricultural pollution; reforming institutions and management; enhancing stakeholder participation; raising awareness and developing information systems; developing human resources; supporting action-oriented research; and adopting innovative technology.

1. **Formulating long-term water policies and related strategies**: every African country has unique legal, institutional, economic, social, physical and environmental conditions that influence its water management policies and strategies. The formulation of national strategies for integrated water management depends on many factors, including a country s size and political organization, its hydrological conditions, its regional context, and the diversity of its stakeholders. Many African countries have only subsector water policies (for irrigation, water supply, etc.), which are often inconsistent, thus calling for agricultural water policies that integrate the management of natural resources including water, soil and biological resources.

   National policies in Africa, especially agricultural policies, make the link between globalized food markets and local water markets. One of the main causes of the food crisis in many African countries are the subsidies paid by industrialized countries to their farmers. Agricultural subsidies in Europe and North America are as high as six times foreign aid to African countries. Subsidies, combined with trade barriers imposed by industrialized countries, prevent African countries from successfully competing in global markets.

2. **Enhancing water availability:** in planning and implementing agricultural projects, African countries try to bridge the gap between population growth and large urban populations on the one hand, and food production and rural development on the other. Several land reclamation projects are, therefore, carried out in conjunction with efforts to provide sufficient water supplies while protecting the environment and ensuring economic and financial support.

   Water stress situations result mainly from limited supplies (as in arid regions) or poor reticulation and inequitable distribution through supply networks, or both. Accordingly, tackling both problems can be done by augmenting water supplies and controlling the demand for water (see point 3).

   To supply more irrigation water, desalination is still too costly a process, and weather modification and cloud seeding techniques raise environmental and social concerns, so that increased storage capacity remains the favoured option. Two main approaches are used in Africa: building dams or reservoirs and artificially recharging aquifers with water for future use. Promoting groundwater storage is important because of its many advantages, including the potential removal of some contaminants and minimal evaporation losses, and because of the continuing opposition to dams.

3. **Increasing water productivity**: to boost the productivity of existing cultivated land, modern irrigation and drainage systems are used. In rainfed areas without water management systems, improvements in agricultural growth can be achieved through watershed management that increases farm productivity.

   Efforts to control the demand for irrigation water represent an alternative to conventional supply-driven water management, which has long responded to shortages by relying on capital investment in new supply and distribution networks. Demand management focuses on reducing water consumption, and thus improving water use efficiency. Demand management measures include:
   - introducing short-age crop varieties;
   - introducing pricing mechanisms to reduce irrigation water demand;
   - developing water-saving irrigation techniques;
   - modernizing irrigation systems;
   - introducing salt-tolerant crops in areas that are arid, saline or served by brackish water; and
   - reallocating irrigation water to crops that consume less water.

   Demand can also be controlled by harvesting and reusing water. Water reuse is becoming an integral part of many national water programmes, particularly in water-short areas. Water reuse efforts require widening the concept of water use efficiency to include basin-wide efficiency and the multiplier effects of water. However, in some cases severe water shortages can lead to hazardous practices, including the use of improperly treated domestic and/or industrial wastewater for irrigation, leading to adverse health impacts and long-term soil contamination.

4. **Controlling agricultural pollution:** agriculture-induced pollution can affect groundwater, seawater or both. Public awareness of irrigation and drainage issues should, therefore, be promoted by strengthening African countries technical knowledge base on waterlogging, salinity and other quality issues.

5. **Reforming institutions and governance:** sustainable agricultural development should be based on balanced plans for resource supplies and demand. African decision-makers are therefore reviewing relevant policies, legislation, regulations and institutions, taking into account the various factors that influence the effectiveness of irrigation and drainage - including the availability of investments for rehabilitating infrastructure and for financing operation and maintenance. The reforms resulting from such reviews should streamline the development of similar future projects using sound, integrated water management.

6. **Enhancing stakeholders participation:** inadequate stakeholder participation is one of the main challenges for water and agriculture management. Such participation provides a variety of views and helps gain public support and the political and financial backing required to sustain projects. To reduce risks of inefficient and inequitable performance, decentralization and subsidiarity reforms in the agriculture sector may include irrigation management transfers, which reassign to farmers the main responsibilities for irrigation (including community issues and full or partial cost recovery initiatives). However, attempts to equitably distribute water among rural populations may be hindered by the

under-representation of women in water resources development and management. Accordingly, recent water management efforts that take gender issues into account have used integrated frameworks that address the interactions between gender and social equity, acknowledging the key role that women play in providing food for their families.

7. **Raising awareness and developing information systems:** lack of information and knowledge can aggravate the effects that irrigated agriculture has on the environment - for example, contributing to groundwater and drainage problems - and accentuate the threats of climate change to agriculture. The challenge is to minimize negative impacts and promote positive impacts, fulfilling the seventh Millennium Development Goal of ensuring environmental sustainability.

   Groundwater has tremendous value in both rural and urban areas for poverty alleviation, livelihoods, drought security, agricultural yields, domestic water supplies and the environment. Indiscriminate exploitation and its consequences, along with pollution, will threaten groundwater resources. Similarly, irrigation without drainage, excessive irrigation, and inefficient irrigation and drainage systems can result in severe waterlogging and salinity problems, which lower crop yields and agricultural productivity. Such problems, as well as those associated with climate change, are unlikely if awareness about hazardous practices and preventive measures is widespread throughout the different levels of the decision-making hierarchy and among farmers.

   To address the potential effects of climate change on agricultural production, information on related uncertainties has been expanded and public awareness raised on possible risks and responses. Regional and national dialogues on water and climate are now being promoted, together with information sharing between the water and climate communities. Efforts are also being made to raise awareness and strengthen capacities for a sound assessment of the impacts of and adaptation to climate change in Africa. Such measures are intended to help reduce vulnerability to the intensified effects of hazards in the agriculture sector, expected to result from climate change and to enhance African people s ability to cope with and adapt to climate change.

8. **Developing human resources:** though institutions can make the difference between success and failure in agricultural development, laws, regulations and organizations may be ineffective without well-trained, motivated individuals to enforce and administer them. Thus human resources development plays a crucial role in determining the outcomes of irrigation-related water management programmes.

   Major capacity building programmes are well underway or have been initiated throughout Africa. Water education and capacity-building needs can be fulfilled through training centres established for such reasons, which strengthen the capacity and skills of water professionals in planning, designing, operating and maintaining agricultural, irrigation and drainage systems.

9. **Supporting research and adopting innovative technology:** research and technology play crucial roles in agricultural production. Without research, the multidisciplinary concerns associated with development are unlikely to be addressed. Using information

technology and evidence on economic evolution, water and food production and needs can be projected. Research can also solve various problems and enlighten the public on the implications of adopting technological innovations. Solutions to food production problems in African water-scarce areas include high-yielding, drought tolerant crop varieties and improvements in crop genetics. Research is responsible for envisaging the role of water relative to future agricultural demands, suggesting structural adjustments to secure funds and attracting investments in agriculture, and working out the transition costs of such adjustments.

10. **Increasing investments in agriculture:** investments in agriculture may appear to produce low yields and slow returns. However, viewed from an African perspective, they can be enormously productive. Agriculture accounts for about 30 percent of sub-Saharan Africa s GDP, at least 40 percent of export value and approximately 70 percent of employment. Furthermore, two-thirds of manufacturing added value in most African countries is based on agricultural raw materials. In a number of smaller countries, agriculture plays an even more dominant role, representing 80 percent or more of export earnings.

    Yet, the overwhelming majority of public irrigation agencies in Africa recover only a minor share of recurrent costs, with no contributions to capital outlays. Most African farmers still receive irrigation water at no or at a nominal cost. The agriculture sector is accordingly dependent on subsidies and international agencies. Such an environment makes raising private funds for expanding and modernizing systems more difficult, because lenders and investors look to future cash flow for repayment.

    African governments are, therefore, responding to the above-described unfavourable environment by translating political decisions into adequate allocations of resources to water, taking advantage of the aid community s increasingly encouraging attitude towards funding water-related activities. This financing effort is supported by an increasingly consistent strategy to recover costs from users and to establish incentives to ensure more efficient use of water. The Millennium Development Goal of reducing poverty and hunger by half by 2015 are achieved only if the current levels of spending for water and food production are increased, through tapping all available sources of finance; not only public funding and users contributions, but also private finance (domestic or international) and development funds.

11. **Formulating regional and continental initiatives to counteract crises:** for example, the recent increase in costs of producing fertilizers, which are of strategic importance to the achievement of an African green revolution that will roll back hunger and disease in many parts of the continent, has been addressed by establishment of the African Fertilizer Financing Mechanism Special Fund, through an initiative by the African Development Bank with a view to mobilizing resources from donors to finance, in particular, fertilizer production, distribution, procurement and use in Africa.

Forming partnerships across Africa

Forming productive partnerships is central to tackling the problems hindering agricultural development in Africa, with regard to the major role agriculture plays in the economy and society of most African countries. Since increased productivity in the sector is considered to be the very basis for the continent s economic and social development, partnerships have been formed between African governments and the international community to create an enabling environment through which agricultural productivity in Africa can be further developed.

The New Partnership for Africa s Development

The New Partnership for Africa s Development (NEPAD), initiated by the five Heads of State (Algeria, Egypt, Nigeria, Senegal and South Africa), to provide a vision and strategic framework for Africa s renewal, through facing the current challenges hindering the continent s progress and development (poverty, underdevelopment, marginalization, etc.). NEPAD is an African Union designed programme that aims to achieve the following objectives:

a) Establish the conditions for sustainable development by ensuring:
- peace and security;
- democracy and good, political, economic and corporate governance;
- regional cooperation and integration; and
- capacity building.

b) Policy reforms and increased investment in the following priority sectors:
- agriculture;
- human development with a focus on health, education, science and technology and skills development;
- building and improving infrastructure, including information and communication technology (ICT), energy, transport, water and sanitation;
- promoting diversification of production and exports, particularly with respect to agro-industries, manufacturing, mining, mineral beneficiation and tourism;
- accelerating intra-African trade and improving access to markets of developed countries; and
- the environment.

c) Mobilizing resources by:
- increasing domestic savings and investments;
- improving management of public revenue and expenditure;
- improving Africa s share in global trade;
- attracting foreign direct investment; and
- increasing capital flows through further debt reduction and increasing ODA flows.

The African Ministerial Council of Water

The African Ministers responsible for water, having noted the establishment of the African Union, the launch of the New Partnership for Africa s Development (NEPAD) with the overall objective of encouraging new approaches to Africa s sustainable development challenges, and being aware of the challenges posed by the Millennium Declaration and the regional intergovernmental responses essential for translating the MDGs on water and sanitation into reality in Africa, established the African Ministerial Council on Water (AMCOW). AMCOW was formally launched in Abuja, Nigeria on 30 April 2002.

AMCOW s mission is to provide political leadership, policy direction and advocacy in the provision, use and management of water resources for sustainable social and economic development and maintenance of African ecosystems, and to strengthen intergovernmental cooperation to address water and sanitation issues in Africa.

AMCOW s major functions are to facilitate regional and international cooperation through the coordination of policies and actions amongst African countries regarding water resources issues, and to review and mobilize additional financing for the water sector in Africa, and to provide a mechanism for monitoring the progress of implementation of major regional and global water resources and water supply and sanitation initiatives. AMCOW aims to develop mechanisms that will promote best practices for water policy reforms, integrated water resources management, food security, water supply and sanitation. AMCOW will also enhance and consolidate intergovernmental and regional cooperation in the management of shared waters, including surface and groundwater.

AMCOW also provides a forum for dialogue with UN agencies and other partners on water issues, and promotes participation in regional studies regarding climate change, development of observation networks, facilitates information exchange and aims to develop policies and strategies to address water issues in Africa.

AMCOW engages in dialogue and consultations with UN agencies, regional economic groupings and with regional and global financial institutions on financing and other issues relevant to the water and sanitation sector in Africa.

The African Water Facility

The African Water Facility (AWF) is an initiative launched in 2004 by the African Ministers Council on Water as a result of the implementation of the objectives of the African Water Vision and Framework for Action for 2025, adopted at the 2000 World Water Forum in The Hague. The AWF s main objective is to expand Africa s access to financial resources for the water and sanitation sector, and create an enabling environment for water management to generate and attract more investment for the development and management of sustainable water resources. The AWF mobilized € 500 million to finance its 2005-2009 operational programme from: (i) Development partners (financial contribution, secondment of staff, co-funding); (ii) African Governments (financial contribution); and (iii) Beneficiary contribution (co-funding; provision of facilities, services and equipment).

Opportunities for sustainable agriculture

Food supply concerns are usually addressed in light of current water availability, taking into account social, economic, environmental and cultural factors that could affect the future of water. It is estimated that increasing water productivity, combined with better water management, could meet about half of the demand of agricultural water. However, the other half cannot be covered unless new water resources are developed. The following courses of action constitute promising alternatives for the development of water resources for agriculture in Africa.

1. **Increasing water productivity:** efforts to improve food security and rural livelihoods must focus on raising water productivity in both rainfed and irrigated agriculture and on increasing the availability of affordable, environmentally acceptable water that generates maximum socio-economic returns. Better agronomic practices and crop selection can save water and reduce waste. Biotechnology can provide seeds with higher yields, better resistance to pests and diseases, and higher tolerance to inundation, drought and saline water. Yield-increasing, water-saving technology can also raise water productivity. In addition, better communication systems can provide market, weather and other information that enhance production decisions. All these technologies will improve the management abilities of irrigation and drainage agencies, leading to better and cheaper services.

2. **Harnessing new water supplies:** whatever agricultural advances are made, the fact remains that growing more food requires more water, both for rainfed and irrigated agriculture. Even under favourable assumptions about improvements in irrigation efficiency and agronomic potential, water supplies for agriculture will have to significantly increase to meet Africa s growing food requirements. Some of this additional water can come from harvesting rainwater in arid and semi-arid regions and from developing small-scale water sources such as shallow aquifers. These are preferred solutions because they can be used in areas with extensive poverty, little water and rapid population growth. Reducing waste in return flows from agricultural users, can improve water supplies. It is obvious that where demands for both agricultural and environmental requirements exceed the amount available, choices and compromises have to be made. The enormous pressure on freshwater resources makes it increasingly necessary to improve communication between farmers and environmentalists. Despite the recent increase in food prices worldwide, importing food would reduce stress on water systems, but its impact on local poverty, socio-economic, cultural and environmental situations has to be better understood.

3. **Expanding storage capacity:** new storage capacity will be required to replace capacity lost to sedimentation and to save water lost during times of scarcity. Water storage can be surface storage in reservoirs or groundwater storage. New techniques and institutional mechanisms are urgently needed to enhance, recharge and improve management of groundwater aquifers. New surface reservoirs are a subject of considerable controversy because of their potential effects on local communities and the environment, including inundation of land, resettlement of people, and disturbance of river ecosystems and fish migrations. In addition, such reservoirs are subject to sedimentation and evaporation. Reservoirs, however, perform functions that are hard to replace by other means and so will remain a necessary option in water resources development.

4. **Empowering communities and water user groups:** individuals and groups must be empowered to make decisions so that local populations can control a share of development resources. New roles for civil society organizations have to be created and enhanced through expanding the formation of water user associations to run irrigation systems. New multi-stakeholder catchment committees should be empowered to influence water allocations and management practices. Such organizations can protect the interests of poor farmers and engage them in other collective actions that improve their livelihoods. The central role of female farmers in many of these activities must be better recognized, and their rights and representation redefined.

5. **Ensuring access to food:** at the individual, local and continental levels should be ensured. Infrastructure for storing and distributing food should be developed, as should the ability to generate foreign exchange to pay for food imports. Domestic development policies (including subsidies and implicit taxes), international assistance programmes and international trade agreements should acknowledge and support the centrality of agriculture-based development in these circumstances.

6. **Reforming water management institutions:** reforms should reorient water management institutions towards people, making them more service-oriented, user-controlled and self-financed, with transparent decision-making and accountability. These institutions should be embedded in a system of integrated water management with empowered multi-stakeholder basin organizations managing surface and groundwater. This approach should enhance water access for poor people and disadvantaged groups, and allow minimum flows for basic needs and the environment.

   Qualified, skilled people are needed to develop and run these institutions. Moreover, the envisaged shift to a service orientation may require changes in attitudes, skills, and management practices. The motivation, knowledge and skills of staff have to be developed through education, training and human resources management. These processes require increasing the capacity of local professionals and researchers to provide education and training on water and food production, facilitating the exchange of knowledge between local users, technicians and professional water managers; and establishing or strengthening links between water users, water managers, education institutions and water research organizations.

7. **Making needed investments:** to meet the demand for food, to increase the productivity and development of water, and to improve the livelihoods of rural people. Investment programmes should respond to the key principles of participation, accountability and transparency and should foster representative institutions in an integrated water resources development and management context.

   Investments should develop water resources to enable community-based irrigation, modernize existing irrigation and drainage systems, and replace and augment storage capacity in reservoirs and groundwater basins particularly in water scarce countries. Groundwater recharge programmes should be initiated to help restore groundwater tables. Moreover, investments are needed in drainage and reclamation of degraded irrigated land,

restoration of eroded lands and provision of flood protection and drainage in frequently inundated areas. Also, environmental regulations and parallel investments in municipal and industrial waste treatment are needed to improve the quality of river water, reduce dilution requirements and increase supplies.

Both funding for investment and for operations are to be the result of a negotiation process between the authorities, the service provider and the users on the level of services and the associated costs of service provision. All costs must be recovered, partly through contribution from users and partly from the government representing the interests of the society.

The way ahead

For agriculture to feed the at least 1.8 billion people in Africa in 2050, water allocated to agriculture must be used more efficiently and new water resources developed. Many organizations and institutes will have to choose water use and development priorities, and carefully consider the difficult tradeoffs between water for agriculture and water for the environment.

Shared understanding of the problems and their consequences, solutions and the interconnections and tradeoffs among these groups is crucial if actions are to achieve common objectives. The starting point must be the development of a common awareness and understanding among current and future decision-makers in Africa. This must be done in schools, in the media, and in workshops, meetings and conferences, allowing those concerned to make decisions. Appropriate actions must then be taken on economic policy and trade, investment, infrastructure, institutional reform, research and capacity building, as follows:

1. **Developing consistent, comprehensive water and food policies:** African governments need to intensify efforts to prepare medium and long-term water and food policies at the local, national and regional levels. National dialogues on such policy-making should be initiated and strengthened among those responsible for and affected by the development and use of water resources. Associated reforms and capacity building in irrigated and rainfed agriculture should be deepened, allowing the main stakeholders to determine their future.

   Trade in virtual water (water embedded in key water-intensive crops) offers potential for making water allocations more efficient. It can help integrate water and food policies in Africa, especially at the regional level.

2. **Promoting equitable trade:** trade arrangements in Africa should encourage water-scarce regions to produce and export high-value crops and import water-intensive staple crops from water-abundant regions. Trade regimes must also make special provisions for African countries not yet able to compete in the market for their food supplies. The economic implications of long-term food imports in food-deficit countries and regions should be evaluated. The impacts of national agricultural subsidies on African countries should be assessed and wisely governed. Trade regimes in African regions should also be adjusted to promote

socially equitable food production and distribution, and to support agriculture-based rural development initiatives.

3. **Expanding water storage and improving water quality:** more water storage at or below the surface is essential to achieving the water volumes required for food production and other purposes. Water storage and harvesting techniques should be further developed to enhance productivity in rainfed agriculture. Work to contain agricultural pollution is urgently needed because the effects take years to materialize in groundwater. Such efforts should be consistent with other pollution control policies, and policies that provide incentives to pollute should be eliminated, especially subsidies that encourage high-yield practices, which often result in highly polluting agriculture. Improving the quality of agricultural return flows requires the development of affordable and effective technologies, such as lower impact pesticides and herbicides (including biological agents) and livestock feed. Strategies are needed to phase out more persistent agricultural chemicals throughout Africa.

4. **Shifting the focus of irrigation development:** many large projects have been implemented, but resources should be devoted to small irrigation systems that provide supplemental irrigation and to rainfed agriculture. Small-scale technologies can provide many benefits in poor rural areas; developing them should be a top priority in the least developed African countries. Innovative technology that enhances affordable small plot irrigation can be one of the most effective ways of raising incomes, increasing land productivity, and achieving household food security, liberating the continent s poorest and hungriest people from poverty and hunger.

5. **Increasing the productivity of irrigated agriculture:** is essential given that growing competition for water will undoubtedly increase tensions between riparian countries. The main challenge is determining how much water should be used to preserve downstream water quality as well as the aquatic ecosystems needed to guarantee that quality. Methods are available to make such determinations and should be widely implemented. In addition, increasing the productivity of irrigated systems requires improving the efficiency of hydraulic systems and enhancing agronomic performance through decent cropping practices and appropriate crop choices.

   Because pumping water is a common way to increase the flexibility of irrigated systems, surface and groundwater management need to be better integrated. Such efforts should rely on individual farmers and irrigation agencies, which must work hand in hand.

6. **Reform of irrigation and drainage institutions:** should shift these agencies towards service-oriented management based on the principle of charging for services, to secure funding for sustainable service provision. Cost recovery mechanisms should be improved significantly to cover costs of operation and maintenance. This approach is feasible only if appropriate, effective accountability mechanisms are in place, if decision-making is transparent and participatory, and if the services provided are sufficient.

7. **Developing information systems and knowledge networks:** Internet-based information systems and knowledge networks are needed to update users on the latest innovations in agriculture, to increase awareness of the potential of updated designs and modern

technologies, and to provide examples of good and bad practices. Such information helps raise people s awareness of the consequences of harmful practices and about coping with the risks associated with climate change and its possible effects on water availability.

8. **Improving water education and building capacity:** water education and capacity building for individuals and staff at all levels should be considered integral elements of all programmes that aim to improve agricultural management and development. These elements include knowledge about water in a framework that responds to sectorial and societal needs. Human resources development can be carried out in different ways, including incorporating training into agriculture projects, establishing specialized training centers and developing relevant education programmes.

9. **Increasing research:** more research is required to develop new and situation-adapted technologies that maximize water productivity and poverty alleviation in irrigated and rainfed areas. This should be accompanied by research on developing institutions for management, operation, and maintenance. Biotechnology research is required to increase crop yields. Private genetic research supports growth in the yields of tradeable cereal and horticultural crops. Public funding is required for research on locally important crops that are unlikely to attract private investment, and on better drought resistance and salinity tolerance of major cereals. Research should also investigate the effects of developing and using genetically modified crops.

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6

Hydropower resource assessment in Africa

Water for agriculture and energy in Africa: The challenges of climate change

Report of the ministerial conference - 15-17 December 2008 - Sirte, Libyan Arab Jamahiriya

Executive summary

Hydropower is one of the cleanest and most reliable sources of energy. Environmentally conscious countries such as Canada, New Zealand, Norway and Sweden have chosen hydropower as their main source of electricity generation.

Compared to other developing countries the level of access to electricity in Africa is low, despite the continent s rich resources. Over 90 percent of the rural population relies on traditional biomass energy sources such as wood, charcoal, crop waste, manure, etc. for cooking and heating, and candles and kerosene for lighting.

The African continent is endowed with enormous hydropower potential that needs to be harnessed. Despite this huge potential, which is enough to meet all the electricity needs of the continent, only a small fraction has been exploited. This may be related to the major technical, financial and environmental challenges that need to be overcome to develop of this resource base.

Energy security and access challenges are the main issues to address in terms of the developmental agenda of Africa to attain the Millennium Development Goals (MDGs). Hydropower has a great role to play in solving Africa s energy security and access issues.

NEPAD s vision for the energy sector has targeted the exploitation of Africa s vast hydropower potential in order to address the socio-economic problems of the continent. The total installed capacity of Africa is about 20.3 GW with a total generation of 76 000 GW/year. A comparison with the gross theoretical hydropower potential of about 4 000 000 GWh/year indicates that the current production from hydropower plants in Africa is about 20 percent of the total potential.

The focus over the years in many African countries has been on large-scale hydropower schemes. Recent studies have shown that electricity generation through small hydropower (SHP) is gaining ground due to its short gestation period, low investment and lowest environmental impacts. Also, economically viable and proven small-scale hydropower technologies have been commercially developed and are available for generating both electrical and mechanical power for rural industrialization and development. This report is an attempt to compile available information on large and small hydropower (SHP) capacities for currently installed, potential, ongoing and pipe-line projects in Africa.

Introduction

Global overview of hydropower

Rising oil prices, increasing global energy consumption and concern for the environment has led to a renewed interest in alternative energy sources such as renewable energy. Renewable energy currently constitutes about 17 percent of the global energy mix with hydropower making up about 90 percent of this. Most renewable energy sources are clean and environmentally benign and would contribute towards mitigating the effects of greenhouses gas emissions and global warming.

Hydropower currently contributes about 20 percent to the global electricity supply, second to fossil fuel. It is anticipated that the global demand for electricity will increase steadily and the growth for hydroelectricity is projected at 2.4 to 3.6 percent from 1990 to 2020. A large number of hydropower development projects with a total capacity of 100 000 MW are ongoing globally. The greatest contribution to current hydropower development is from Asia (84 000 MW). Contributions from other regions are: South America (14 800 MW), Africa (2 403 MW), Europe (2 211 MW), North and Central America (1 236 MW) (Bartel, 2002).

The technical hydropower potential of Africa is around 1 750 TWh which is about 12 percent of the global capacity. Only 5 percent of this technically feasible potential is exploited.

Small hydropower (SHP) development is poor throughout Africa. It is anticipated SHP will form part of the solution to the growing demand for rural electrification programmes in Africa.

Hydropower and poverty

A number of research studies have indicated a strong correlation between energy consumption and economic growth. Access to modern energy services directly contributes to economic growth and poverty reduction through the creation of income-generating activities. Contributions to poverty reduction may arise from time being freed for more productive activities.

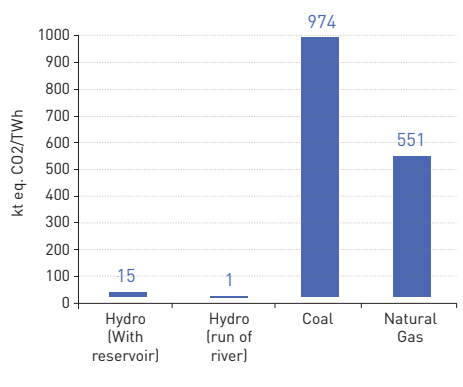
The Millennium Development Goals (MDGs) are the international community s commitment to halving poverty in the world s poorest countries by the year 2015. Whilst some of these countries have seen tremendous success in poverty reduction over the past decade, others, especially in the sub-Saharan African region, are lagging behind. Electricity is essential for the provision of basic social services, including education and health, and also for powering machines that support income-generating activities to reduce poverty. Harnessing hydropower to generate electricity can ensure energy security, which can be an effective way to reduce poverty in Africa.

Hydropower and climate change

Energy derived from moving water is environmentally benign as compared to that obtained from burning fossil fuels. Hydroenergy does not lead to the emission of greenhouse gases (GHG) and therefore do not contribute significantly to global warming. It was previously held that dam reservoirs does not emit any greenhouse gases. This view is changing due to clean development mechanism (CDM) studies which were undertaken.

Under the Kyoto Protocol industrialized nations are committed to reducing their greenhouse gas emissions, including carbon dioxide and methane. One mechanism for achieving emission reductions is the CDM approach, where countries can reduce emissions by purchasing emission credits from other countries that invest in projects and programmes that avoid GHG emissions and produce a net global reduction in emissions. CDM depends on the ability to assess accurately the emissions avoided so that a net reduction can be verified and evaluated. Studies carried out on dams to verify their suitability for CDM projects have

Figure 1: Greenhouse gas emissions of selected power generation technologies



shown that dam reservoirs produce small quantities of greenhouse gases. Figure 1 shows GHG emissions from selected power generation technologies. Hydropower from run-of-river shows the least GHG emission.

Hydroelectric power development in Africa

Energy supply is the main economic challenge facing the African continent. Electricity production is mainly from hydropower and fossil fuels. Access is very low in most countries, the lowest per capita consumption being 80 KWh as compared to a continental average of 359 KWh. This is very low when compared with the EU average of 3 750 KWh. New research indicates a direct correlation between energy usage and economic development. China, for example, has moved 300 million of its people out of poverty since 1990 due to increased access to energy.

Hydroelectric power potential in Africa

Africa has 14 percent of the world s population but only four percent of the global energy. The majority of Africans live in rural areas using traditional biomass for cooking. Africa has enormous potential for hydropower development due to adequate water resources both perennial and non-perennial which need to be harnessed for socio-economic development. It has about 10 percent of the world s hydropower potential but less than 10 percent is utilized. Hydropower potential of the continent is estimated at 100 000 MW, the bulk of which can be found in the Inga in the Congo basin. The Inga rapids which is one site that has an estimated hydropower potential of 40 000 MW.

Large hydropower/SHP development in Africa

Current status of large hydropower

Africa has one of the biggest hydropower potentials in the world but currently uses only a fraction. The total installed capacity is 21 000 MW, 90 percent of which is concentrated in eight countries (DR Congo, Egypt, Gabon, Ethiopia, Nigeria, Zambia, Madagascar and Mozambique). Figure 2 shows the hydropower potential for selected countries. The highest installed capacity is found in DR Congo. Figure 3 shows the contribution of hydropower to net electricity generation and Figure 4 shows the hydropower potential by region. All regions of the world are experiencing increases in the world installed capacity with China showing the greatest increase.

The potential for exploitable hydropower in Africa is high but only 7 percent is exploited. Table 1 shows the summary of Africa s hydropower development. It indicates that the installed hydropower capacity is about 20.3 GW with a total generation from hydroplants of about 76 000 GWh/year. Comparison with the gross theoretical hydropower potential of 4 000 000 indicates that the current production of hydropower in Africa is about 20 percent of the total potential. Table 2 shows the installed large hydropower by region. Countries with installed capacity of more than 1 000 MW have a total installed capacity of about 13 GW comprising 65 percent of the total hydropower installed capacity of Africa. The remaining 45 countries account for 35 percent of the total installed hydro capacity.

Figure 2: African hydropower potential

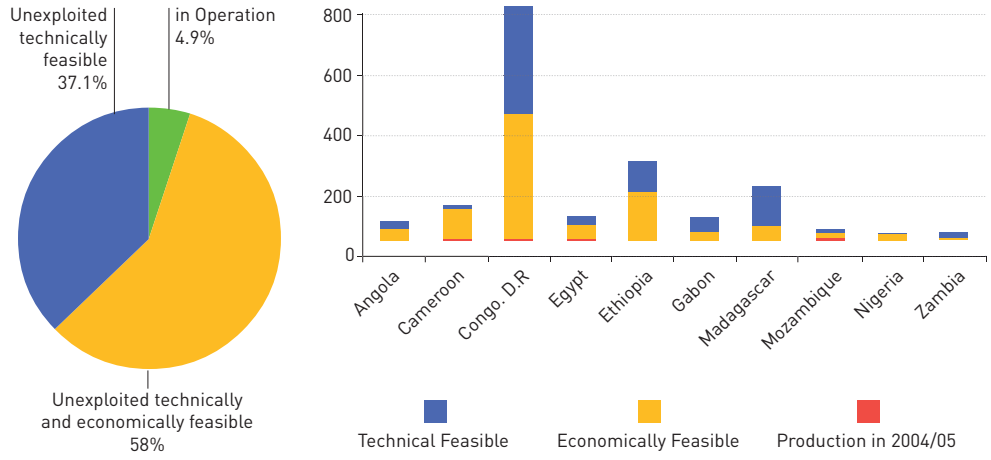
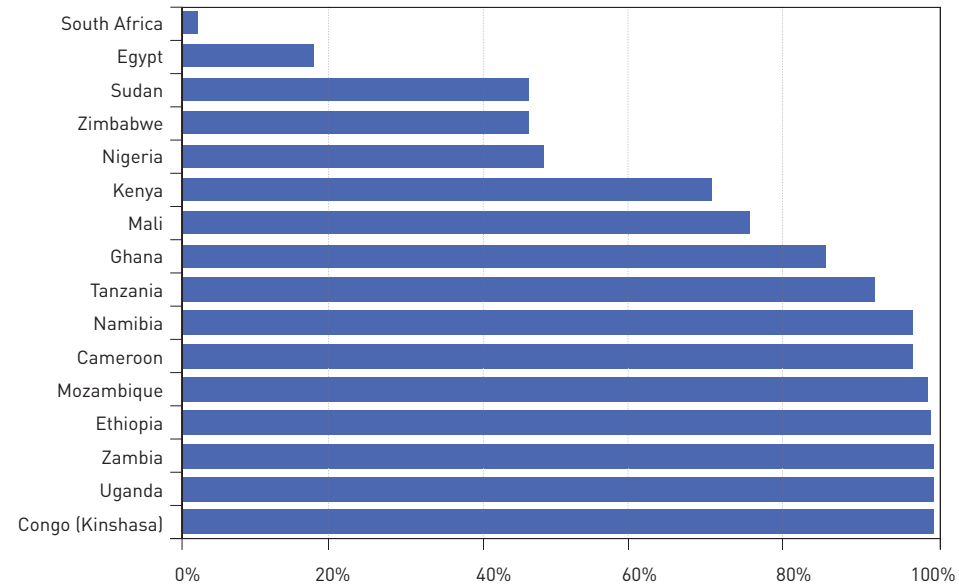


Figure 3: Contribution of hydropower to net electricity generation (2002)

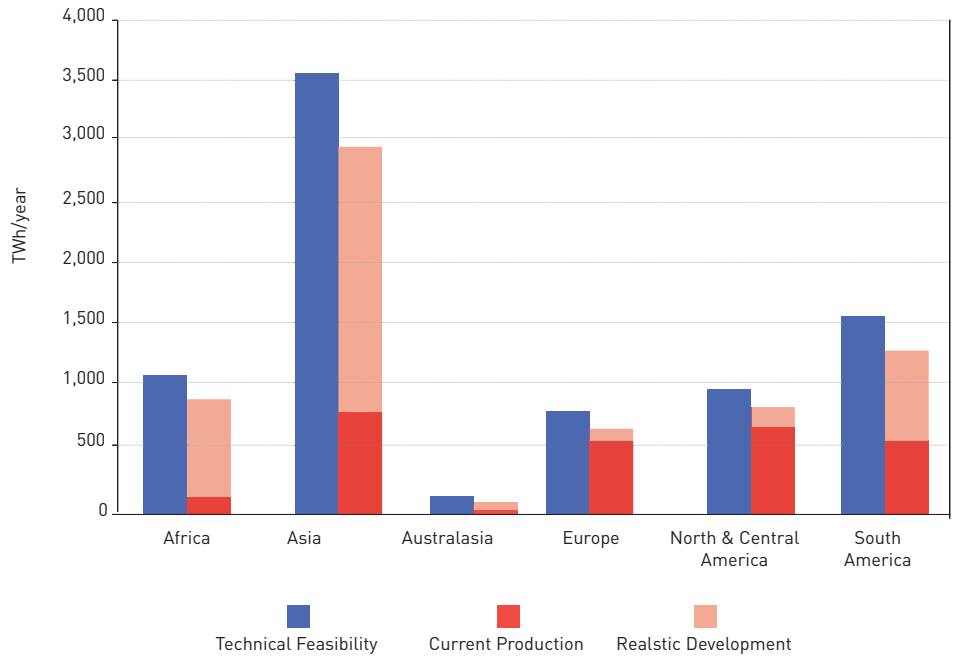


Source: International Energy Agency

Table 1: Summary of Africa s hydropower development

Theoretical hydropower potential (GWh/ year)	Technically Feasible hydropower potential (GWh/ year)	Economically feasible hydropower potential (GWh/ year)	Installed hydropower capacity (MW)	Generation from hydropower plants (GWh/ year)	Hydropower capacity under construction (MW)	Planned hydro capacity (MW)
4 000 000	1 750 000	1 000 000	20 300	76 000	2 403	60 000

Figure 4: Hydropower potential by region



Source: WEC, 2007, Survey of Energy Resources

Table 2: Installed large hydropower by region

Country	Subregion	Capacity
Egypt	North Africa	2 810
DR Congo	Central Africa	2 440
Mozambique	Southern Africa	2 180
Nigeria	West Africa	1 938
Zambia	Southern Africa	1 634
Morocco	North Africa	1 205
Ghana	West Africa	1 072
Total		**13 279**

Current status of SHP

Renewable energy constitutes about 17.9 percent of global energy out of which hydropower forms 16.1 percent. The remaining 1.8 percent comes from wind, geothermal, bioenergy and solar. This means that hydropower forms 90 percent of total renewable energy.

Small hydropower plays a dominant role in rural renewable energy markets. SHP plays a great role in remote off-grid communities with typical applications in areas such as rural residential community lighting, television, radio and telephony, rural small industry (agriculture and other uses) as well as grid-based power generation. SHP can serve two main purposes, namely, social

and commercial. The social SHP supplies electricity in stand alone mode characterized by small capacity and poor load factor; often used in distribution and normally government supported. Overheads and maintenance costs are recovered through collection of user charges. Commercial SHP, on the other hand, have larger capacities, sell power to power-distribution or trading companies, are grid connected and have higher load factor.

Table 3 shows the regional contribution to global SHP installed capacity. It indicates that Africa has one of the lowest SHP installed capacities despite the enormous potential for SHP development. Table 4 shows the installed capacities for some selected countries in Africa. Nigeria, for instance, has an installed SHP capacity of 33 MW and a potential of 3 500 MW. This indicates only 1 percent of the SHP potential.

Table 3: Regional contribution to global SHP installed capacity

Region	Installed capacity	Percentage of total
Asia	32 642	68
Africa	228	0.5
South America	1 280	2.7
North & Central America	2 929	6.1
Europe	10 723	22.3
Australasia-Oceania	198	0.4
Total	**47 997**	

Source: Taylor et al. 2006

Table 4: SHP capacities for selected countries

Country	Installed capacity	Country	Installed capacity
Algeria	42	Lesotho	3.54
Morocco	30	Mali	5.0
Tunisia	15	Ghana	10
Egypt	10	Nigeria	33.18
Uganda	0.5	Malawi	1.52
Mauritius	6.7	Botswana	1.0
Kenya	6.28	Rwanda	1.0
Burundi	5.17	South Africa	0.4
Somalia	4.60	Swaziland	0.3
Zambia	4.50	Mozambique	0.1
Tanzania	4.00		

Barriers

The key barriers to the development of SHP in Africa are summarized below:

1. Lack of infrastructure in the design and manufacture of turbines, installation and operation.
2. Lack of access to appropriate technologies pico, micro, mini and small hydropower. Networking, sharing of best practices and information dissemination through fora and conferences.
3. Lack of local capacity (local skills and know-how) in developing SHP projects. There is the need for technical assistance in the planning, development and implementation.
4. Lack of information about potential sites (hydrological data).
5. Lack of SHP awareness, incentives and motivation.
6. Lack of national governments investment and policies in energy technologies.

Table 5: Economic and technical hydropower that have been developed

Country	Installed Capacity
Asia & Eastern Europe	22
Western Europe	75
Africa	7
North America	69
Oceania	49
South America	33

Source: World Atlas of hydropower & dam, 2002

Regulation

There is no single definition of SHP in Africa. In Nigeria, for example, the following definition is used:

Small hydro: 1.001 10.0 MW
Mini hydro: 0.50 1.00 MW
Micro hydro: less or equal 0.5 MW

The regulatory framework in most countries is by Act of parliament. The mission of such Acts will *inter alia* seek to ensure adequate, safe, reliable and affordable power supply. A country s electricity regulatory commission may be tasked with the following responsibilities:

- promotion of competition and fair market practices;
- protecting the interest of consumers;
- ensuring cost recovery and adequate ROI; and
- ensuring best practice in power and service delivery.

The electricity regulatory commission may also perform the following functions:

- issuance of license to operators;
- setting of tariffs;
- arbitration of disputes;
- performing audits; and
- reporting regulatory activities to government.

The above definition indicates that SHP schemes with capacities of less than one MW may not require a license but may still come under regulations of the electricity regulatory commission.

With respect to SHP the regulatory commission s tasks will include licensing/registration, setting of tariffs, performance and customer service standards. The regulation of SHP schemes is found to be problematic due to complexities arising from factors such as the small size, high

unit cost and the dispersed nature of SHP projects. The large number of projects involved makes it difficult to adopt a case-by-case treatment. Additional factors such as remoteness of the site, civil works involved (waterways), transmission lines, generating equipment (turbines, generators, etc.) lead to cost variations adding to the complexities of regulation.

The small-scale nature of SHP makes it difficult for operators to carry regulatory burdens such as licensing fees, operating charges, operating standard codes, high technical standards for power supply, service delivery and performance requirements.

For the promotion of SHP in Africa, it is imperative for the above regulations to be reduced in favour of the small player. Such relaxed regulations may include permitting a new entrant to register or receive a permit, flexibility in quality regulation between categories of providers and the use of subsidies to bridge the gap between tariffs and cost recovery levels.

The primary goals of effective SHP regulation will incorporate increased SHP penetration into the electricity market, SHP sustainability, system cost reduction, development of local industry, sound investment climate and simplicity of implementation.

Regional energy integration: the regional power pools

A recent study conducted by the World Energy Council (WEC) members in Africa discovered that the conventional approach of limiting energy planning and provision to the individual nation states is detrimental to energy access issues on the continent. The nation-based planning is not the best in several respects including the:

- cheapest and cleanest source of energy may be found across national boundaries;
- national energy markets are often too small to justify investments;
- cross border energy could contribute towards energy security due to diversification of energy sources.

The study further revealed four major benefits that regional integration could bring. These are: improved security of supply, enhanced environmental quality, wider deployment of RE resources and better economic efficiency.

Proposed regional integration projects include Zambia-DR Congo, South Africa interconnections, Zambia-Tanzania interconnections and West Africa Grid Network and Power Pool.

Access to modern energy services is vital for the socio-economic development of Africa. The problem of low access could be eradicated through projects such as the INGA. The large hydro potential of Africa could be developed as a regional rather than a national project. This would help expand energy markets in the area and secure supply to those who have no access to electricity. In DR Congo INGA could provide sufficient electricity to the African continent and help Africa export energy through possible interconnection links with southern Europe. Three major INGA interconnection projects identified include:

- Northern Highway (between INGA site and Egypt).
- Southern Highway (between INGA site and South Africa).
- Western Highway (between INGA site and Nigeria).

The main objectives of a project such as the INGA are to bring affordable and clean energy to the African continent and to improve the standard of living. The project will lead to cross border cooperation in Africa and beyond. This will bring interdependence and prosperity to Africa.

The Manantali dam on the Senegal River with a capacity of 200 MW is an example of a regional Integration project serving Senegal, Mali and Mauritania. The objectives of the project are to install power generation capacity to generate economic and financial benefits, to minimize the cost of electricity supply to the three countries, and to provide hydropower to help meet the increased electricity demand and reduce costs in Dakar, Bamako and Nouakchott.

Security of supply and accessibility

Security of supply involves ensuring uninterrupted daily operation of power supply systems, at the same time coping with short-term problems such as international price volatility and environmental concerns and industrial action. Security of supply underpins the development of interconnection between countries and regions. In the long term, security of supply involves the depletion of global and national energy resources and the capacity to diversify energy supply options.

Hydropower/small hydropower database for Africa

Overview

There is enormous potential exploitable hydropower on the African continent. In spite of this, Africa has one of the lowest electricity utilization rates in the world. Presently, less than 7 percent of this potential has been harnessed. Africa has many rivers running through the Eastern, Western, Central and Southern parts of the continent that provide excellent opportunities for hydropower development. Many countries in Africa do not, however, have coherent data on both large and small hydropower potentials. The UNIDO Regional Centre on SHP (U-RC-SHP) in Abuja is currently collating such information.

Regional contributions

North Africa

Countries like Algeria, Egypt, Libya, Morocco and Tunisia are grouped under this region. Out of the current 20.3 GW about 23 percent is located in North Africa. In terms of large hydropower development, Algeria, Libya and Tunisia are poorly developed. These countries depend more on

sources of electricity other than hydropower. Egypt and Morocco have installed capacities of 2 810 and 1 205 MW respectively, making the greatest contribution to the total installed capacity in the region. The potential of North Africa is almost exhausted. The majority of the installed capacity can be traced along the Nile with the Aswan Plant taking about 2 100 MW of Egypt s total capacity.

Southern Africa

The countries that constitute the Southern region are: Botswana, Lesotho, Madagascar, Namibia, South Africa, Swaziland, Zambia and Zimbabwe.

The region exploits about 60 percent of its potential. South Africa has very little potential left to be exploited. Botswana has very little potential and relies on other sources of electricity. Zambia has the greatest potential in the region and has developed 30 percent of it. Much of the potential in Zambia is along the rivers Zambezi and Kariba, shared by Zambia and Zimbabwe. Plans are in place for the exploitation of the potential in the region.

East Africa

East Africa has the second largest potential in Africa with about 20 percent of its capacity developed. It comprises the following countries: Burundi, Kenya, Djibouti, Eritrea, Ethiopia, Kenya, Malawi, Rwanda, Somalia, Sudan, Tanzania and Uganda.

Somalia, Eritrea and Djibouti are poorly developed. Ethiopia has the greatest potential in the region with a capacity of 15 000 MW followed by Kenya with 9 000 MW. Kenya has, however, developed more of its potential (13 percent) than Ethiopia (1 percent).

West Africa

West Africa s contribution to installed large hydropower capacity is about 25 percent. Nigeria and Ghana are the biggest contributors. The potential for large hydropower is enormous in countries such as Guinea (6 100 MW) and Nigeria (11 500 MW). Sierra Leone, Togo, Gambia and Cape Verde are poorly resourced with hydropower potential. The contribution from SHP is very small in West Africa despite the high potential for SHP.

Central Africa

Central Africa has enormous hydropower potential concentrated around the Congo basin. DR Congo contributes the most. The current installed capacity of large hydropower is around 3 816 MW and a potential of 419 000 MW with the highest contribution coming from the INGA sites. This indicates that DR Congo has exploited just 1 percent of its potential capacity.

Africa s hydropower project partners

A number of financial institutions have provided and continue to provide billions of dollars in assistance for large hydropower projects in Africa. This section seeks to highlight a few of these donors and the projects they have funded.

Large hydropower projects

Multilateral banks/World Bank and African Development Bank (AfDB)

Multilateral organizations such as AfDB and the World Bank have financed a number of large hydropower projects in Africa. AfDB, for example, has provided financial support to the following projects:

- US$14 million for part of the INGA II project;
- US$18.7 million grant to finance a hydropower project in Conakry, Guinea; and
- US$16 million for the Bumbuna dam project, 50 MW, in Sierra Leone, West Africa.

World Bank projects:

- US$300 million for the Bujagali Hydropower project on River Nile, Uganda, 250 MW capacity ongoing and to be commissioned in 2011; and
- Uganda, 200 MW Karuma Falls hydropower project.

China

The power sector in Africa attracts the largest amount of financing from China. Much effort is concentrated in hydropower schemes. By the end of 2007 China was involved in ten major hydro-electric power dams in nine African countries with a combined generating capacity of 6 000 MW of electricity. The location, capacities and current status of these projects are:

Country	Capacity (MW)	Status
Mambilla dam, Nigeria	2 600	Under Federal government discussion
Merowe dam, Sudan	1 250	Advanced stage of construction
Katue, Zambia	Over 1 000	Under construction

The projects total cost is around US$5 billion out of which China is financing US$3.3 billion. China uses African natural resources to secure some of the financing; for example, ongoing projects on the Congo River in Congo and Bui dam in Ghana are financed by China Ex-Im Bank loans backed by guarantees of crude oil in Congo and Ghana respectively.

Others

- East African Development Bank (EADS) partly financed the installation of 150 km high voltage transmission line from the Kiambre power station to Nairobi, Kenya; and
- West African Development Bank (WADB).

Small hydropower projects

World Energy Council (WEC)

The World Energy Council is a multi-international organization covering all types of energy resources with members in 94 countries. WEC s mission is to promote sustainable supply and use of energy for the benefit of people.

Accessibility is one of WEC s millennium energy goals in Africa where the access rate is the lowest in the world. The INGA project offers a unique opportunity to provide affordable and clean electricity access to millions of Africans. In this regard, WEC, to facilitate action on the Grand INGA, organized an International Forum in 2007 on How to make the Grand INGA River hydropower project happen for Africa in Botswana. This was followed up in 2008 by a Workshop organized on Financing INGA Hydropower Projects in London.

WEC s Policy framework for Africa s Hydropower development can be summarized as: improving existing hydropower capacity, advancing the development of regional projects identified, implementing identified projects (INGA, Mepanda Uncua, etc.), identifying and implementing other regional projects and building capacity for small and medium hydropower projects.

Under the WEC/NEPAD policy framework, these policy initiatives were established:

Establish a committee on hydro power development with specific tasks:

- map out the existing facilities and identify opportunities for improving their performance; and
- identify centers of excellence within each subregion to serve as training centers to share experience.

Work with Regional Economic Commissions (REC) and appropriate institutions at the national level to:

- support the development of identified regional projects such as Grand INGA;
- finance facilitation of country projects;
- develop policy at sub-regional levels;
- support African Energy Commission (AFREC) to institutionalize actions mentioned above;
- set up a fund to facilitate the development of small to medium hydro projects to which corporate entities could apply;
- produce annual hydropower publications in Africa to provide information on new projects and status of on-going works; and
- support and collaborate with hydro power research centers and networks.

Africa s hydropower project partners

UNIDO - UNIDO has identified SHP as a tool for rural industrialization and poverty reduction in Africa.

UNIDO-IC-SHP/Lighting up Rural Africa - UNIDO and the International Centre for SHP in 2007 organized the Third Hydropower Potential in China with the theme Lighting up Rural Africa . Under South-South cooperation, UNIDO in collaboration with IC-SHP plan to scale-up SHP production in Africa through the development and production of 100 SHP projects in the next three years.

UNIDO-RC-SHP/Pilot Projects in Africa - UNIDO Regional Centre for SHP (RC-SHP) was established in 2005 in Abuja, Nigeria with the mandate to provide technical assistance to countries within the region. U-RC-SHP hosted the Fourth International Hydropower for Today Forum in Abuja, Nigeria on Small/Mini/Micro hydropower development and management in Africa. UNIDO is currently running a number of pilot projects on SHP in countries such as Tanzania (75 KW), Nigeria (34 KW), Madagascar, Uganda (250 KW) etc. UNIDO-RC-SHP has also carried out SHP refurbishment projects in the following parts of Nigeria: Talata Mafara, Zamfra State (3.4 MW) and Oyam Dam, Ogun State (9 MW). Table 6 is a list of UNIDO projects in selected African countries.

RC-SHP is currently involved in activities such as the collection of data and creation of an SHP database for Africa, organizing workshops and conferences for capacity building and SHP potential site identification.

Table 6: UNIDO Project in Africa

Nigeria	Enugu - Waya	40 kW - 150 kW
Rwanda	Nyamyotsi 1	75 kW
Kenya	4 sites	2 kW
Tanzania	Kinko	12 kW
Mali	Sirakorbougou	3-5 kW

UNIDO-AFREC - Africa Energy Commission (AFREC) has a plan of action that complements U-RC-SHP in Abuja s activities and includes:

- developing information system database for SHP;
- developing a continental master plan for SHP;
- identifying and removing barriers;
- technology transfer;
- capacity building - designing short courses and training sessions; and
- financing, organizing symposiums on strategies for attracting finance for SHP projects.

Impacts

Inter-linkages between agriculture and hydropower

Availability of water is of considerable importance for agriculture. The majority of dams are constructed primarily for irrigation or agricultural purposes, thus contributing to the world food production. Most African staple foods need processing, are conserved and cooked, and these require modern energy for a reasonable quality of life. Paradoxically, most countries in sub-Saharan Africa that suffer from hunger also suffer from major on-farm and off-farm food losses that could be reduced by improving harvesting and storage facilities, by introducing modern energy, in this way large food imports could be reduced.

On the other hand, the construction of dams affects land use, either directly or indirectly. For example, hydropower projects with reservoirs transform forests and land into aquatic ecosys-

tems, thereby effectively reducing available farmlands. Dams constructed for power generation can also compete in part with the use of water for irrigation since using the energetic potential of hydropower by running turbines means that the water is only available at a lower altitude afterwards. For this reason there has been consensus in most countries that an integrated approach to the management of water resources serves best the exploitation of hydropower resources.

Dam construction assessment

World Commission on Dams Report

The World Commission on Dams (WCD) was established to address the controversial issues associated with large dams. In 2000, the WCD produced a report that made recommendations ensuring the social and environmental aspects of large dams are addressed adequately in the planning, construction and operation phases. The report summarized the lessons learned from a Global Review of experience with large dams and elaborated the development framework within which controversies and underlying issues can be understood and addressed, and proposes a decision-making process based on negotiated outcomes. It offers a set of strategic priorities, principles, criteria and guidelines to address the issues around existing dams to be used in exploring new water and energy development options. The Commission s framework for decision-making is based on five core values: equity, sustainability, efficiency, participatory decision-making and accountability.

International Union for the Conservation of Nature (IUCN)

Many organizations and governments have reacted to the World Commission on Dams Report following its release. For most, the report does not offer a final verdict on dams; instead it provides a new framework for improved decision-making for water and energy development (UNEP, 2001). Several other organizations, however, are in favour of the recommendations and are committed to their dissemination. One such body is the International Union for the Conservation of Nature (IUCN). Founded in 1948, its headquarters is located in Gland, Switzerland; the IUCN brings together 83 states, 108 government agencies, 766 non-governmental organizations and 81 international organizations and 10 000 experts and scientists from around the world. IUCN has many years of experience in ecosystem rehabilitation and participatory management and, more specifically, in field level activities.

Following up from the WCD Report, the IUCN developed a programme that provides a good basis for acting proactively in support of the WCD recommendations. It provides a clear mandate to make full use of the WCD Report through the effective management and restoration of ecosystems, and the assessment of biodiversity and of other related social and economic factors. Furthermore, IUCN aims to demonstrate how the ecosystem approach to water management should be implemented through a new portfolio of 30 projects around the world. At these sites, IUCN will play an important role in fostering implementation, adaptation and testing of the WCD recommendations by working with the main dam stakeholders (UNEP, 2001).

Public and private investors

As seen from the discussion in the previous sections, dams are generally built to generate hydroelectricity, provide irrigation water, or as part of flood control programmes. Depending on the interest group, dam building has brought major benefits; resulted in considerable human

suffering; or had a harmful effect on the environment. These factors have had considerable impact on the prospect of building large dams.

Globally, only a handful of private sector hydroelectric projects have managed to attract the investment required, most rely on state involvement in one form or another. One reason is that hydropower is perceived as carrying a number of financial risks that make dams a less attractive investment than other power projects (Hildyard, 1998).

Economic impacts

Hydropower schemes generally involve a huge civil engineering effort and are characterized by high capital costs. The payback on the investment required can be a lengthy process and sometimes has a detrimental effect on a nation s economy. In Africa, where financial resources are scarce, the high up-front costs of hydropower investment are a barrier to the development of this resource (European Union, 2007).

Despite the high upfront costs, hydropower is a well-established and proven technology with low operating and maintenance costs. The economy of countries that depend heavily on fuel imports could benefit from hydropower as it does not depend on energy imports and is unaffected by fluctuating international energy prices.

Conclusions and recommendations

The major conclusions and recommendations are summarized as below:

- Africa is currently using 20 percent of its hydropower potential with non-uniform regional distribution. Some regions are more endowed than others. A few countries with installed capacities of more than 1 000 MW constitute about 65 percent of the total energy installed. The energy imbalance needs to be addressed through regional integration.
- Financing of energy projects is low because of the low level of hydropower technology and the huge cost of power projects in Africa.
- Private-public partnership option to raise capital and share investment risk.
- Reform power sector to attract private sector participation and financial flow.
- Africa is characterized by a low level of technology for hydropower. Hydropower technology is widely available elsewhere worldwide and technology transfer is the immediate option to enhance development.

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7

The Lake Chad Basin: a system under threat

Water for agriculture and energy in Africa: The challenges of climate change

Report of the ministerial conference - 15-17 December 2008 - Sirte, Libyan Arab Jamahiriya

Geographical context

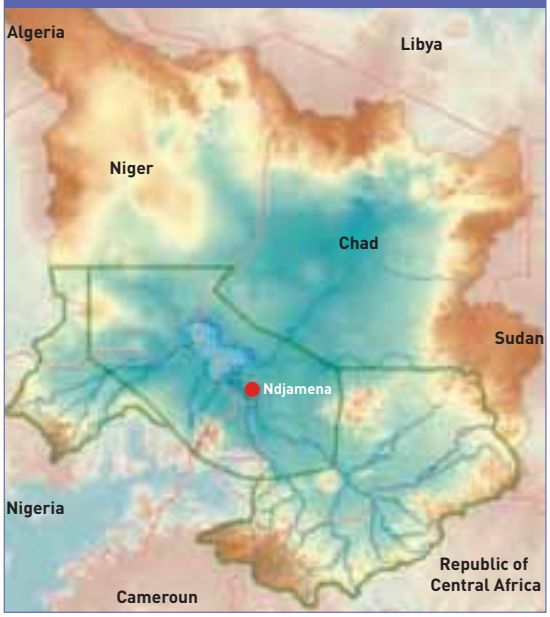
The Lake Chad Basin is a transboundary basin stretching over 2 397 423 km^2. It is distributed, as indicated in Table 1, between Chad, Niger, the Central African Republic (CAR), Nigeria, Algeria, Sudan, Cameroon and Libya.

Table 1: Regional distribution

Country	Basin surface area (km^2)	Portion of basin (%)	Country surface area (km^2)	Portion of basin in the country (km^2)
Chad	1 109 201	46.3	1 284 000	86.4
Niger	671 868	28.0	1 267 000	53.0
Central African Republic	217 340	9.1	622 980	34.9
Nigeria	180 364	7.5	923 770	19.5
Algeria	89 694	3.7	2 381 740	3.8
Sudan	81 360	3.4	2 505 810	3.2
Cameroon	46 049	1.9	475 440	9.7
Libya	1 548	0.1	1 759 540	0.1
Total	2 397 423	100	11 220 280	

The region is bounded to the north by the Ahaggar Mountains in Algeria. From this summit, the border descends southwards towards the Tibesti Highlands that form the border between Libya and Chad, and continues to about 19 N near the Djebel Mara volcanic mountains in Sudan. The southern border is defined by the Mongos Hills in the Cenral African Republic and the Adamawa Mountains at about 6 N and further west by the Mandara hills in northern Cameroon at approximately 10 N. The Jos Plateau marks the western boundary in the Nigerian sector of the Basin and further north the A r Plateau in Niger.

Figure 1: Relief Map of the Topographic Lake Chad Basin (Conventional basin is in green outline)



The Lake Chad Basin is an endorheic (closed) basin. That is, it does not flow into the ocean, but the hydrographic system flows out towards a low point. Lake Chad is located at about 280 m above sea level. (Figure 1)

Lake Chad is the epicenter of human, animal and plant life for the region, it is the fourth largest lake in Africa after lakes Victoria, Tanganyika and Nyassa. In 1964, when the Lake Chad Basin Commission (LCBC) was established, Lake Chad covered 25 000 km^2. However, the Lake has been shrinking since the droughts of the 1970s, and now covers less than 1 000 km^2 when the water is annually at its lowest level.

Lake Chad Basin s ecological regions

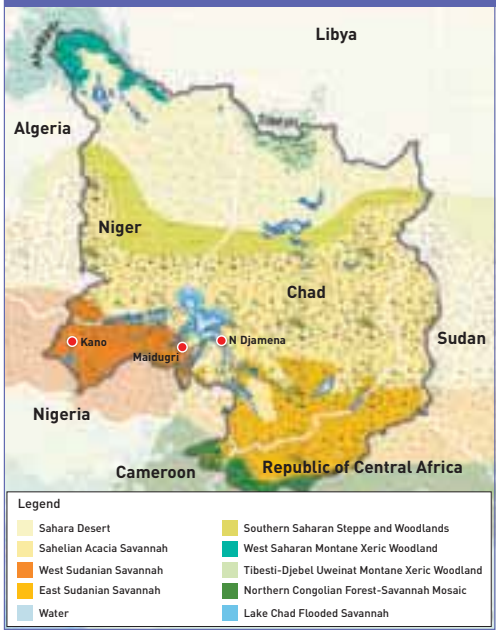
Figure 2: Giraffes in the Waza National Park

The Lake Chad Basin contains a variety of habitats, including deserts, shrub steppes, savannahs, forests, lakes, wetlands and mountains. These terrestrial and aquatic habitats form a unique sanctuary for the diverse fauna of the region: ostriches, cheetahs, hyenas, crocodiles, hippopotamus and elephants. These habitats are also well stocked with water birds, migratory birds and waders that thrive in the river valleys. They depend primarily on the waters of the numerous small lakes that are formed during periods of receding floods. The humid zones of the basin and the lake itself constitute a unique ecosystem in this area of the Sahel, and is a preserve of biodiversity of global importance. For example, 140 species of fish and 372 species of birds, of which one-third are migratory species have been listed. The integrity of the ecosystem is an essential shield against desertification.

The Lake Chad Basin is made up of the following subhydrographic basins:

Lake Chad is composed of the north and the south pools, which are separated by a distinct morphological feature called the Great Barrier visible at an altitude of about 279 m.

Figure 3 Ecological Zones of the Lake Chad Basin (after WWF)



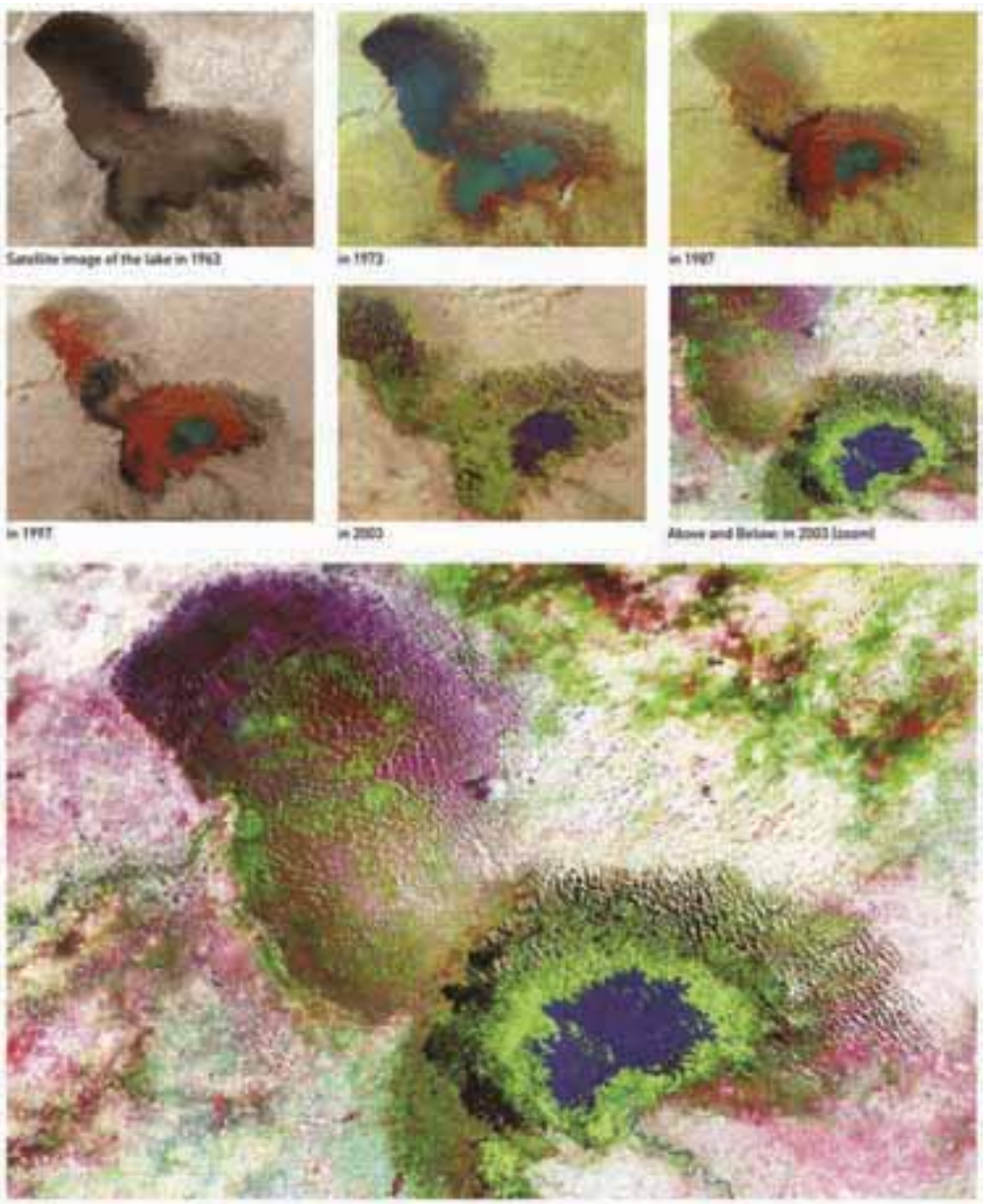
The lake occupies less than 1 percent of the drainage basin and is extremely shallow, with a mean depth of 4 m. The dry season and wet season variation in water level is about 0.5 m while it can vary by up to 5 m from year-to-year. The annual average temperature of Lake Chad water varies between 25.5 and 27.5 C (1956-1975) and is closely related to the annual, seasonal and diurnal variation in air temperature. Rainfall on the lake contributes 17 percent of annual inflow. The surface of the lake is covered with a mixture of island archipelagoes, reed beds and open water. Areas of open water persist in the southern pool, mostly near the Chari River inflow. Swamps are found to the west of this open water. Vegetation in the southern pool consists of *Cyperus papyrus, Phragmites mauritianus, Vossia cuspidata,* and other wetland plants. *Phragmites australis* and *Typha australis* grow in the more saline north pool. Occasionally, the floating plant Nile lettuce (*Pistia stratiotes*) covers large areas of open water. Over 1 000 species of algae have been described, Spirulina, a blue-green algae reputed to have nutritional and medicinal value is found natively in the pools around Lake Chad.

A cattle breed called Kuri, unique to the Lake Chad Basin is found on the shores and islands. This is one reason that Lake Chad is a critical and strategic zone for world biodiversity.

The Chari-Logone system is the biggest supplier of water flowing into the lake. It comprises of two major courses: the River Chari and the Logone River. The Chari-Logone River basin area is approximately 650 000 km^2 and the Chari River extends 1 400 km. The Chari and Logone rivers have a tropical regime with a single flood occurring at the end of the rainy season, which lasts from August to November and feeds the extensive Waza-Logone floodplains and Yar s . The rivers contribute 80 percent of all riverine inputs into the lake, an average of 37.8 km^3/year. The floodwaters take between one and two months to reach the southwest shore of Lake Chad. The flow is at its minimum in May/June at the beginning of the following year s rainy season. However, in the last 40 years the mean Chari discharge has decreased significantly because of the persistent change in rainfall patterns over the contributing catchment.

The Logone flood plains occupy about 25 000 km^2, the largest area of the Waza-Logone floodplain and the most important being the Grand Yar s with a surface area of 8 000 km^2. The Logone floodplains are used for pasture, fishing, flooded rice production and flood recession cropping.

Figure 4: Evolution of the Lake through four decades



The Komadougou-Yobe basin is a water drainage system of 148 000 km^2, which is a typical example of a water course that loses a large part of its annual flow as a result of infiltration and evapotranspiration. The Komadougou-Yobe River is the border between Nigeria and Niger, over the last 160 km, and is the only perennial river system flowing into the northern pool of Lake Chad. The Komadougou-Yobe is formed by various tributaries, in particular the Jama are River which flows from the Jos Plateau (Nigeria), and the Hadejia River, which flows from the area around Kano (Nigeria). The two rivers join to the southwest of Gashua (northeastern Nigeria). Upstream of the confluence of the Hadejia and Jama are rivers the Hadejia-Nguru wetlands (fadamas) in Nigeria start. Peak inflow to the wetlands occurs in late August, resulting in extensive shallow

flooding. These wetlands cover 6 000 km^2, with a water surface area of 2 000 km^2. Much of the Hadejia-Nguru floodplain is dry for part or all of the year. It provides a wide range of resources including fertile agricultural soils, grazing, non-timber forest products, fuelwood and fisheries. In addition, the wetlands are a unique migratory habitat for many wildfowl and wader species.

Lake Fitri is Lake Chad in miniature and is located in Chad, it has a surface area of 300 km^2. During the dry season it is part of a large biosphere reserve covering 1 950 km^2. It is normally a freshwater Sahelian lake, fed by seasonal rainfall and runoff from the seasonal Batha River. Unlike Lake Chad, it is one of the few Sahelian water bodies that have not experienced large-scale hydrological change, although it dried during the severe drought of 1984-1985. It provides pasture in an area where drought abounds. There is intensified competition for the resources of this sub-basin amongst the indigenous populations, resulting in increased risk of conflict over resource use.

Mayo Kebbi is a unique watershed divide filled with a string of lakes that flow either to the Logone or Niger Rivers. The Mayo Kebbi is a unique landscape feature not only within the larger Lake Chad basin but is unique and remarkable in the global context. The Binder Lere wildlife reserve is found within the Mayo Kebbi and Lake Lere, the only known habitat of the Manatee in the basin, is also found here.

The Yedseram and Ngadda rivers and their tributaries rise in the Mandara Hills (northern Cameroon) and they lose most of their waters while flowing northwards through a 7 km wide flood plain. Further downstream of the Ngadda River (Nigeria) a 80 km^2 swamp is formed where the river no longer maintains a definable water course to the lake. The Sambisa Game Reserve (important for elephant conservation), the Chingurimi Duguma and the Lake Chad Game Sanctuary Sectors of the Chad Basin National Park are situated in this sub-basin. It is also home to the largest, failed irrigation scheme, which became moribund as lake levels fell.

The Northern Diagnostic Basin is noted for its Oasis, this is the largest diagnostic basin (807 360 km^2). It supplies no inflow to the lake, as it is also the most arid sub basin. Major resources use concerns include the devastation of dunes by trampling livestock and the over harvesting of increasingly scarce trees.

Demographic context

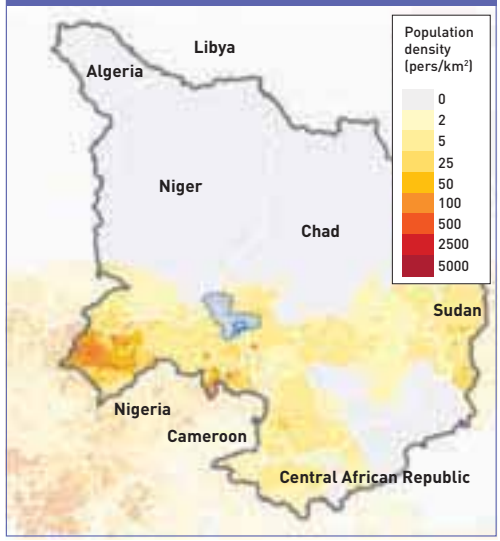
Presently more than 30 million inhabitants, who are nationals of Cameroon, Central African Republic, Chad, Niger and Nigeria, including migrants from various African countries, live in the Lake Chad Basin where their livelihoods are fishing, agriculture and animal husbandry.

In 1991, the population of the conventional basin was 24 104 000 inhabitants, including the Central African Republic portion. However, in 2001, with an annual growth rate of 2.72 percent, this population was estimated at 30 691 260 inhabitants distributed as in Table 2:

Table 2: Population of the Lake Chad Basin					
Member State	Population.1991 (1000 inhabitants)	Density in 1991 (inhabitants/km^2)	Growth rate (%)	Pop. In 2001 (1000 inhabitants/ha.)	Density in 1991 (inhabitants/ha/km^2)
Cameroon	2 100	37	2.72	2 671.2	47
Nigeria	13 856	67.4	2.72	17 648.8	85.77
Niger	2 400	67.6	2.72	3 052.8	53.1
Chad	5 048	14	2.72	6 428.06	17.76
Central African Republic	700	3.5	2.72	890.4	4.5
Total	**24 104**			**30 691.26**	

Population density is greatest in Nigeria and surrounding Lake Chad and decreases in the more arid north provinces. For example, in the Tibesti Highlands people are primarily nomadic pastoralists, and population density is as low as 0-1 people/km^2. Figure 5 shows the population density distribution in the region.

Figure 5: Population density in the Lake Chad basin



Economy

In the Lake Chad Basin production activities are dominated by the primary sector and tertiary sectors, with a predominance of informal, low productivity activities. The primary sector employs more than 80 percent of the population and comprises primarily agriculture and livestock rearing.

Economic activities in the Lake Chad Basin include:

- mining: for example, gold mining in Central African Republic;
- oil: exploration and exploitation;
- agriculture: cotton, groundnuts, cassava, millet, sorghum, rice, onions. Mixed cropping is widely practiced;
- fisheries: in dams, rivers, floodplains and the Lake Chad; and
- manufacturing: cotton ginning, brewing, leather industry, machinery, milling and food industry.

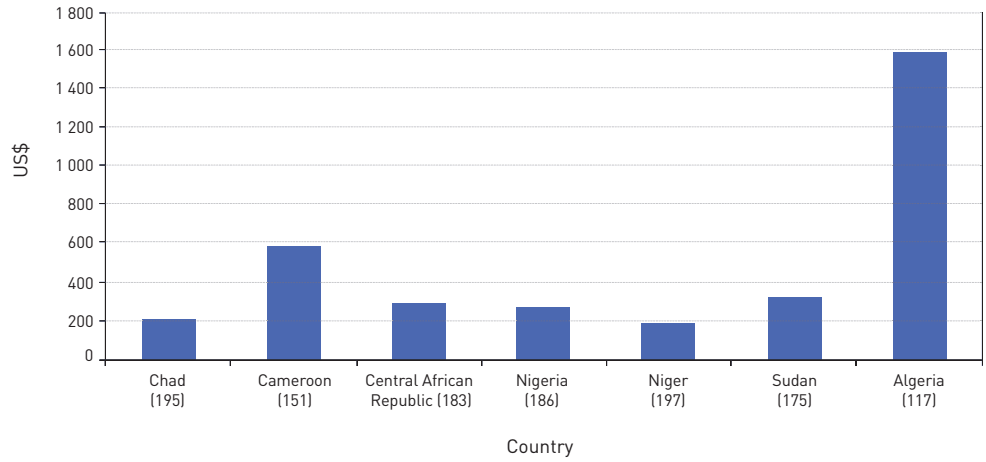
Table 3 shows the region s typical sources of income.

The countries within the region are among the poorest in the world. Economic growth is very slow and variable. Figure 6 shows the disparities in GNI between the riparian countries.

Table 3: Sources of household income in the Lake Chad Basin

Activity	Million US$ (billion CFA*)
Fishing	45.1 (26.3)
Rain-fed and flood recessional cropping	26.6 (15.5)
Animal husbandry	14.7 (8.6)
Small irrigated areas	10.8 (6.3)
Large irrigated areas	9.4 (5.5)

Figure 6: Distribution of Gross National Income among the Lake Chad Basin Countries



The economies of the Basin s countries generally suffer from very low productivity, insufficient infrastructure, poor governance, a lack of a dynamic private sector, an oversized informal sector and a vulnerability to domestic and external shocks (see Figure 6).

The Lake Chad Basin Commission (LCBC)

The Lake Chad Basin Commission was established by the Fort Lamy Convention on 22 May 1964, by the four riparian countries (Cameroon, Niger, Nigeria and Chad) that share the lake. This conventional basin did not include the Central African Republic and, in particular, excluded the upstream part of the active basins of the Chari-Logone and Komadougou-Yobe. In March 1994, the Central African Republic was admitted as the fifth member state during the Eighth Summit of Heads of State (held in Abuja, Nigeria) leading to the New Conventional Basin thus increasing the conventional area to approximately 987 000 km^2. This has enlarged the conventional basin to include the upper basins of the Chari-Logone and Komadougou-Yobe systems. Sudan was admitted into LCBC in June 2000, but is yet to ratify the Convention establishing the Commission. The admission of Sudan has now increased the conventional area from 427 000 km^2 in 1964 to

1 035 000 km^2 in 2000. This new definition of the conventional Lake Chad Basin thus takes into account almost all the water resources that supply the lake, the floodplains and the aquifers in the lake area. The Great Libyan Arab Jamahiriya joined the LCBC family as the sixth member state in 2008.

The of LCBC mandate can be summarized as sustainable and equitable management, conservation of the natural resources of the Basin and promotion of economic integration, cooperation, peace and security. Its mission stated in Article IX of the Statutes of the Commission is to:

a) Prepare general regulations which shall permit the full application of the principles set forth in the present convention and its annexed Statute, and to ensure their effective application.
b) Collect, evaluate and disseminate information on projects prepared by Member States and to recommend plans for common projects and joint research programmes in the Lake Chad Basin.
c) Keep close contact between the High Contracting Parties with a view to ensuring the most efficient utilization of the waters of the Basin.
d) Follow the progress of the execution of surveys and works in the Lake Chad Basin as envisaged in the present Convention, and to keep the Member States informed at least once a year thereon, through systematic and periodic reports which each State shall submit to it.
e) Draw up common rules regarding navigation and transport.
f) Draw up staff regulations and to ensure their application.
g) Examine complaints and to promote the settlement of disputes and the resolution of differences.
h) Supervize the implementation of the provisions of the present Statute and the Convention to which it is annexed.

Finance

The main source of funding for LCBC is the contribution from its member states that contribute the annual budget of LCBC in accordance with the following formula.

The annual budget of LCBC approved every year by Council of Ministers (COM) at its session is a two-line budget. One line is recurrent expenditure while the second line is for development projects. LCBC pays counterpart funding from its development budget for assistance received from donors and development partners for implementation of specific projects (Table 4).

Table 4: Funding of the Lake Chad Basin Commission

Country	Contribution %
Cameroon	26
Niger	7
Nigeria	52
Chad	11
CAR	4

This percentage of the LCBC budget paid by its Member States will soon change due to admission of Libya as its sixth member.

LCBC administration

- The Summit of Heads of State and Government is the supreme organ for the Organization s decision making. It meets once every two years in an ordinary session.
- The Council of Ministers, members of this council, are called Commissioners. Each Member State is represented by two Commissioners. It meets every year in an ordinary session to regulate the operation of the Commission.
- The Executive Secretariat, headed by the Executive Secretary, is the organ for the implementation of statutory provisions, management and execution of the resolution and decisions of the higher authorities on LCBC projects and programmes. Its headquarters is in N Djamena, Republic of Chad. In order to achieve global environmental benefits and re nder it more adaptive and efficient, in view of current challenges and stakes, the Commission has adopted a new structure for the Executive Secretariat following an institutional reform conducted with the assistance of the World Bank and UNDP, within the framework of the LCBC/GEF project. This new structure has been operational from 2009.

Chronology of important events in the life of the Lake Chad Basin Commission

December 1977: The LCBC signed a protocol to allow the harmonization of regulations related to flora and fauna in the four original Member States. It adopted plans seeking multiple donors to support major developments in the Conventional Basin. In 1994, the Member States approved a Master Plan that refocused LCBC support to the development and ecologically sound management of the natural resources of the Lake Chad Conventional Basin.

June 1992: The LCBC, with assistance from the UNEP and United Nations Department of Economic and Social Affairs, produced a Master Plan that established a strategy for the development and environmentally sound management of the basin s natural resources in order to ensure sustainable development of the LCBC region. The principal objectives of the LCBC Master Plan included plans to:

1. increase the availability of water resources and promote their rational utilization, including environmental and socio-economic assessment of water projects,
2. prevent soil erosion and improve soil fertility; maintain and improve vegetative cover and nutritive value of pasture land through sound management of livestock,
3. restore denuded landscapes, balance regeneration of wood biomass with offtake, and
4. establish sustained yield management for hardwoods, and work towards food security preparedness scheme, combining irrigated agriculture, food processing, preservation and storage.

1994: The Campaign to Save Lake Chad Basin aimed to enhance public awareness of the ecological problems faced by Lake Chad to promote indigenous skills/knowledge, to devise and incorporate new policy on the adoption of appropriate technologies, including alternative energy sources other than firewood, and to enhance stakeholder participation in environmental management practices. However, since the project expired, LCBC has not consciously or systematically embarked on increasing its visibility in the region.

1998: The LCBC approached the Global Environment Facility for support to address the environmental degradation problems faced by Lake Chad. The UNDP and World Bank have both assisted.

Key project components include a Transboundary Diagnostic Analysis (TDA) and preparation of a Strategic Action Programme (SAP). The full implementation of the SAP is expected to be conducted during a subsequent Second Phase of the project. The TDA leading to the formulation of SAP commenced in April of 2005. Priority country specific issues have been identified and harmonized and a 25-year SAP developed.

2000: The LCBC developed Vision 2025, a framework for action that suggests that the mobilization of political will, and ensuring good governance, is fundamental to the realization of the objectives of the LCBC and, by extension, the Member States. It complements activities supported by the GEF such as development of a TDA and longer term 20-year SAP framework for Integrated Resources Management, to be implemented across the region.

2000: The LCBC Technical Committee (TC) was established. The TC was created to contribute to harmonization of water resources management in the basin. The committee includes specialists from each of the Member States. The primary responsibilities of the Technical Committee include:

- reinforcement of the dialogue between the Member States on the issues of Lake Chad Basin;
- promotion of a mutual approach towards water management;
- harmonization of environmental and water policies and regulations in the Member States
- preparation of technical inputs to the meetings of the Council of Commissioners or Summit of Head of States ; and
- facilitation of the implementation of LCBC recommendations within the institutions of Member States.

The Directorate of Water Resources and Environment is in charge of organizing an annual Technical Committee (TC) Meeting. Due to a lack of funding, however, the Technical Committee has met only twice. During its last meeting, a draft agreement concerning the use, development, management, and conservation of water in the Lake Chad Basin was formulated. The role, agenda, constitution and working conditions of the Technical Committee is found to be a useful mechanism for the LCBC decision making process, especially as it can include other natural resources issues such as land and soil in the discussions.

2000: A Technical Inter-ministerial Committee (IMC) consisting of Senior Member State Personnel was established to disseminate information regarding LCBC activities at the various administrative levels, from local to national. The IMC provides a forum by which Member States offer feedback to the LCBC. The IMC is to provide logistical support, including provision of resource management personnel for the implementation of projects and as Members in various standing committees.

2002: A Memorandum of Cooperation (MOC) was signed by the Ramsar Convention and LCBC, covering three principal areas of Lake Chad management related activity:

- wise use of all Basin wetlands; the partners seek to involve all stakeholders in organizational cooperation and strengthen the role of wetland management and ecosystem science in sustainable development planning;
- mobilization of funding: the partners will work to ensure that projects focus on the combined importance of wetlands for biodiversity conservation and poverty reduction; and
- designation and management of Ramsar Sites: the partners will explore possibilities for a coherent national and regional network of Ramsar Sites at the Basin level as the basis for the sustainable management of wetlands.

Currently, LCBC participates in the Conference of the Parties (COP) of the Ramsar Convention. It also receives a small grant of 30 000 CHF for a project its objective was the identification of more wetlands within the Basin. Resolution No. 10 of the Fifty-second Session of the Council of Ministers of the LCBC held in June 2005 reaffirms the commitment of LCBC to the objectives of it partnership by the joining Ramsar Convention through supporting CHADWET a new regional initiative for the conservation and sustainable management of wetlands.

2003: The Global International Waters Assessment (GIWA) undertook a project to identify 1) decisions on appropriate management of interventions prepared while incorporating more sustainable approaches to the utilization of water and related resources; 2) protocol for the execution of additional costs and trans-boundary diagnostic analyses; and 3) augment co-financing. The project completed an evaluation of the Lake Chad River Basin, identified major threats, and recommended policy options for managing the Basin and its subsystems. The main concerns for the Lake Chad Basin were ranked in descending order:

- freshwater shortage;
- global climate change;
- habitat and community modification; and
- unsustainable exploitation of fish and other living resources.

2003: The Forty-ninth Council of Ministers Session of the LCBC in January 2002 conducted a feasibility study of the Lake Chad Restoration Project. The Lake Chad Restoration Project seeks to divert water from the Congo Basin to replenish Lake Chad. The LCBC submitted funding requests to potential donor countries directly and through the New Partnership on African Development (NEPAD). The planning for the feasibility study continues and the TOR for the feasibility study were approved during the Fifty Second Session of the Council of Ministers in N Djamena with the participation of the Republic of Congo (Congo-Brazzaville) and the Democratic Republic of Congo (Congo-Kinshasa). During this session, Nigeria committed US$5 million.

2003: The European Union/International Scientific Cooperation (EU-INCO) conducted a 22-month study to develop a better understanding of the role of fish marketing in the livelihoods of the fisheries communities in each of the countries of the Lake Chad Basin. The report was developed to enable decision makers in each country to use information generated by the study to guide policy and identify possible development interventions to improve the livelihoods of the various stakeholders in the fisheries sector. A premise of the study was fish marketing networks in each country, and how different groups of actors relate, their economic and social interests, must be understood to draft policies that take various stakeholder interests into account. Options were identified for drafting new development policy documents for government to promote fish marketing and the livelihoods reliant on it.

2004: The Regional Parliamentary Committee of Lake Chad Basin (RPCLCB) was established with a broad mandate to ensure payment of budgetary contributions to LCBC from Member States, and to assist LCBC in obtaining funds for project implementation. The RPCLB met in Abuja in 2004, Yaounde in 2005, and again in Abuja in 2006. The RPCLB organized a workshop to consider the Oubangui Inter-basin Water Transfer project in 2006, and members of the RPCLB have attended meetings and events hosted by the LCBC. The RPCLCB assists in raising public awareness at local, national, regional and international levels, and in the formulation of policies and legislation necessary for effective IWRM.

2005: The German Technical Assistance (GTZ) began providing assistance to LCBC through an institutional strengthening project, Lake Chad Sustainable Water Management and Institutional Strengthening . The project aims to strengthen information and data management capacity at LCBC. GTZ sponsored two workshops to identify problems associated with information generation and dissemination during the third quarter of 2005. A GTZ mission launched a new institutional strengthening project on 16 August 2005 during a LCBC workshop at its headquarters in N Djamena. Regional stakeholders and technical partners of Member States were all invited to participate.

Several key LCBC operational issues had been discussed during the GTZ workshop including relationships and mechanisms (or lack of) between the LCBC and Member States regarding data exchange; integrated water resources management in the Lake Chad Basin; knowledge management for a sustainable water resources management; and, new technologies regarding information and knowledge exchange to reinforce the relationships between the partners concerning water resources management issues.

A main recommendation arising from the GTZ workshop was for LCBC to establish a monitoring committee including one delegate per Member State. A technical team under the leadership of the Director of the LCBC Planning Department was developed and included the Director of the Water Resources Management Department, a hydrologist, a remote sensing specialist, a computer specialist and consultant experts.

2007: The GTZ issued a fact sheet announcing its intent to sponsor a project, to provide the LCBC with technical and methodological advice on establishing a sound knowledge-management system. The capacity of the Commission s Secretariat is to be developed to strengthen its overall capacities. Digital maps and hydro-meteorological data are to be made available, along with an improved data exchange between the riparian countries through implementation of an Internet map server.

2008: The LCBC GEF project produced a 25-year SAP and supports the development of a National Action Plan in the Lake Chad portion of each LCBC Member State. Management plans were developed for the Lake Fitri, Lake Chad shoreline and the Northern Diagnostic Basin and for Komadougou-Yobe and Waza-Logone basins.

Stakes and challenges of the Lake Chad Basin

Environmental problems

The Transboundary Diagnostic Analysis (TDA), carried out between 2005-2006 under the LCBC GEF Project led to the identification of seven regional environmental problems. They are listed by order of priority:

1. **Variability of the hydrological regime and availability of freshwater** refers to the dramatic decrease in fresh water availability in the Lake Chad Basin, illustrated by the decrease in the lake s volume by 95 percent from 1963 to date. It also pertains to a marked variability in the hydrological regimes of the rivers that feed it, as well as rainfall regimes in the region. This has led to continuing decline in local access to water, crop failures, livestock deaths, collapsed fisheries and wetlands services, etc. The socio-economic consequences of the impacts include food insecurity and declining health status of the populace. It is rated as the most significant problem not only because of the above impacts and consequences, but also because it drives or contributes towards all the other six problems.
2. **Water pollution** is rated relatively high and this problem is based on foreseeable trends, rooted in the absence of working regulations and standards for environmental protection. Commercial cotton and rice production, known to use large quantities of agro-chemicals are on the increase, and will lead to inorganic chemical pollution and eutrophication. There is also the issue of increasing oil exploitation in Chad, which will give rise to increased urbanization, and the pollution of water bodies from oil spills. Increased water pollution will contribute to fisheries depletion and the prevalence of invasive species.
3. **Low viability of biological resources** pertains to the inability of the regenerative rates of plant and animal resources to keep apace with exploitation and disturbances, Disappearance of tree seedlings, collapse of fisheries, sterilization of soils, etc. This phenomenon has a spiralling effect, as shortages cause unsustainable harvesting of resources and further degradation. The net socio-economic consequence is deepening poverty from lack of resources. It also contributes to biodiversity loss and increasing variability of hydrological regime and freshwater availability.
4. **Loss of biodiversity** this refers to the loss of plant and animal species, as well as damage to ecosystem health. This reduces ecosystem productivity and availability of resources, resulting in deepening poverty. It also contributes to the decreasing viability of biological resources.
5. **Destruction and modification of ecosystems e**xtensive habitat and community modification has been experienced in the lake and the river environment. The lake, for example, has changed from open water to a marshy environment, and about 50 percent of wetlands have been destroyed. This has been caused by reduced flows linked to lack of sustainable development on the political agenda of member countries, as well as a low level of environmental awareness. The impact of this phenomenon is most felt in the collapse of some fisheries and recessional rice cultivation, as well as biodiversity loss and the decreased viability of biological resources.

6. **Sedimentation of rivers and water courses** has led to changes in channel flow patterns as well as a reduction in the inflows to the lake through channel diversion, and the colonization of the silted sites by invasive species. It is driven mainly by unsustainable farming practices on marginal lands.
7. **Invading species** such as typha grass and water hyacinth; typha is a major problem in the Komadougou Yobe Basin, and quelea birds are a major invasive pest prevalent throughout the basin. The invasive species are, to a large extent, related to poor water resources management, poor enforcement of environmental regulations and standards, and the absence of resources use planning. The typha grass blocks the river channels and diverts flows, while the quelea destroys crops, hence both contribute to poverty through the loss of livelihoods.

These transboundary problems are social risks and a threat to the riparian populations of the Lake Chad Conventional basin. They are the product of the combined effects of accelerated global climate change and unsustainable practices in the use of resources by the ever-increasing population.

Identified remote causes

Three remote causes of the degradation deserve special attention and are discussed and presented below.

- Lack of a sustainable development concept for rational use of natural resources in political programmes. Governments of all the member countries devote a meagre part of their budgets to the management of biological resources and environmental protection. This is a paradox given that the economy of the region is based on the exploitation of natural resources, be it through agricultural production or direct harvesting of resources. The most plausible explanation is that officials are more concerned with short-term subjects because of the instinct for survival within a context of economic and political instability.
- Low level of education and sensitization on environmental issues. The impression is that decision-makers and people in the region have not understood the link between environmental stability and economic well-being. Proof is that each Member State spends large sums of money to fight the effects of environmental disasters rather than proactively protecting environmental degradation. With respect to the aspirations of the people, especially as expressed by their representatives, it appears that there is little desire for change and this is yet another indication of the lack of environmental awareness. It is noted that various users of resources continue to tap them in an irresponsible manner.
- Population pressure cannot be considered a major concern. However, the low level of technical knowledge for sustainable exploitation of natural resources in the region and problems of short-term survival (low standard of living), irreversibly lead to careless exploitation of natural resources by the ever-increasing population.

Some achievements

Within the limits of its mandate as spelt out by the statutes, LCBC has achieved remarkable success in its operation since its creation in 1964. It has delivered dividends in small-scale agriculture such as the promotion of good fishing practices, production of livestock, rural water supply, communication, transport, regional economic integration and cooperation as well as coordination of regional security.

Some of the outstanding achievements include:

1. The successful demarcation exercise of international boundaries between Chad, Niger, Nigeria and Cameroon between 1988 and 1992, which has now formed the basis of the dispute settlement between Cameroon and Nigeria by International Court of Justice.
2. The successful preparation of a Master Plan for the Basin in collaboration with experts from Member States and supported by FAO, UNDP and United Nations Sudano-Sahelian Office. The Master Plan basically amends the environmentally sound management of the natural resources of the conventional basin . It was adopted in 1994 by the Summit of LCBC Heads of State and Government, which at the same time launched an international campaign to save the Lake Chad.
3. The Strategic Action Plan (SAP), which is based on the Master Plan identified 36 projects as priority and projects to ensure the continued existence of the people and natural resources in the subregion. The project for water transfer Inter Basin Water Transfer (IBWT) from Oubangui to Lake Chad was second in the list of the project contained in the SAP.
4. The preparation of LCBC Vision 2025, based on an analysis of the current situation, challenges to integrated management of the basin natural resources. It defines the means to get to the envisaged situation in 2025 vis-ˆ-vis the short, medium and long-term action required to implement the reversal of degradation trends, restoration and conservation of the ecosystem for environmentally sound and sustainable development of the subregion. The document Vision 2025 identified the cause of the current environmental degradation as global climate change, unsustainable decisions, lack of good policy and the reigons political will on the part of member states, poor coordination mechanisms, poverty and fragile economic situation. Five challenges to integrated management of the Lake Chad Basin Resources are:
    a) conservation to preserve water resources, restore vegetations and protect aquatic ecosystems;
    b) restoration of the level of the lake, including wetlands;
    c) fight against desert encroachment;
    d) data collection; and
    e) regional cooperation.

Today the LCBC is making all efforts to achieve the goals of its 2025 Vision. That is, by 2025 the LCBC, its Member States and development partners envision the Lake Chad Region as:

- a common heritage, with other wetlands maintained at sustainable levels to ensure the economic security of freshwater ecosystem resources, sustained biodiversity and aquatic resources in the basin, use of this region should equitably serve the needs of the population and reduce the poverty level;

- a secure area where the national and regional authorities accept responsibility for freshwater, ecosystem and biodiversity conservation and judicious integrated river basin management to achieve sustainable development; and
- a place where every Member State has equitable access to safe and adequate water resources to meet its needs and rights and maintain its freshwater, ecosystem and biodiversity resources.

The LCBC 2025 Vision provides a way forward through:

- strengthening sub-regional cooperation;
- developing practical and donor-friendly strategies, approved by all LCBC member states;
- disseminate the vision and make it acceptable to all; and
- creating the institutional framework for implementation of the vision at both regional (LCBC) and national (member states) level and ensuring financial and political support for strengthened efficiency.

Saving Lake Chad and its Basin: An absolute necessity

The problems of the Lake Chad Basin are numerous, severe and of global importance. They call for concrete and urgent solutions not only by the LCBC (as a subregional institutional framework) and its members but the active and sustained support of the international community. The drastic shrinkage of Lake Chad is an imminent world disaster if no action is taken. The Lake Chad Basin ecosystems can be restored with combined action to reverse degradation, re-establish the former levels of Lake Chad and other wetlands through sustainable and integrated management of all water resources in the basin.

Adoption of campaign to save Lake Chad

The Eighth Summit of Heads of Government of LCBC held in Abuja (Nigeria) adopted an international campaign to save Lake Chad and approved:

a) launching of the campaign to save Lake Chad;
b) launching the campaign at the Summit;
c) directing the Executive Secretary to seek the assistance of UNDP, UNEP, UNESDCO, FAO, and ADB to organize a donors conference; and
d) signing a joint letter calling for assistance from all external support agencies, countries, institutions and organizations.

Efforts of the LCBC

Faced with these challenges, the LCBC and its member states, with assistance from its development partners carried out extensive work especially in the area of studies, which served as the basis for actions to save Lake Chad. The Strategic Action Plan (SAP), developed within the framework of GEF project was adopted in June 2008 by the LCBC Council of Ministers and was transformed into an Investment Programme available by the end of 2008, to reverse general ecosystem degradation trends in the Lake Chad Conventional Basin, if funding is obtained.

Similarly, on the basis of an internal inter-sectoral diagnostic analysis, the LCBC member states have developed national action plans to meet the priorities of the national portion of the Lake Chad Conventional Basin in their respective territories. The total investment budget for all National Plans amounts to US$788 million over a period of 15 years.

Inter-Basin Water Transfer Project (IBWT)

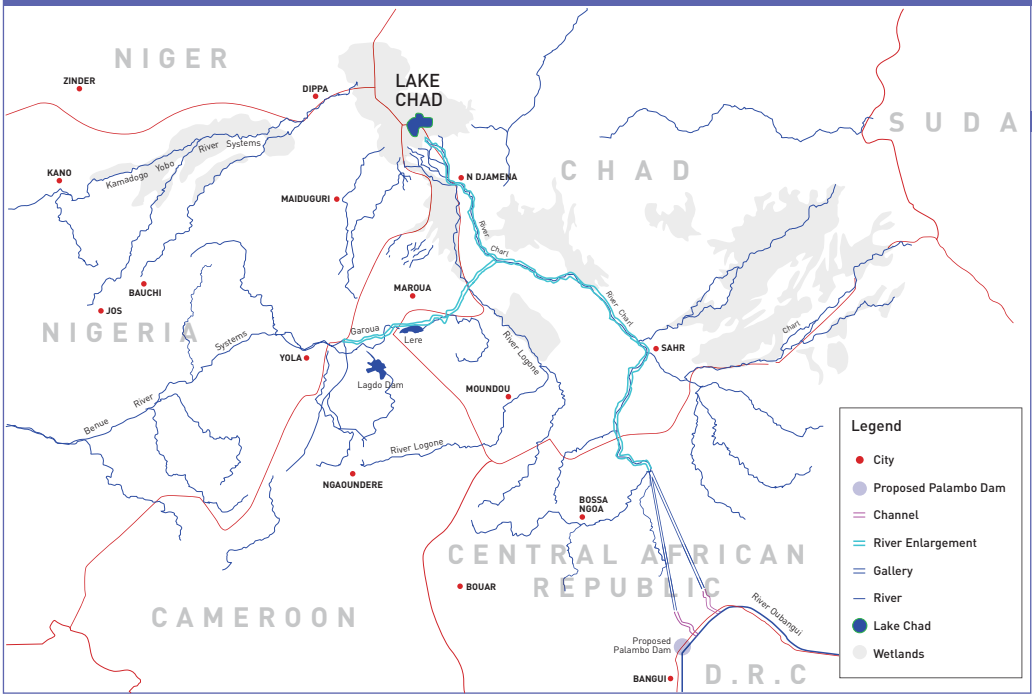
Part of the inflow from the Congo/Oubangui into Lake Chad is transferred to stop the drying and to gradually restore of its normal level (Figure 7). Lake Chad has shrunk considerably in recent years and is still shrinking. This situation may worsen to the complete drying of the lake. The affect on the local economy, especially on the survival of a population of more than 30 000 000 inhabitants who depend on the resources of the lake will be of catastrophic dimensions. To these emerging problems can be added: food insecurity, migrations to neighbouring countries, crime, conflicts and poverty. In consideration of the above, the project was launched in Abuja in 1994 at the Eighth Summit of Heads of State and Government and was given top priority. The first stage of the project, the feasibility studies, in early 2000 was estimated at US$6.07 million, and contributed by member states of LCBC.

The feasibility study aims to define: a) the mean discharge of the transfer and its modulations in compliance with socio-economic constraints; b) method of crossing the divide (ridge) between the two basins of Oubangui and Chari for passage of maximum discharge; c) necessary hydro works to ensure navigation and free flow of Lake Chad water. The feasibility study will evaluate the navigable canal linking the Logone and Benue through Mayo-Kebbi; d) Conduct an environmental impact assessment (EIA) and carry out mitigation measures; and (e) study associated projects to increase IBWT effectiveness.

The Oubangui Chari IBWT addresses the problem of under development, food insecurity and poverty in the West and Central African subregion by providing unique opportunities for:

- Basin-wide joint infrastructure investments that will benefit both the donor basin and recipient basin;
- Basin-wide joint sustainable and investment at the regional level in agriculture, livestock, fisheries, water supply, navigation and power for industrial development;
- bring socio-economic development and benefit-sharing to the member states of LCBC and the member states of CICOS; and
- extend African integration by economically linking the Economic Community of West African States (ECOWAS) and Economic Community of the Central African States (ECCAS).

Figure 7: Map of the proposed water transfer



Call for water actors cooperation and networking

Activities of all stakeholders in water: river basin organizations, other African basin organizations, NGOs and civil societies need to be properly coordinated. AMCOW could promote a forum for exchange of ideas between all water actors in the subregion, and throughout Africa to eliminate duplication. AMCOW can spearhead and organize such a forum locally, independent of the international fora for water, such as the World Water Forum.

Lake Chad and its Basin is drying, the challenges facing member states are immense. This imminent world disaster requires international cooperation and solidarity. The LCBC appealed to the international community to save Lake Chad, the environment and its ecosystems and save the lives of close to 30 million inhabitants living in the Lake Chad Conventional Basin. The Lake Chad Basin Commission therefore requests that:

- Lake Chad be declared a world ecological patrimony;
- the international community support the effective implementation of the international campaign to save Lake Chad launched by the Heads of State in 1994;
- the international community provide financial and technical support to the project for water transfer from Oubangui to Lake Chad after the feasibility study; and
- the international community support the implementation of SAP and its investment programme financially and technically.

The Ministerial Conference on "Water for Agriculture and Energy in Africa: the Challenges of Climate Change" was held in Sirte, Libyan Arab Jamahiriya, on the 15-17 December 2008.

The Conference discussed the prospects for food and energy demand by 2015 and the projections for 2030 and 2050, based on the key drivers of population and income growth and under the threat of climate change, concluding that policy decisions and budget allocations should prioritize assistance to farmers to adapt to climate change and budgets should as well be made available for large-scale infrastructure for irrigated agriculture and hydropower generation.

While recognizing the importance of national financing and regional cooperation for implementing strategies to address country needs and boost food production, the Conference Declaration appealed to multilateral agencies for additional funding and called upon developed and developing countries to realize their commitments in terms of budget allocation to agricultural production.

The Sirte Declaration called upon the African Union Commission to design a road map and a mechanism for monitoring and evaluating implementation, in collaboration with FAO, The African Development Bank, The Economic Commission for Africa, NEPAD, and the Libyan Arab Jamahiriya.

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