



# Water Research Center, University of Khartoum

## Relevant Research Areas and Activities

Kick-off Meeting of the NEPAD Networks of  
Centres of Excellence in Water Sciences,  
Cape Town, South Africa, 24 - 26 May, 2016

**Prof. Gamal M. Abdo**  
**Director, Water Research Center**

# University of Khartoum

Website: <http://www.uofk.edu>



- **Founded in 1939 as Gordon Memorial College**
- **1956 after Independence University of Khartoum**

- ❖ **12 Faculties** : *Engineering, Architecture, Science, Arts, Law, Economics, Geography , Medicine, Pharmacology, Agriculture , Veterinary Sciences, Education*
- ❖ **6 Research Institutes**
- ❖ **Graduate College**
- ❖ **50,000 Students including about 5000 Post Graduate Students**
- ❖ **Over 2000 Academic Staff**

# Faculty of Engineering

## Departments

**Civil and Environmental  
Engineering**

**Electrical and Electronic  
Engineering**

**Petroleum Engineering**

**Mechanical Engineering**

**Agricultural  
Engineering**

**Mining Engineering**

**Chemical Engineering**

**Surveying Engineering**

## Research Centres

**Water Research  
Centre**

**Space Research  
Centre**

**Energy Research  
Centre**

## Training Unit

**Hosting the Remote Sensing  
Centre, Higher Council for Research**

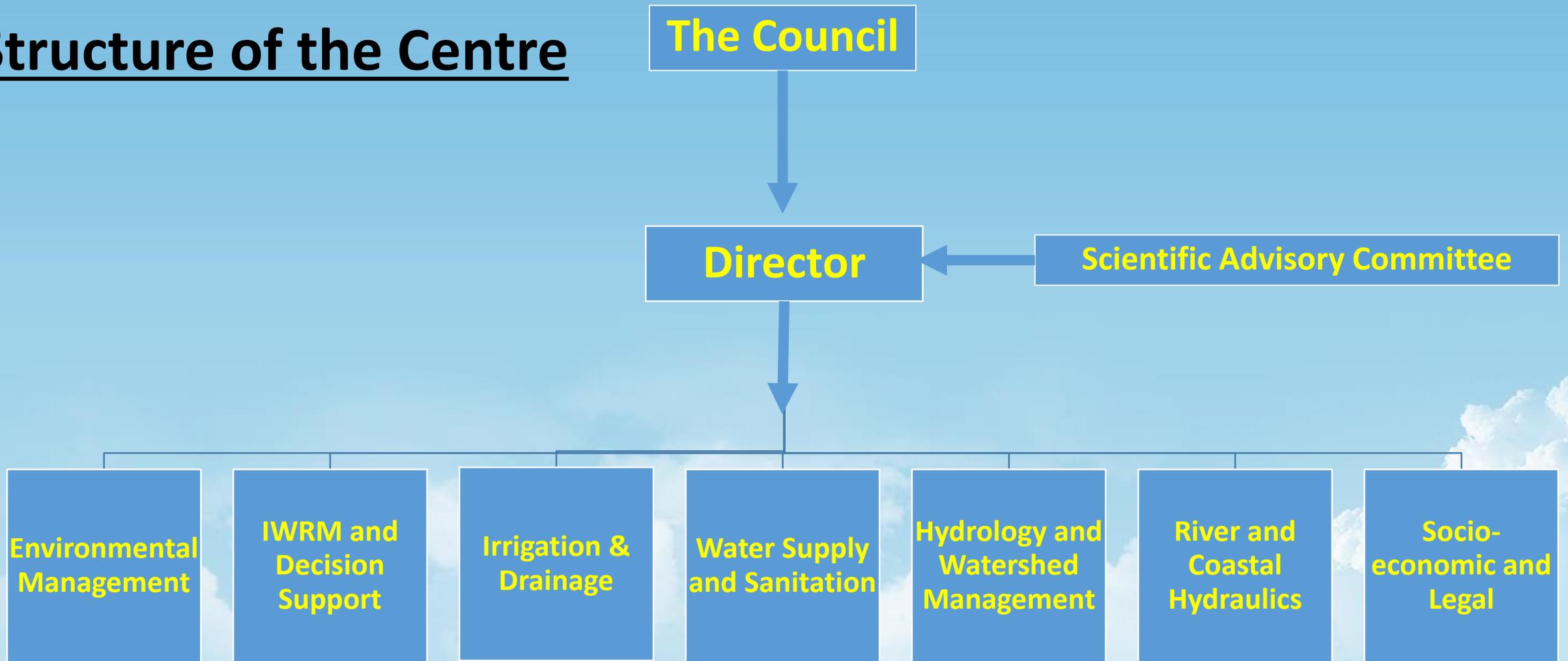
# *The Water Research Center - UofK*

A multidisciplinary research and capacity building centre established by the University of Khartoum in 2009 within the Faculty of Engineering with the following aims:-

- **Conduct multi-disciplinary research and development studies addressing needs related to water and the environment.**
- **Promote capacity building through continued training of water resources professionals**
- **Provide technical, strategic and policy advice to policy makers and stakeholders.**
- **Adapt relevant technologies and methodologies in the world to contribute to knowledge transfer**
- **Enhance the role of the university in community development and its involvement and leadership in regional and international water activities**

**In 2014 the Centre has been promoted to a Centre of Excellence in Water Research by the Ministry of Higher Education and scientific Research**

# Structure of the Centre



# *Core Staff of the Centre*

<b>Title/Position</b>	<b>Number</b>
<b>Professors</b>	<b>3</b>
<b>Associate Professors</b>	<b>6</b>
<b>Assistant Professors</b>	<b>1</b>
<b>Lecturers</b>	<b>3</b>
<b>Research Assistants</b>	<b>4</b>

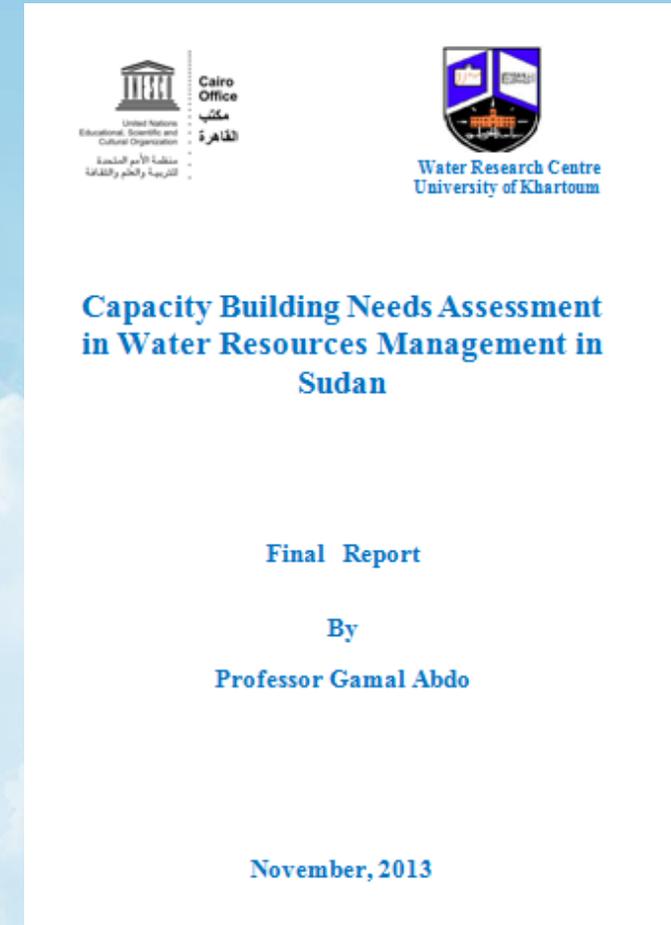
**Plus a large Number of Associate Staff from other University Faculties  
and Water Institutions**

# *Core Staff of the Centre*

<b>Name</b>	<b>Specialization</b>
<b>Prof. Abdin M. A. Salih</b>	<b>Water Resources Management</b>
<b>Prof. Gamaledin M. Abdo</b>	<b>Groundwater Management</b>
<b>Prof. Mohamed O. Akode</b>	<b>Hydraulics and River Mechanics</b>
<b>Dr. Mohamed A. A. Khadam</b>	<b>Environmental Engineering</b>
<b>Dr. Elsadig M. A. Sharfi</b>	<b>Hydraulics and Hydropower</b>
<b>Dr. Babikir I. Barsi</b>	<b>Hydrologic Modeling, Watershed Management</b>
<b>Dr. Elfadil A. Azrag</b>	<b>Water Supply and Sanitation</b>
<b>Dr. Adil M. Elkhidir</b>	<b>Irrigation Management, Hydraulic Structures</b>
<b>Dr. Ishraga Sirelkatim</b>	<b>Hydraulics and Sediment Transport</b>
<b>Eng. Reem Fekri</b>	<b>Water Resources Engineering</b>
<b>Eng. Waleed Hashim</b>	<b>Irrigation Management, Hydraulic Structures</b>
<b>Eng. Mohamed Omer</b>	<b>Groundwater Modeling</b>
<b>Eng. Michael Magdy</b>	<b>Environmental Engineering</b>
<b>Eng. Fatima Taha</b>	<b>Water Law, Transboundary water Management</b>
<b>Eng. Al Hadi Mohsen</b>	<b>Research Assistant, RS, GIS</b>
<b>Eng. Ahmed Khalid</b>	<b>Research Assistant, WIS</b>

# *Programs of the Centre*

- **M.Sc Program in Water Resources Management (by courses)**
- **M.Sc. Program in Environmental Engineering (by courses)**
- **M.Sc. Program in Transboundary Water Management (under process)**
- **M.Sc. and PhD Programs by Research**
- **Research and Studies in Priority Areas**
- **Training Program**



# Priority Research Areas

- **Arid Zone or Dry land hydrology (surface and Groundwater)**
- **Water Conservation (water harvesting, Management of aquifer Recharge, demand management, non-conventional water)**
- **Watershed Modeling and Management**
- **Hydraulics, River Morphology and Sediment Transport**
- **Climate change Studies (Impacts and Adaptation)**
- **Irrigation Management (irrigated and rain-fed agriculture)**
- **Water Supply, Sanitation and water quality management**
- **Transboundary Water Management (Surface and groundwater)**
- **Water-Energy-Food Nexus**

# International Cooperation

- ❖ **UNESCO-IHP, Global G-Wadi, African G-Wadi, Arab G-Wadi, FRIEND/Nile, IFI, ISI**
- ❖ **World Bank/ Nile Basin Initiative NBI/ Eastern Nile Technical Regional Office ENTRO, Ethiopia (Focal Point for ENTRO in Sudan )**
- ❖ **UNESCO-IHE, Delft the Netherlands**
- ❖ **Cologne University of Science and Technology, Germany**
- ❖ **Imperial College of Science and Technology, London, UK**
- ❖ **Oxford University, Oxford, UK**
- ❖ **Leuven and Gent Universities , Belgium**
- ❖ **Regional Universities such as (AAU, Nairobi Univ., Kenyatta University, Dar el Salam Univ., Cairo Univ., Ain Shams Univ.)**
- ❖ **Arab Association of Water Resources Research, Federation of Arab Universities, (Hosting Secretariat)**
- ❖ **ICID (Hosting the Secretariat of the National Committee for ICID)**

# Internal Links

- **UNESCO Category II Regional Center for Capacity Development and Research in Water Harvesting, Sudan.**
- **UNESCO Chair in Water Resources, Omdorman Islamic University, Sudan**
- **Hydraulic Research Centre, Ministry of Water resources, Irrigation and Electricity**
- **UNESCO National Committee for IHP**
- **Water Harvesting Centre, University of Nyala, Darfur**
- **Other Universities in Sudan**
- **Ministry of Higher Education and Scientific Research**
- **Other relevant Ministries, Water Institutions and NGO's**

# Examples of Research, Studies & Capacity Building Activities

## Recent PhD Theses

- **Climate studies on the Nile Basin: case studies on land use sensitivity analysis in the White Nile, and impact of El Nino on droughts and floods in the Blue Nile , Modathir Zaroug , 2016**
- **Transboundary Water Resources Management in the Eastern Nile, Mohamed M. Abbas, 2016**
- **Impact of Improved Operation and Maintenance on Cohesive Sediment Transport in Gezira Scheme, Sudan, 2015, Ishraga Sokrab (Joint Supervision between WRC, UNESCO-IHE, Delft.)**
- **Optimization of Coordinated Operation of Reservoirs in Sudan, Reem Fikri (Joint Supervision between WRC, UNESCO-IHE, Delft.), still going**



United Nations  
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Cultural Organization



International  
Hydrological  
Programme

# Activities with UNESCO-IHP

- ❖ **Study on : Water Resources Assessment, Development and Management in Darfur, (2009-2010).**
- ❖ **Study was conducted Jointly by WRC , Leuven and Gent Universities, Belgium, Funded by UNESCO- Flanders Fund in Trust.**
- ❖ **The Study involved Two Training Workshops for Water Resources Professionals.**



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Scientific and Cultural Organization



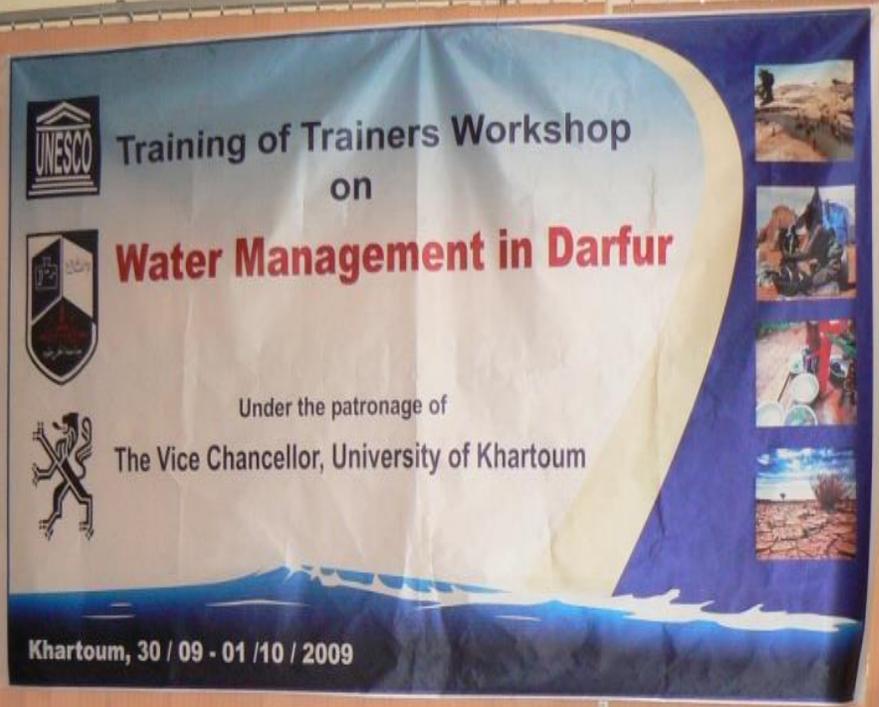
UNESCO Flanders Fund-in-Trust  
(FUST)



## Water Resources Assessment, Development and Management in the Conflict Affected Region of Darfur, Western Sudan



**Final Report  
March 2010**







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International  
Hydrological  
Programme

# Activities with UNESCO-IHP, Contd

- **FRIEND/NILE Project (Phase I & II), Funded by UNESCO- Flanders Fund in Trust . The project had these components**
  - **Flood and low Flow Frequency Analysis Component**
  - **Rainfall Run off Modelling Component**
  - **Water shed Management Component**
  - **Ecohydrology Component**
- **The WRC Conducted the Flood and Low Flow Frequency Analysis Component for Sudan.**



# Arab IHP – National Commissions Coordination Initiative & Web site Development Training Program (Arab IHP and Regional G-Wadis), June 2015 Khartoum, Sudan

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# **Arab IHP – National Commissions Coordination Initiative & Web site Development Training Program (Arab IHP and Regional G-Wadis), June 2015 Khartoum, Sudan**

## **Outcomes:**

- **Establishment of a coordination mechanism between the UNESCO water family in the region.**
- **Enhancement of links and communication between Arab IHP National Commissions and G-Wadi networks in the Arab and African regions.**
- **Training and capacity building for sustainable and updated communications through a pro-active web portal.**



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# Activities with UNESCO-IHP, Contd

## UNESCO Project on Capacity Development in Managing Natural Disaster Risk of Flash Floods in Sudan, Egypt, Jordan, and Yemen (2015-2016)

- **The project is funded by the Japanese Government through UNESCO-Japan Fund in Trust.**
- **ICHARM (International Centre for Water Hazard and Risk Management), and DPRI (Disaster Prevention Research institute), Kyoto University are advisors**
- **The project has study component (case study) and a Training component**



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Programme

# Flash Flood Project Activities

- 1. Training in flash flood early warning and preparedness.**
- 2. Training in Flash Flood Hazard and Risk Mapping.**
- 3. Training in identification and implementation of effective flash flood remedial measures.**
- 4. Training and capacity building for community awareness to reduce vulnerability to flash floods and on how to alleviate and manage risks during and after flash floods.**
- 5. Application to the four case study catchment.**

# **Flash Flood Training Workshops conducted**

- ❖ Flash flood Project: Urgent Capacity Development for Managing Natural Disaster Risks of Flash Floods in Sudan, Inception Workshop, Khartoum, 17 , 18-Oct. 2015.**
- ❖ Training Workshop on Flash Flood Early Warning and Flood Risk Mapping, Cairo 14<sup>th</sup> – 20<sup>th</sup> December 2015**
- ❖ Training Workshop on Flash Flood Remedial Measures, Amman, Jordan, 17-20 may 2016**

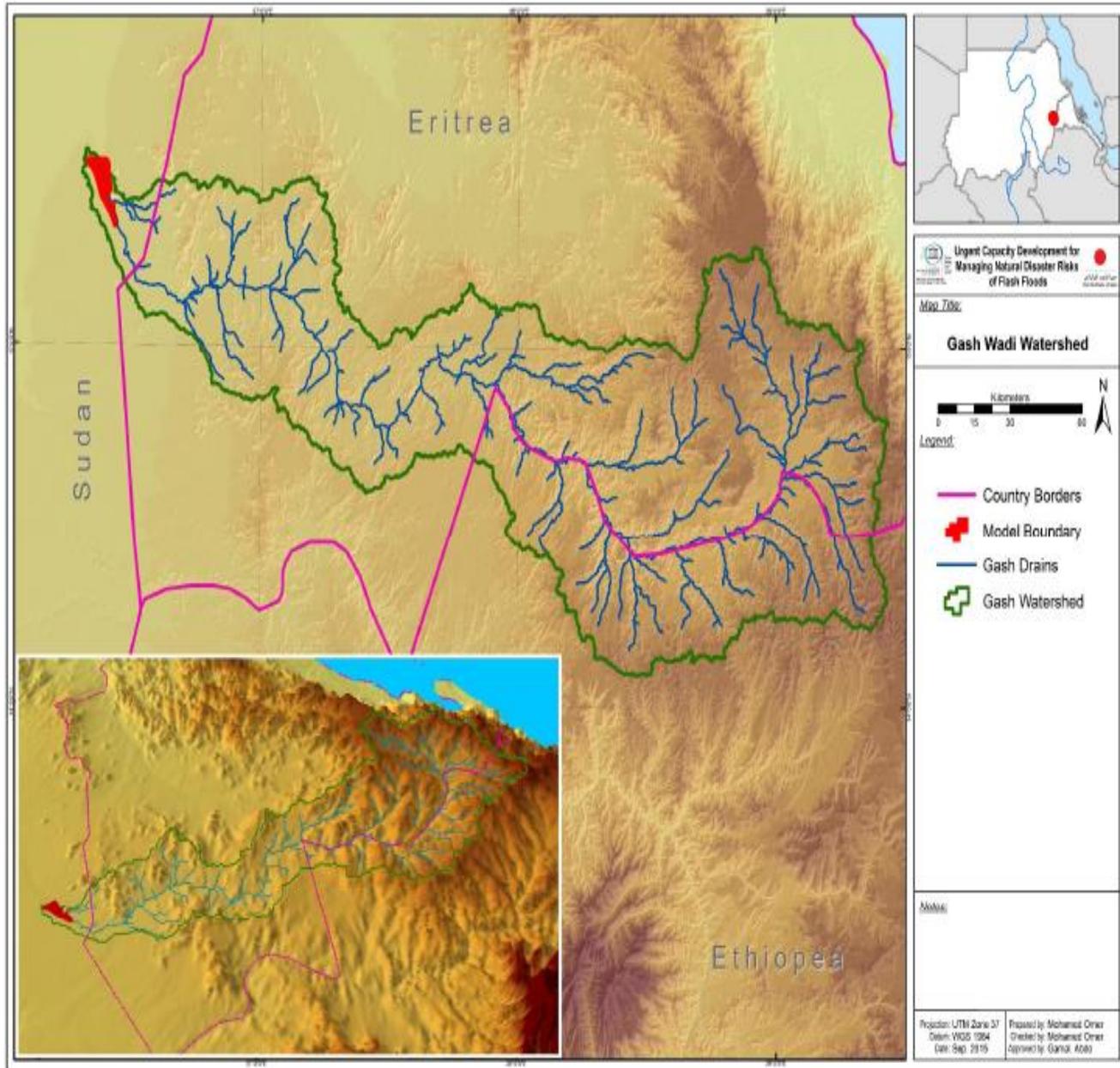


Figure 3.1: Catchment Area of the Gash Wadi



**Flash flood Project: Urgent Capacity Development for Managing Natural Disaster Risks of Flash Floods in Sudan, Inception Workshop, Khartoum, 17-18-Oct. 2015**

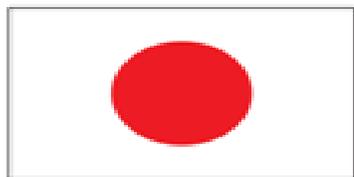




# Flash Flood Project



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قاهرة



من الشعب الياباني  
From the People of Japan

United Nations  
Educational, Scientific and  
Cultural Organization  
Regional Bureau for Science  
and Technology in Arab States

UNESCO - JAPAN  
FUND-IN-TRUST PROJECT



United Nations  
Educational, Scientific and  
Cultural Organization



From  
the People  
of Japan

THE REGIONAL BUREAU FOR SCIENCE  
IN THE ARAB STATES  
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REGIONAL



## UNESCO – JAPAN FUND-IN-TRUST on Flash Floods

Training Workshop on Flash Flood Remedial Measures, Amman, Jordan, 17-20 May 2016

**G-WADI Training Workshop on  
“Advances in Water Resources Management  
in Arid and Semi-Arid Areas: A G-WADI approach”  
February 17th – 18th, 2016**



**7<sup>th</sup> University of Khartoum Graduate College Conference on  
Science, Technology and Innovation for Sustainable Development in Africa  
19 – 23 Feb, 2016**

<b>Participating International Institutions</b>	<b>Country</b>	<b>Representative</b>
<b>International Center for Integrated Water Resources Management (ICIWaRM) (Secretariat of Global G-Wadi)</b>	<b>USA</b>	<b>Dr. William S Logan</b>
<b>Centre of Hydrometeorology and Remote Sensing – University of California Irvine (UCI)</b>	<b>USA</b>	<b>Prof. Soroosh Sorooshian</b>
<b>ITT - Cologne University of Applied Sciences</b>	<b>Germany</b>	<b>Prof. Lars Ribbe</b>
<b>Faculty of Life and Environmental Sciences, University of Tsukuba</b>	<b>Japan</b>	<b>Prof. Maki Tsujimura</b>
<b>National Geophysical Research Institute</b>	<b>India</b>	<b>Prof. Shakeel Ahmed</b>
<b>Cold and Arid Regions Environmental and Engineering Research Institute</b>	<b>China</b>	<b>Prof. Xin Li</b>

<b>Participating International Institutions</b>	<b>Country</b>	<b>Representative</b>
<b>Water for Sustainable Development and Adaptation to Climate Change</b>	<b>Serbia</b>	<b>Dr. Nikola Zlatanovic</b>
<b>AGRHYMET Regional Center (African G-Wadi Secretariat)</b>	<b>Niger</b>	<b>Dr. Abdou Ali</b>
<b>Department of Hydrology - University of Dakar</b>	<b>Senegal</b>	<b>Dr. Cheikh Becaye Gaye</b>
<b>Regional Center for Integrated River Basin Management (RC-IRBM), (UNESCO Category 2 Center)</b>	<b>Nigeria</b>	<b>Dr. Dogara Bashir</b>
<b>International Center for Water Resources and Global Change (UNESCO Category 2 Center)</b>	<b>Germany</b>	<b>Prof. Siegfried Demuth</b>

# **G-Wadi Training Workshop Themes**

- 1. Challenges of Water Resources Management in Arid and Semi Arid Zones.**
- 2. Use of Isotopes and Tracers for Water Resources Management in Arid and Semi Arid Area.**
- 3. Challenges and Limitations of Hydroclimatological Forecasting for Water Resources Management in Arid and Semi-Arid Areas and Future Prospects.**
- 4. Global Impacts on Water Resources in Arid and Semi-Arid Areas and Adaptive Measures**
- 5. Water Efficiency and Accounting in Arid and Semi Arid Areas.**
- 6. Panel Discussion on :Tools and Methodologies to Address Water Resources Management Challenges in Arid and Semi-Arid Areas**

**“Advances in Water Resources Management  
in Arid and Semi-Arid Areas: A G-WADI approach”**



# **“Global G-WADI Advisory Committee Meeting”**

**19<sup>th</sup> February, 2016**

**4 Regional G-WADI Secretariats participated:**

**1- Arab G-WADI, 2- African G-WADI, 3- Asian G-WADI, 4- European G-WADI**



## **G-WADI Thematic Areas**

**Water Harvesting**

**Water Research Center,  
Sudan**

**Real Time Precipitation  
Estimates**

**University of California  
Irvine**

**Hydrologic Monitoring and  
Forecasting**

**ICIWaRM, Princeton  
University**

**Modeling Tools**

**Cold and Arid Regions  
Environmental and Engineering  
Research Institute (Asia G-WADI )**

**Chemical and Isotopic  
Tracers**

**University of Tsukuba, Japan**

# Link with Technical University of Cologne, Germany

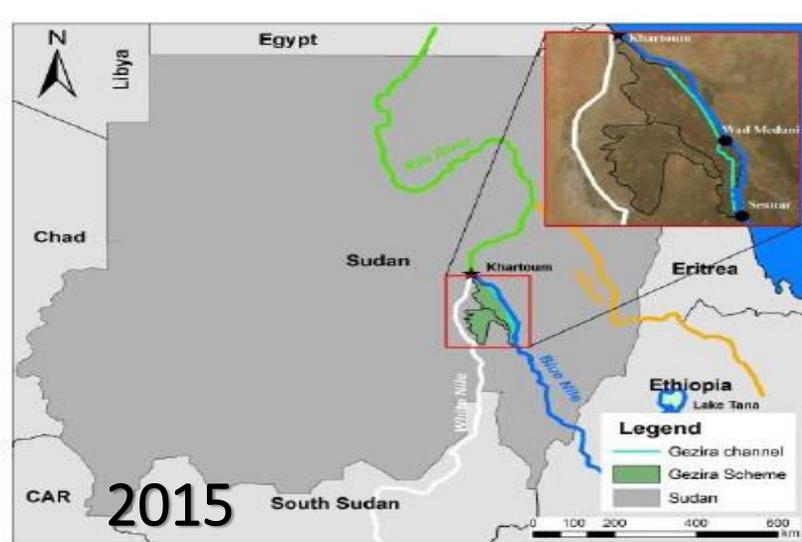
**EBL Project (2012-2016) (Cologne, Khartoum, AAU, Jordan Universities)**

**Funded by DAAD**

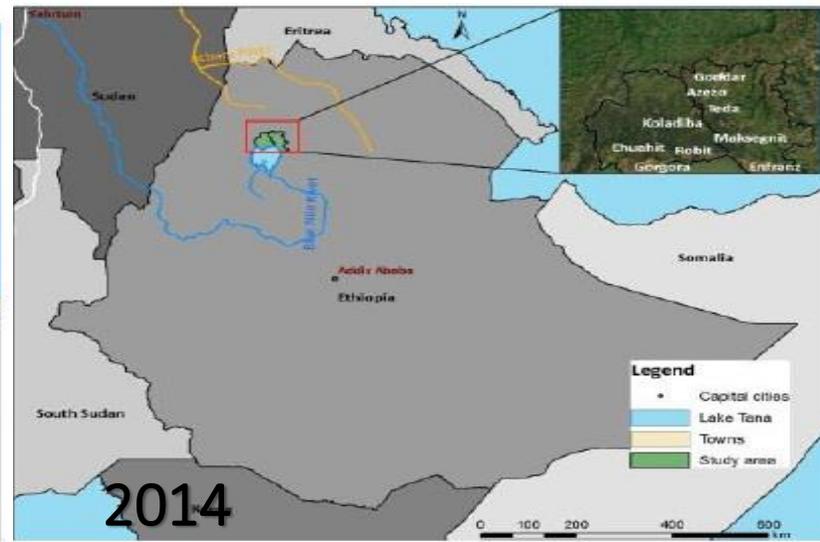
**Joint Student Projects in case study areas**

**MSc. Students Exchange between the four universities**

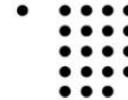
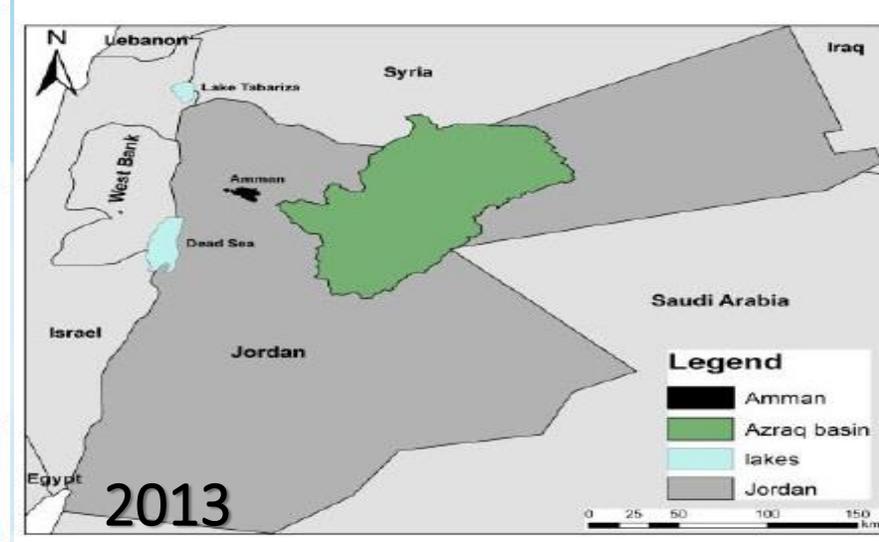
**Gezira Irrigation Scheme, Sudan**



**Gondar Rain-Fed (Dembia – Koladiba)**



**Azraq Groundwater Basin, Jordan**



Fachhochschule Köln  
Cologne University of Applied Sciences

**DAAD**  
Deutscher Akademischer Austausch Dienst  
German Academic Exchange Service

# Enquiry Based Learning (EBL Nexus) Project

## Sudan Joint Student Project (JSP)

**“Challenges of Irrigation Management in Gezira Scheme , Sudan”**  
**28 Nov – 4 Dec, 2015**



Fachhochschule Köln  
Cologne University of Applied Sciences

**DAAD**

Deutscher Akademischer Austausch Dienst  
German Academic Exchange Service



**EBL-Nexus**

**Joint Student Project (JSP)**  
**“Challenges of Irrigation Management in Gezira Scheme in Sudan”**  
**28 Nov – 4 Dec, 2015**



# Link with Technical University of Cologne, Germany

## CNRD

The CNRD is

- An international **network and knowledge hub for natural resources management and development**
- Oriented towards **the Sustainable Development Goals and Post-2015 Agenda of the UN** in research, teaching, and capacity development
- Coordinated by **Technische Hochschule Köln (*University of Applied Sciences*)**

# Objectives of the CNRD

Interdisciplinary research on management of natural resources:  
Water, Land, Energy  
in a regional context

Conduct trans-disciplinary research

Serve as science-policy interface

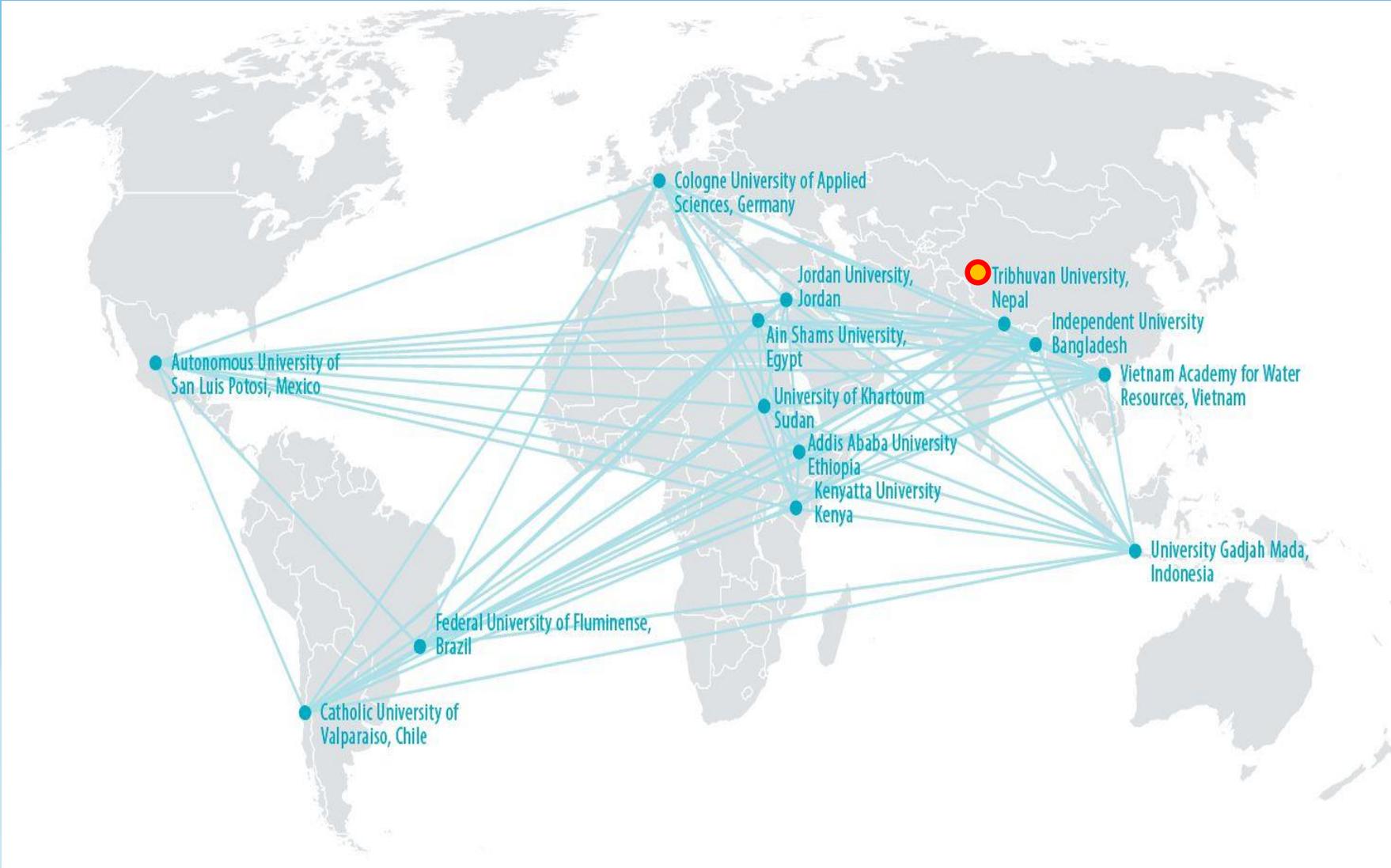
Foster innovation and exchange in higher education

Build a virtual knowledge center

Develop capacities for life long learning

Build and expand network of expertise





Coordinated by TH Köln, Germany

- **Autonomous University of San Luis Potosi, Mexico**
- **Federal University of Fluminense, Brazil**
- **Catholic University of Valparaiso, Chile**
- **Ain Sams University, Egypt**
- **Tribhuvan University, Nepal**
- **University Gadjah Mada, Indonesia**
- **Vietnam Academy for Water Resources, Vietnam**
- **Jordan University, Jordan**

Since 2015, four new partner universities:

- **Addis Ababa University, Ethiopia**
- **University of Karthoum, Sudan**
- **Kenyatta University, Kenya**
- **Independent University of Bangladesh (IUB)**



Bundesministerium für  
wirtschaftliche Zusammenarbeit  
und Entwicklung



DAAD

Deutscher Akademie  
German Academy

CNRD-exceed (Network of 13 Universities)  
Inception Meeting, Cologne, Germany  
March 2015



# Training Workshop on “Mainstreaming Climate Change in the Formulation of Natural Resources Management Strategies & Action Plans” 22 – 24 October 2015 Khartoum – Sudan



## Participating CNRD Partners:

**Addis Ababa University, Ethiopia**



**Tribhuvan University, Kathmandu, Nepal**



**Technische Hochschule Köln (TH Köln),  
Germany.**

**Institut für Tropentechnologie**  
Institute for Technology in the Tropics





# Workshop Themes

- 1. Theory and observations of climate change**
- 2. Models and modelling global climate change including downscaling to regional and local models**
- 3. Climate risk assessment in planning and development of various sectors**
- 4. Formulation of policies and action plans in the context of climate change**

## Participating Institutions

- 1. Ministry of Water Resources, Irrigation & Electricity**
- 2. Ministry of Physical Planning**
- 3. UNESCO NatCom – Khartoum**
- 4. Higher Council for Environment & Natural Resources**
- 5. National Centre for Research**
- 6. Sudanese Metrological Authority**
- 7. University of Medical Sciences & Technology**
- 8. Sudan University of Science & Technology**
- 9. International University of Africa**
- 10. Institute of Environmental Studies**
- 11. Ministry of Agriculture**
- 12. Regional Water Harvesting Centre**
- 13. Dams Implementation Unit**
- 14. University of Khartoum**
- 15. Tribhuvan University**
- 16. Addis Ababa University**
- 17. University of Kassala**
- 18. University of Dongola**
- 19. TEKNO**

# Training Workshop on “Mainstreaming Climate Change in the Formulation of Natural Resources Management Strategies & Action Plans” 22 – 24 October 2015 Khartoum – Sudan



# Training Workshop on “Mainstreaming Climate Change in the Formulation of Natural Resources Management Strategies & Action Plans” 22 – 24 October 2015 , Khartoum – Sudan



# **CNRD Planned Workshop**

**Water Balance and Accounting in the Eastern Nile Using Advanced Methodologies**

**WRC, Khartoum, November, 2016**

- **Participating CNRD Partners**
- **ITT Cologne,**
- **AAU**
- **ASU**
- **Two External Experts**



UNIVERSITY OF  
**OXFORD**

# Link with University of Oxford

- ❖ **Joint Research**
- ❖ **Staff and Student Exchange**
- ❖ **Training Workshops**
- ❖ **MSc and PhD fellowships**



**PhD Student form Oxford Researching  
on the Nubian Sandstone Aquifer**

# **Training Workshop on RIVERWARE Modeling**

- **Application of Riverware Software for Water Resources Management in the Blue Nile .**
- **Main participants : Engineers of the Ministry of Water Resources, Irrigation and Electricity .**
- **Software was developed by (CADSWES) Center For Advanced Decision Support For Water And Environment Systems, University Of Colorado .**
- **Training offered by Kevin wheeler for Oxford University**

# Training Workshop on Riverware Modeling WRC, 10-20 FEB 2016



# Training Workshop on Riverware Modeling WRC, 10-20 FEB 2016



# Link with UNESCO-IHE

UNESCO-IHE  
Institute for Water Education



Cooperation in the eastern Nile basin through The Nile Hydro-Solidarity Program which is funded by UNESCO-IHE

Two staff members have been funded by IHE to obtain their PhD degree as part of this program



NBCBN

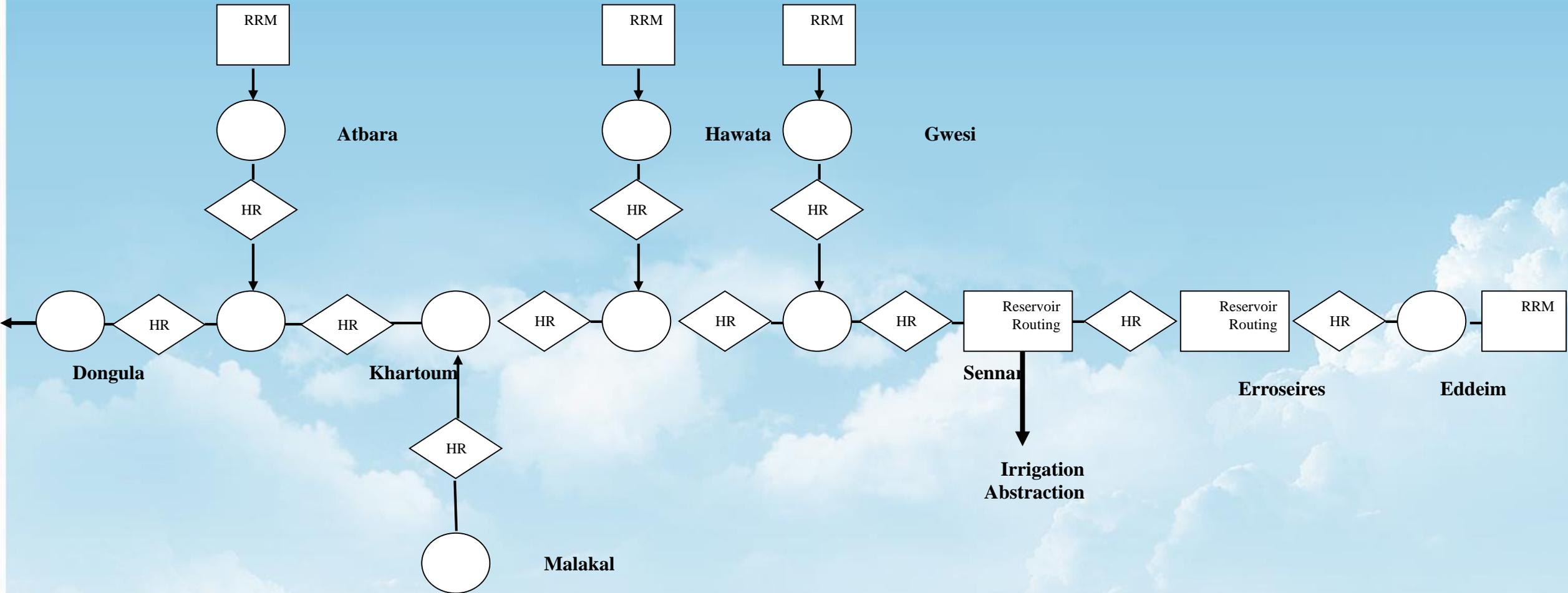
The topic of discussion was capacity development in water diplomacy (water cooperation & peace), and also represent short presentation about "Water Diplomacy" & "Why Water Conflict?"



## **Link ENTRO/NBI**

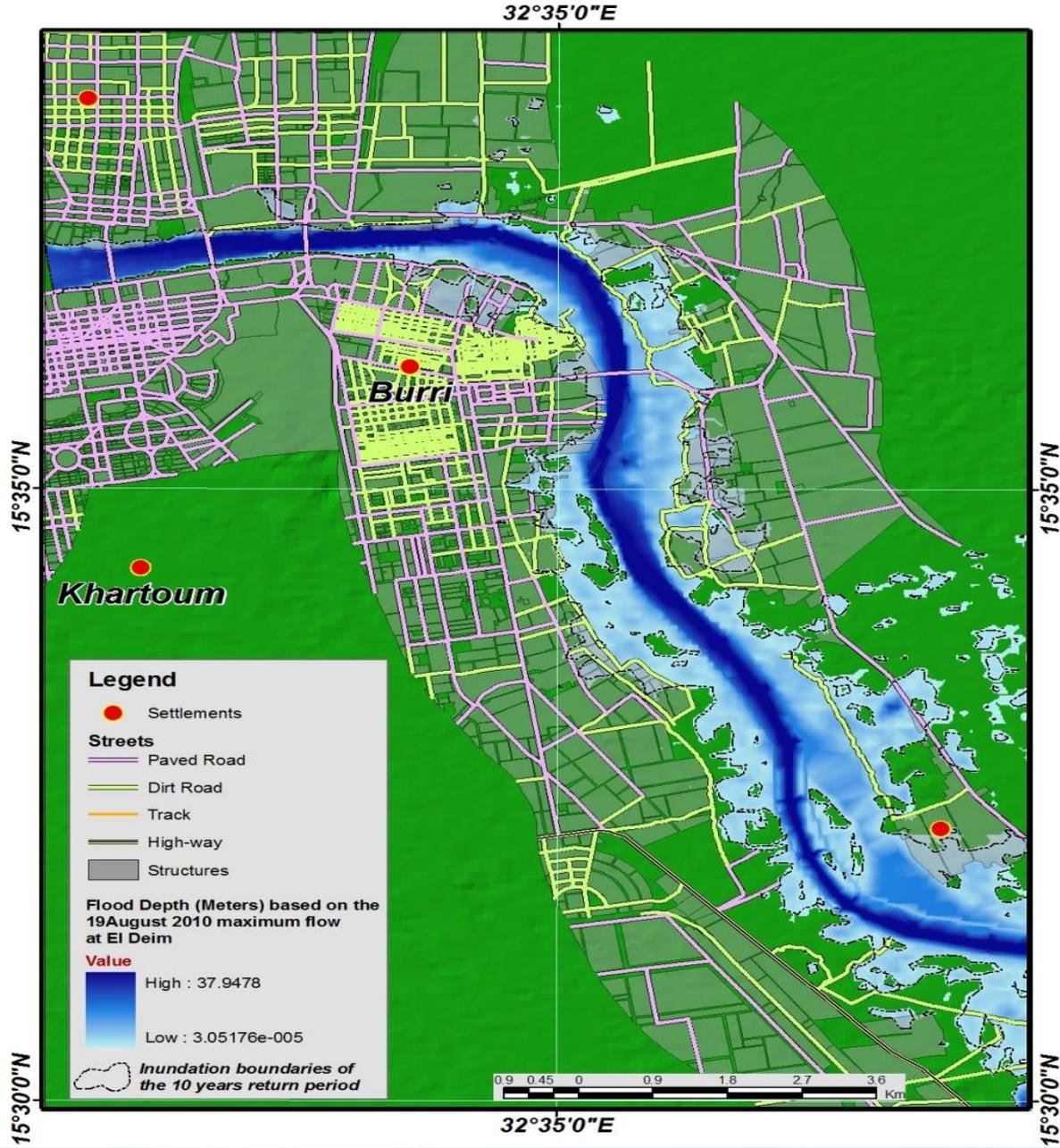
- **Organized 5 Workshops in Khartoum for the Eastern Nile Countries**
- **16 young Professionals from Sudan Participated in the Internship Program (3 months at ENTRO)**
- **Received funds for some studies**
- **Example : Development and Operation of Flood Forecasting and Early Warning System for the Nile in Sudan**

**HR => Hydrologic/Hydraulic Routing**  
**RRM => Rainfall-Runoff Modelling**

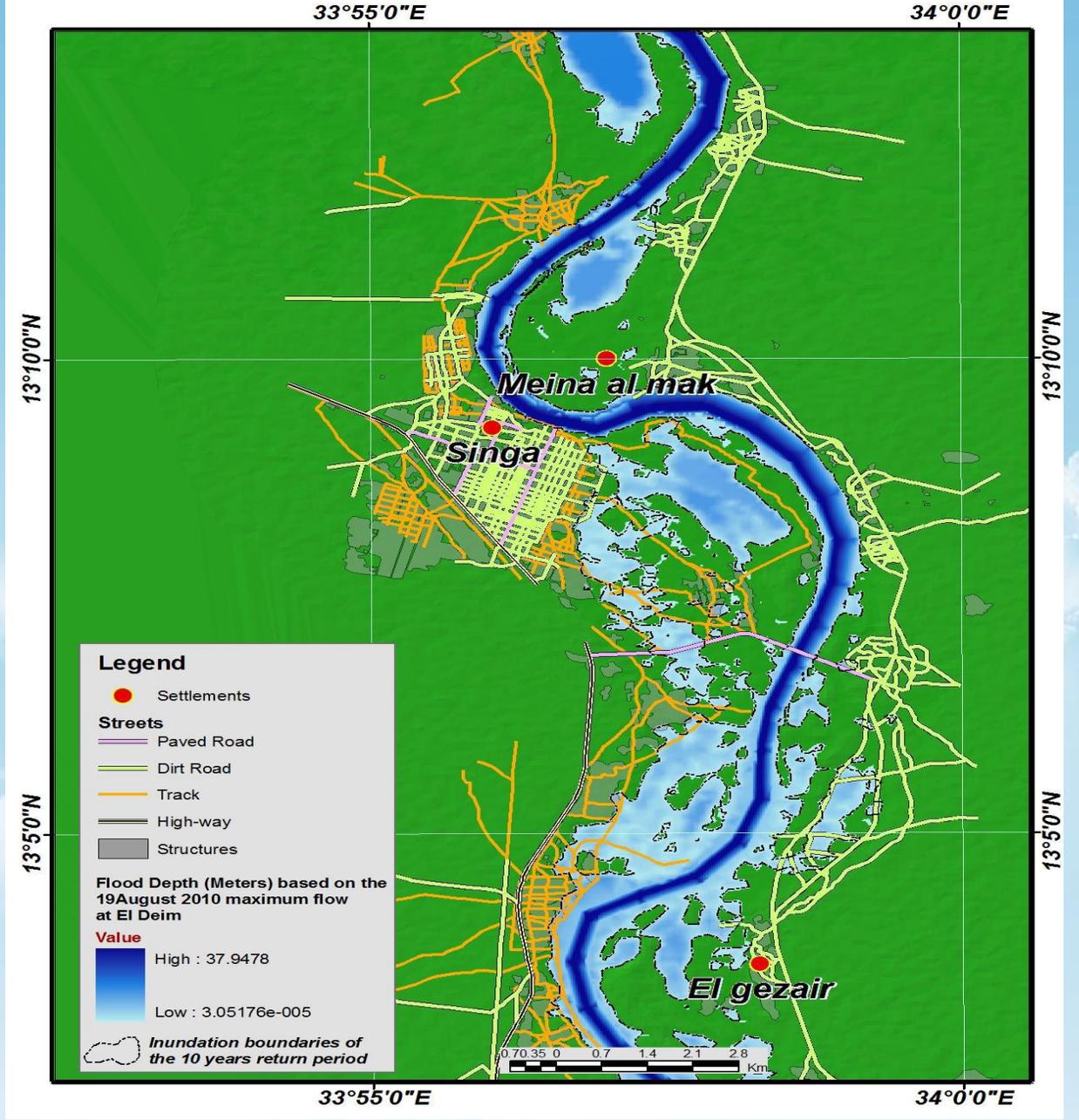


**Figure F4.1: Schematic Diagram for Model Components**

Flood Inundation Map Of Khartoum Area Based On the 19 August 2010 Maximum Flow At El Deim



Flood Inundation Map Of Singa Area Based On the 19 August 2010 Maximum Flow At El Deim



# Link with Addis Ababa



**2014 March (12 – 10) Opportunities for Cooperation in the Eastern Nile**



# Ongoing Studies and Research Activities (Funded by the Ministry of Water Resources, Irrigation and electricity)

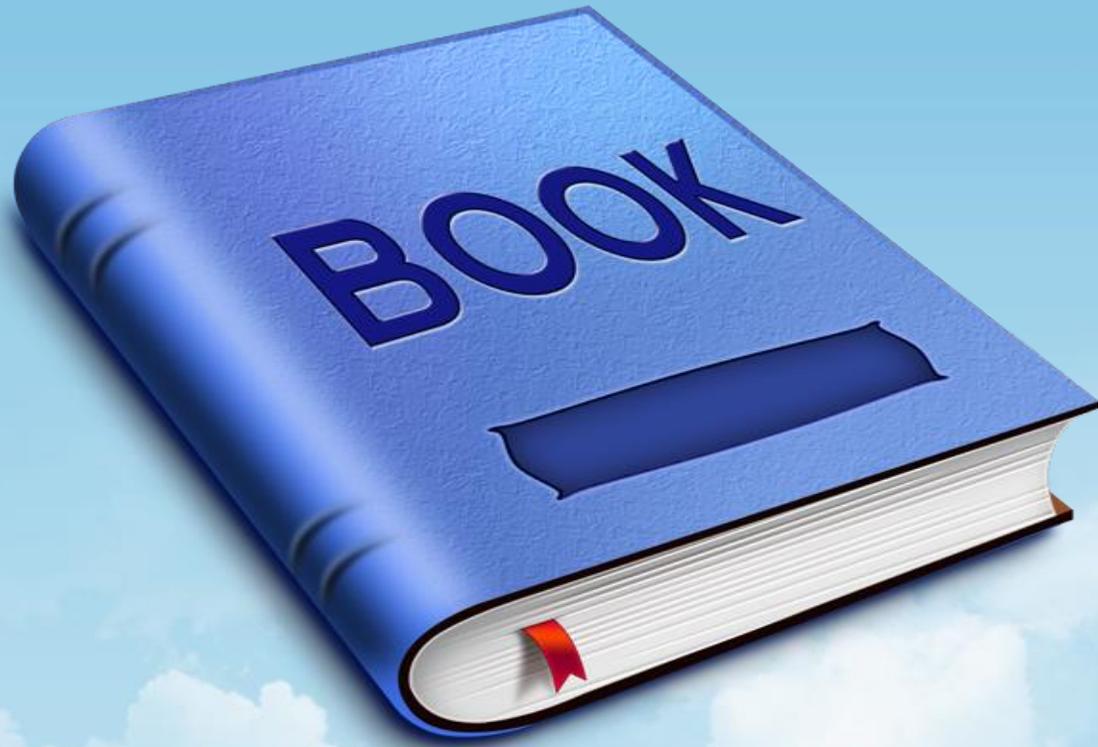
## Impact of the Grand Ethiopian Renaissance Dam (GERD) on:

- **Downstream Hydrology of the Blue Nile.**
- **Reservoir Operation and Hydropower Generation.**
- **River-Aquifer interaction and Groundwater Recharge.**
- **Recession Agriculture.**
- **Environmental Impacts of GERD Reservoir.**
- **Scenarios of GERD filling.**



# **On going projects Funded by the Ministry of Higher Education and Scientific Research**

- 1- Development of Flood Early Warning System for Gash Wadi (FEWS) (In collaboration with Kassala University).**
- 2- Development of Manual for the Design of Water Harvesting Systems in Sudan (In collaboration with UNESCO Category-II Centre in Water Harvesting and Water Harvesting Centre of Nyala University).**



Work is going on a publication  
**“ Water Resources in Sudan”.**

Vol-1: Water Sources

Vol-2: Water Applications

Vol-3: Water Management

Vol-4: Atlas

# What can WRC offer ?

- **The Centre has the capacity and diverse experience to contribute to Africa's water resources development and management.**
- **The Center has the experience in research, education, training and human capacity development**
- **The Center has the experience in networking Nationally, Regionally and Internationally.**
- **The Centre has experience in research support to policy makers in the water sector.**
- **In conclusion, the Centre has the necessary capacity to be part of the NEPAD network C of E.**
- **The Council of the Centre and the top administration of University of Khartoum encourage and support this participation.**



**THANK YOU**

*for your attention!*