Proposal for the Establishment of an African Regional Centre for Ecohydrology (ARCE) in Ethiopia as a Category 2 Centre Under the Auspices of UNESCO

Item 6.1 of the provisional agenda

Summary

On 6 June, 2012, the Ministry of Water, Irrigation and Energy of Ethiopia transmitted to the Secretary IHP a preliminary proposal for the establishment of an African Regional Centre for Ecohydrology in Ethiopia. On 3 February, 2014, and following several communications with the secretariat, the Ministry submitted a revised proposal addressing the comments by the Secretariat on the Initial proposal. This document presents the proposal as submitted by the Permanent Delegation of Ethiopia.

Action Expected of the Bureau:
Please refer to document IHP/Bur-L/9
The Federal Democratic Republic of Ethiopia
Ministry of Water, Irrigation and Energy

Dear Ms Jimenez-Cisneros,
Director, Division of Water Sciences, UNESCO
Secretary, International Hydrological Programme
1 rue Miollis, 75732 Paris Cedex 15, FRANCE
Tel.: + 33 (0)1 4568 4096 - Fax: + 33 (0)1 4568 5811
E-mail: ihp@unesco.org

Subject: Sending the revised proposal for the establishment of the African Regional Centre for Ecohydrology (ARCE) in Addis Ababa, Ethiopia

Upon the recipient of your good office’s constructive comments through Prof. DR Mitiku Haile, Minister Councilor, Deputy Permanent delegate of Ethiopia to UNESCO, we have revised the proposal.

Therefore, enclosed herewith, we are sending the revised proposal for the establishment of African Regional Centre For Ecohydrology (ARCE) for your acceptance and considerations.

Please, accept, the assurance of our highest commitment.

Regards

CC.
Permanent Delegation of the Federal Democratic Republic of Ethiopia to UNESCO
1 rue Miollis,75015 Paris, France
Tel. +33 (0)1 45 68 3461/62
Fax. +33 (0)1 47 83 31 45
Revised Proposal

For

Establishment of African Regional Center for Ecohydrology (ARCE)

Prepared by

Ministry of Water, Irrigation and Energy

Submitted to UNESCO-IHP

Addis Ababa, Ethiopia

Feb, 2014
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1. Back Ground

Ethiopia is relatively well endowed with water resources, having an estimated annual surface runoff close to 122 billion m$^3$. However these water resources are unevenly distributed both spatially and temporally. The large diversity of ecological conditions determined by topography ranging from 110 m below sea level at Kobar sink in the Afar depression to a peak of 4620 m above sea level (masl) at Ras Dejen, has created diverse and conducive environments for the development of a wide variety of fauna and flora. The flora of Ethiopia is very heterogeneous and has a rich endemic element. It is estimated to contain between 6500 - 7000 species of higher plant, of which about 12 percent are endemic. Ethiopia is also a very important centre of crop genetic diversity and for this reason it is one of the 12 Vavilov centres. It has a very high genetic diversity in four of the world's widely grown food crops (wheat, barley, sorghum, peas), in three of the world's most important industrial crops (linseed, castor bean, cotton), in the world's most important cash crop (coffee), and in food crops of regional and local importance (tef, finger millet, noug, sesame, enset).

However, despite all these endowments, Ethiopia is among the poorest countries due to:

1. Between 80-90% of the country’s surface water resources are found within four major river basins – Abay (Blue Nile), Tekeze, Baro Akobo and Omo Gibe
2. Rain is erratic and unevenly distributed
3. Land degradation, resulting from deforestation, improper agricultural practices and overgrazing, is a major contributor to food insecurity and rural poverty in the country.
4. Drying up of lakes
5. Siltation of reservoirs

Environmental degradation is most severe in the highlands, especially in the northern half of the country. The highlands occupy nearly half of Ethiopia’s total land area and are the centre of the country’s economic activity. More than 85 per cent of the population and 75 per cent of the country’s livestock are found there Land degradation has become a crucial impediment to the conservation and sustainable use of natural resources in the region, increasing the rural population’s vulnerability to recurrent drought and famine. This deteriorating situation is a result of overgrazing,
deforestation, unsustainable agricultural practices and overexploitation of wetlands. Siltation of water bodies is a major threat to irrigation development

Ethiopian economy is based on agriculture, accounting for almost 50% of GDP, more than 85 per cent of the population and 75 per cent of the country’s livestock are found there. The agricultural sector suffers from frequent drought and poor cultivation practices. It is well understood that a strong relationship exists between the seasonal hydrological variability of the rainfall and the National GDP (the National Economy). This relationship is natural and obvious in a rain-dependent agriculture based economy. Several recommendation were made and important to this study are the need for an effective monitoring of the hydrological variability and an increase in investment on hydraulic infrastructures such as dams, reservoirs, ponds and other in-situ water harvesting schemes to smoothen the highly significant hydrological variability. These are important for hydropower generation, stable crop production and for the control of flood and drought in the country.

In some areas of the country, delayed entrance of rainy seasons, early withdrawal and mal-distribution of rain were challenges from which great lessons have been drawn to seriously look into expansion of small, medium and large scale irrigation in perspective.

Given these facts, the Ethiopian Government is striving aggressively to extricate Ethiopia people from poverty, to attain food self sufficiency and even to make among middle-income countries country. Ethiopia has achieved commendable development results over the past decade and aggressively engaged in watershed management through participatory approach and launched irrigation project developments. In order to ensure that future developments in Ethiopia are sustainable, it is essential to integrate environmental concerns into development activities. Environmental assessment and management have been recognized as effective tools for facilitating the inclusion of the principles of sustainable development into development proposals.

However, In spite of substantial progress in watershed management, land degradation and unsustainable natural resource base is still continuing. There are a lot of lessons to be learnt from the water resources management of the developed countries both from their success and failures. We are at infant stage in developing our water ecosystems. Therefore, it is of great importance applying / incorporating Ecohydrological principles in our study, design and construction of water
related developments to ensuring the sustainability of our socio-economic development. Unlike the other parts of the world that proceeded to development of water resources initially and start planning of management only after environmental disasters.

Therefore, how we proceed in the future will greatly depend on the way we view the developed countries past approaches to problem solving. One thing is for certain, our future problems are not getting simpler and will require innovative approaches at all levels.

It is well recognized that in the present situation, environmental protection and reversal of the degradation are not sufficient to maintain the global homeostasis and provide the required services. It is therefore necessary to concomitantly increase the “absorbing capacity” (resistance and resilience) of catchments against the impact.

2. Justifications

Developed countries began managing their water resources since time immemorial; however, a decline in freshwater (such as rivers, lakes, reservoirs and wetlands) and biodiversity observed at the global scale in both developed and developing countries has provided sobering evidence that existing or traditional water resources management, which has concentrated largely on hydrotechnical solutions alone, is clearly insufficient for achieving the sustainable use of the world’s water resources. The progressive deterioration of freshwater systems under the existing threat-based water resources management regime has resulted in the destruction of natural ecosystem structure and processes.

We learnt that in the face of global climate change and variability as well as in conditions of the increasing demographic pressures, environmental protection and reversal of the degradation are not sufficient to maintain the global homeostasis and provide the required services. It is therefore necessary to concomitantly increase the “absorbing capacity” (resistance and resilience) of catchments against the impact. Ecohydrology offers a methodology whereby sustainability, in the face of global climate change and variability as well as in conditions of the increasing demographic pressures becomes an achievable goal by addressing regulation of the whole range of water biota interactions from molecular- to landscape-scales in order to enhance carrying capacity. The methodology integrates water resources, biodiversity and ecosystem services and resilience. It uses ecosystem properties and dual regulation between the hydrological and ecological processes at a
catchment scale as a tool for water resources management Ecohydrology (EH) has been developed over time by the United Nations Education, Scientific and Cultural Organization (UNESCO) International Hydrological Programme (IHP-V) (1996-2001).

3. Objectives of the ARCE

The African Regional Center for Ecohydrology (ARCE) will provide a platform for Africa where joint studies by specialists of different fields allow for mutual cooperation, cross exchange of information and identification of synergies among different systems. This leads to better understanding of the patterns of water/biota interplays, and their importance for societies. It is also a key, not only for dissemination of the concept, but also for implementation, and substantial contribution to sustainable use of water resources by African societies.

3.1. The objectives of the Centre shall be to:-

(a) Advance ecohydrology through scientific research, publications, international cooperation;

(b) Advance international cooperation and contacts and provide a platform for the exchange of scientific information about Ecohydrology and Integrated Watershed Management (IWM) between institutions in Africa/worldwide within the framework of the International Hydrological Programme (IHP) of UNESCO;

(c) Provide advisory activities, technical information and training as a basis to develop and implement new integrated methods of water restoration and management;

(d) Develop a network of demonstration sites for the implementation of the ecohydrology concept to improve water resources quantity and quality, create positive socio-economic feedback and provide relevant ecosystem services;

(e) Promote advanced scientific research on ecohydrology, monitoring and modeling systems, as well as transfer of knowledge and its implementation in order for water bodies to be ecologically sound, and implement the Water Related Framework Directive of the African Countries, and other environment-related legal regulations;

(f) Promote social awareness-raising within the scope of ecohydrology application for integrated management of water resources including: society at large, NGOs and governmental institutions at central and regional levels;
(g) Develop potential and facilities for training, education, dissemination and popularization of scientific achievements.

4. The functions of the Centre shall be to:

4.1. Conduct experimental and theoretical scientific research; Conduct education and training courses;

4.2. Participate in the UNESCO-IHP network as a focal point for ecohydrology in the region and support IHP international activities;

4.3. Create and reinforce institutional and information networks for the exchange of scientific, technical and policy information at the international level;

4.4. Cooperate with government agencies, NGOs, institutions, stakeholders and decision-makers in order to put the results of scientific research into practice;

4.5. Spread ecohydrological knowledge through publications, scientific meetings, seminars and scientific conferences;

4.6. Promote ecological education and increase public awareness of the links between water systems, biodiversity and sustainable development.

5. Cooperation Partnership with UNESCO

The Centre shall pursue the above objectives and functions in close cooperation with IHP and other water-related centres under the auspices of UNESCO.

6. The Centre’s organizational framework shall consist of:

(a) A Governing Board;
(b) A Director;
(c) Research units;
(d) A Secretariat

7. Contribution of the Government

7.1. Contribution by the Government

The Government shall employ staffs and provide all the resources, either financial or in kind, needed for the administration of the Centre:

The Government shall take appropriate measures, in accordance with its laws and regulations, which may be required for the Centre to receive adequate funds
8. Legal Status

8.1. The Centre, to be located in Addis Ababa, Ethiopia, shall be established and act under Ethiopian law within the framework of the Ministry of Water, Irrigation and Energy, which is a governmental institution.

8.2. The Centre shall be an autonomous institution within the framework of the Ministry of Water, Irrigation and Energy, established in accordance with the relevant Ethiopian legislation with which UNESCO and UNESCO Member States in the region may cooperate.

9. Funding sources:

9.1. Contribution of the Government, included in the State budget for science, in conformity with relevant regulations;

9.2. Contributions which may be foreseen for this purpose in the part of the State budget entitled The Ministry of Water, Irrigation and Energy;

9.3. Contributions made by UNESCO, in accordance with the relevant decisions of its governing bodies concerning UNESCO’s programme and budget;

9.4. Payments made by other institutions participating in the activities of the Centre;

9.5. Payments made for the development of research projects or services rendered by the Centre in the framework of elaboration, evaluation, consulting and others activities related to programmes and projects on management of water resources and protection of environment;

9.6. Other donations, grants or legacies in conformity with existing law and accepted by the Centre.

9.7. The Government (the Ministry of Water, Irrigation and Energy) and UNESCO will cooperate in order to mobilize additional extra budgetary resources for the activities of the Centre.

10. Support from the Ministry of Water, Irrigation and Energy (MoWIR)

The MoWIE shall provide the centre with both human resources and infrastructure to implement the proposed activities and take appropriate measures, in accordance with its laws.

11. Partnership

The Ministry of Water, Irrigation and Energy of Ethiopia is the main coordinator and it currently has 6 partners (Fig.1)
MoWIE= Ministry of Water, Irrigation and Energy, ORDA= Organization of rehabilitation and development of Amhara, IBE= Integrated Biofarm Enterprise, IWMI= International Water Management Institute, MoA= Ministry of Agriculture, BDU= Bahirdar University, EIWR= Ethiopian Institute of Water Resources, BFALRC= Bahirdar Fish and Aquatic Life Resources Center, RWB= Regional Water Bureaus and AAU= Addis Ababa University

11.1. Ministry of Water, Irrigation and Energy (MoWIE) is a regulatory at federal level while ORDA, TDA, ODA, etc are working at respective regional level. There are also Regional water bureaus (RWB) responsible for water resources development in their respective regions is potential for ARCE.

MoWIE initiated the introduction of Ecohydrology in to Ethiopia mandates and responsibilities of the Ministry of Water, Irrigation and Energy relevant to Hydropower for Sustainable Development 2011 include:

- Promoting the development of water resources and energy;
- Undertaking basin studies and determining the country’s ground and surface water resource potential in terms of volume and quality, and facilitating the utilization of same;
- Undertaking studies and negotiations of treaties pertaining to the utilization of boundary and transboundary water bodies, and following up the implementation of same;
- Causing the carrying out of study, design and construction works to promote the expansion of medium and large irrigation dams;
- Undertaking studies concerning the development and utilization of energy; and promoting the growth and expansion of the country’s supply of electric energy;
• Promoting the development of alternative energy sources and technologies

11.2 Key Partners

11.2.1. Organization for Rehabilitation and Development in Amhara (ORDA)

It is an indigenous, non-governmental, and not-for-profit development organization. ORDA implements projects and programs in a view of ensuring livelihoods and environmental security and reducing poverty in the Amhara National Regional State. Its local and regional engagement focuses on helping communities to achieve economic, social and ecological sustainability. There are also other similar regional organizations like TDA (Tigray Development Association), ODA (Oromiya Development Association) which have expressed their interest to work with us in utilizing ecohydrology for water related problem solving.

11.2.2. Bioeconomy Africa (BEA)

The main of this Enterprise objectives are: Human, animal, plant health improvement, Environment restoration and Wealth creation.

11.2.3. Bahir Dar Fishery and Aquatic Life Research Center (BFALRC)

In Bahidar, process of optimization of Tilapia fish production from pond has started with Bahirdar Fish and Aquatic Life Research Center (BFALRC).

11.2.4. RWB (Regional Water Bureaus)

As they are responsible for all kinds of water resources developments in their respective regions demonstration sites are being developed with their partnership.

11.2.5. MoARD (Ministry of Agriculture and Rural Development)

Ministry of Agriculture is also our key partner as it is responsible for soil and water conservation activities connected with agricultural area in the watershed.

11.2.6. Ethiopia Institute of Water Resources (EIWR)

The Ethiopian Institute of Water Resources (EIWR) was established under the Africa-U.S. Higher Education Initiative to serve as the central administration unit to coordinate research, education and outreach activities amongst the partnering U.S. and Ethiopian Universities. One of its tasks is facilitating and conducting research aimed at addressing water related developmental problems in Ethiopia through community engagement and student thesis advising by prominent U.S. and Ethiopian Scientists.
ANNEXE I, The ongoing ecohydrological demonstration sites

I. The ongoing ecohydrological demonstration sites in Ethiopia which have been developed in the framework of the Ministry of foreign Affairs of Poland “Polish Aid Programme” by joint action of ERCE u/a UNESCO, Ministry of Water, Irrigation and Energy of Ethiopia, Bioeconomy for Africa and Organization for Development and Rehabilitation of Amhara:

1) Sequential Biofiltration System (SBS) in Assela;
2) Enhancement of aquaculture of tilapia - reproduction efficiency, stocking material and fishery yield;
3) Utilization of geotextile for the rehabilitation of eroded land;
4) Shelterbelts for enhancement of the landscape resilience to climate change;
5) Restoration of Papyrus at Littoral zone of Lake Tana
6) Monitoring of toxic algal blooms in Tana Lake and Koka Reservoir as background for early warning system and elaboration of water quality improvement strategy.

In 2008,
- The bilateral agreement was signed between Ethiopia and Poland, thanks to the Polish Embassy in Addis Ababa, the Ministry of Water, Irrigation and Energy of Ethiopia and the Ministry of Foreign Affairs of the Republic of Poland.
- The ERCE and the Ministry of Water, Irrigation and Energy of Ethiopia, and supported by the Ministry of External Affairs of Poland, Polish Embassy and UNESCO IHP, conducted technical trips, site visits, capacity building, brainstorming.

In 2009, The international Symposium entitled “Ecohydrology for water ecosystems and society in Ethiopia-Africa” was held in 2009 in Addis Ababa, Ethiopia.
The goals of the Symposium were:
1. Review the recent state of knowledge in water ecosystems in Africa and especially in Ethiopia.
2. Identification the gaps in knowledge.
3. Identification of perspectives for implementation of ecohydrological solutions.
4. Elaboration of action plan for implementation of key demonstration projects.

The key expected outcome of the Symposium was recognizing the possibilities of the use of Ecohydrology scientific framework for:
1. Reduction of stream and rivers siltation due to deforestation and grazing.
2. Reversing of eutrophication of lakes and reservoirs.
4. Methodology for monitoring and abatement river pollution by industry.
5. Adaptation of ecohydrological biotechnologies for reduction of domestic sewage in rural and dispersed urban areas of Africa.

The Symposium revealed large capital of the existing experience, knowledge as well as good quality and quantity of data generated by the Ethiopian universities and research institutes. The experience of the local research institutes was found to be crucial for quantification of processes generating the
basis for development ecohydrological system solutions towards solving the existing ecological, economical and social (including health) problems of Ethiopia.

As the result of these activities, the following potential areas for implementation of ecohydrological systemic solutions were identified both for Agricultural and Urban areas(Fig.4):

![Fig. 3, Primary Ecohydrological Biotechnology and Systemic Solution For Ethiopia (Zalewski et al. in press)](image)

In 2010, The first demonstration site, Sequential biofiltration system was constructed in the outskirt of the Assela town with the aim of preventing the Assela Reservoir from further pollution and sedimentation and the organic sediments, which has been trapped in the sedimentation chamber, is in turn converted into food production(Fig.4).
Fig.4. Ecohydrological systemic solutions for reduction of siltation, eutrophication and dioxin-induced toxicity (Preliminary results of the project “Ecohydrology – a transdisciplinary science for...” carried out by Zalewski et al.).

2011

The second demonstration site, Sequential biofiltration system was developed (Fig 6) with the aim of retaining nutrients, organic matter and eroded soils in the landscape preventing the receiving water body (Lake Tana) from pollution. The trapped sediment/nutrients and organic matter are in turn applied to the nearby farms increasing crop productivity.
In 2012

Fig. 7. The third demonstration site, construction of shelterbelt, application of biodegradable geofibers for soil erosion control and land water buffer zone/ecotone were developed in the head water of upper Rib/Gumera river (Lake Tana sub basin).

Degraded Agricultural land

Application of biodegradable geotextile

Planting fast growing trees

Current status
Fig. 7. Shelterbelts for restoration of water cycle and for creation micro climate of microclimate

Fig. 8. Enhancement of aquaculture of tilapia - reproduction efficiency, stocking material and fishery yield by regulating the abiotic factor-Temperature
In high altitude African countries like Ethiopia the most important limiting factor for aquaculture is the diurnal temperature oscillation with it rapid declines during nights. The low cost-low energy method was therefore proposed in order to enhance the water temperature during nights and improve the production of stocking material and fish yield. The proposed method was applied in small farms wherein fish ponds are used for retention of water during rainy season and can generate the additional ecosystem services by production of Nile tilapia (O. niloticus) fingerlings and aquaculture yield.

The coverage of the pond surface reduced the variability of water temperature. The use of termoisolating foil resulted in 5.21°C and 5.86°C higher pond water temperature in cold and warm season, respectively, comparing to the non-coverd pond, with a small decline in dissolved oxygen concentration which not exceeded 0.80 mg/L. This enable to spawn the O. niloticus and produce the fingerlings at the amount of 683 and 2862 individuals at cold and warm season, whereas in pond without termoisolation accounted to 0 and 139, respectively.

The results obtained suggest that the use of proposed low cost/low energy method contributes to fish yield production in small farms and in consequence generate the additional benefits for local farmers.

Table 1. O. niloticus fingerlings reared during the experimental period

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<th>uncovered Pond</th>
<th>Sampling date</th>
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</table>
ANNEX II. Participatory Watershed Management

Fig. 9. Restoration of Papyrus at Littoral zone of Lake Tana by replacing recession farm with aquaculture and buffer zone

Fig. 10. Peoples participation in watershed management (planting trees, bushes and grasses)

Fig. 11. Rehabilitated watershed (covered with green trees, bushes and grasses).
Fig. 12. Resulted Ecosystem Services from the rehabilitated provided for landless female & unemployed youth organized in the name of “Key beret honey producers association”

ANNEX III, Ecohydrological Demonstration Sites in Ethiopia
ANNEX IV. Publications

Scientific articles published on the basis of the project “Implementation of Ecohydrology – a transdisciplinary science for integrated water resources and sustainable development in Ethiopia” are listed below:


6) Polish scientific thinking used ensure sustainable development in Ethiopia. ThinThank, dossier 2011;


