

Climate Change Current Activities in Sudan

By

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**Presented in
The regional workshop on the status of climate
change activities in the Nile Basin Countries**

Entebbe–February 8-9, 2010

1. Overview:

Sudan is the largest country in Africa, covering some 2.5 million km² (250 million ha) and stretches from 4° to 22° N, where about one third of it is desert. Its vegetation cover is mainly governed by the amount of rainfall, which is ranging from virtual zero in the north to more than 1400 mm in the south. This dictated its climatic-ecological zones: desert (hyperarid) in the north, passing through semi-desert and savanna (arid, semiarid and subhumid) in the central belt to a true equatorial zone (humid) in the south (Jackson and Harrison, 1958; Andrews, 1948; Goda, 1977; World bank, 1987). Sudan population is approaching 40 million with growth rate of about 2.8 to 3%. It is primarily an agricultural country with 75% of the labor force engaged in cropping, pastoral and forestry activities. The cultivable area is about 96 million ha of which 1.9 million ha is irrigated and 9.6 million ha is rainfed. The irrigated sector produces 95 % of the cotton, 32 % of the groundnuts, most of the vegetables and fruits, and all wheat and sugar grown in the Sudan. Irrigation water is provided from the River Nile, its tributaries, and to a limited scale from groundwater. The rainfed sector produces sorghum and millet, which are the most important staple food for the inhabitants, as well as sesame, short staple cotton, groundnuts and sunflower, which are cash crops. Rainfed agriculture has a very important role in the national economy and food security as it provides a large share of the staple food (about 90 %) and employs 66 % of the total population.

Sudan is one of the top 13 countries regarding the extent of dry land coverage (**Fig. 1**). Hence, climate change poses serious challenges to Sudan's overriding development priorities in agriculture, forestry, water resource management, and health. According to the recent UNEP report, "an estimated 50 to 200 km southward shift of the boundary between semi-desert and desert has occurred since rainfall and vegetation records were first held in the 1930s. This boundary is expected to continue to move southwards due to declining precipitation. The remaining semi-desert and low rainfall savannah which represent some 25 % of Sudan's agricultural land, are at considerable risk of further desertification. This is forecasted to lead to a significant drop (approximately 20 %) in food production."

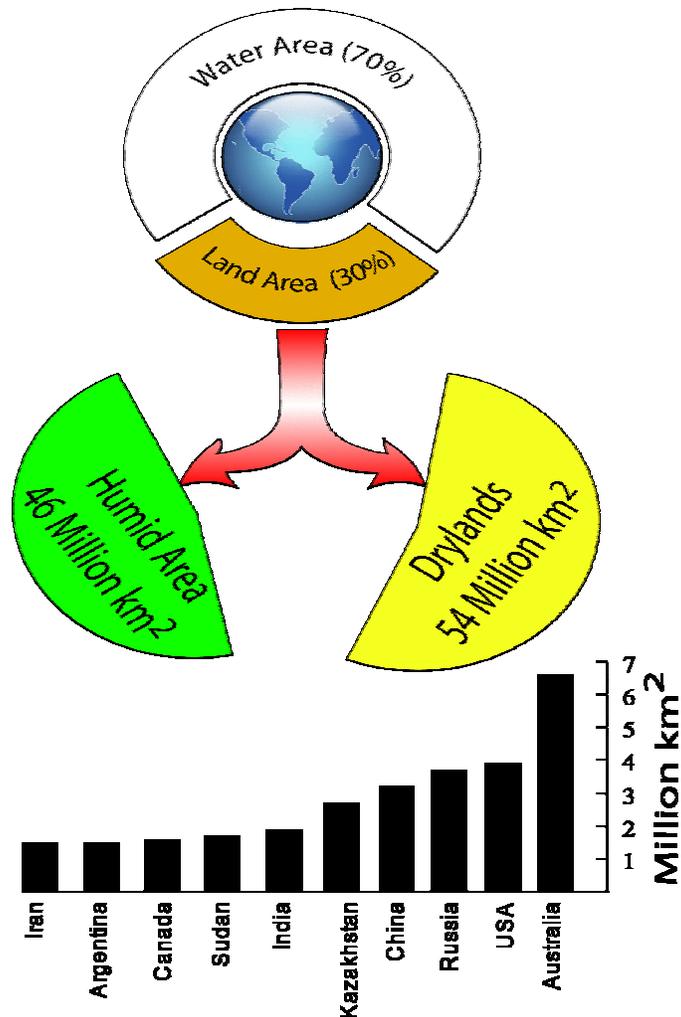


Fig. 1. Global drylands and the top ten countries with more than 1.4 million km² of dryland

One of the most important anticipated effects of climate change on agriculture is directly related to changes in local temperature and rainfall patterns thus directly affecting the length and on-set of the growing season. **Fig. 2 and 3** show an example of the temperature trends indicating clear recent temperature rise in two Stations representing the Northern and Eastern parts of the Sudan. Such changes may well depend on location but, most of the studies revealed a negative consequences in terms of reduced crop yields, increased incidences of heavy rainfall and floods with longer droughts. Those impacts on agricultural activities imposed by higher temperatures, floods and droughts would be devastating in areas with less adaptation capacities and plans as in western and

eastern parts of the country. Changes in growing season and on-set of rainfall would imply changes in cropping patterns and land use which intern may induce land degradation.

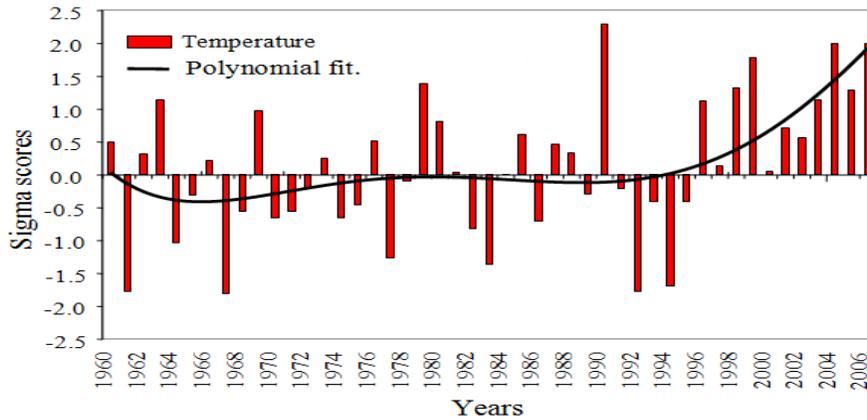


Fig. 2. Annual temperature anomalies and trend at Karema station in Northern Sudan (1960-2006)

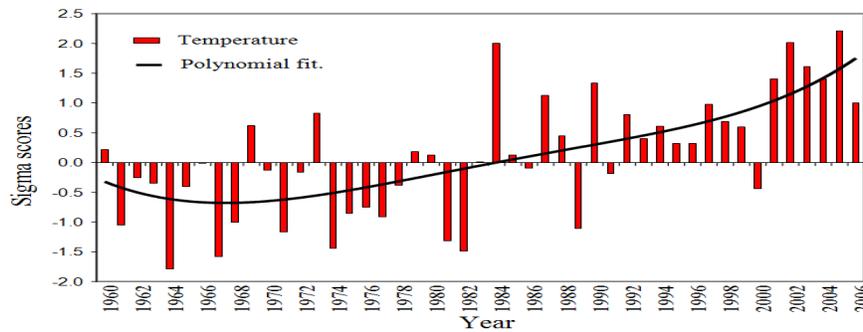


Fig. 3. Annual temperature anomalies and trend at Gedarif station in Eastern Sudan (1960-2006)

Due to land degradation more land has to be put under cultivation to attain an equal amount of yield (Mensching and Ibrahim, 1976; Olsson, 1993). As a result of extensive horizontal expansion, the rainfed agriculture cropped area increased more than five-fold between 1970 and 2000, while total production was unstable and land productivity tended to decrease with time (**Fig. 4**). Mechanized rainfed cultivation continued to expand on the expense of the natural pastures and forests (**Fig. 5**). This antagonism between the rainfed agriculture and natural pastures and forests resulted in land degradation and desertification, which are intimidating the productivity and sustainability of the current land use system. Therefore, two major problems hamper productivity and unsustainably

of the rainfed agriculture in the Sudan those can be identified as: a) variability in climatic conditions, and b) land degradation.

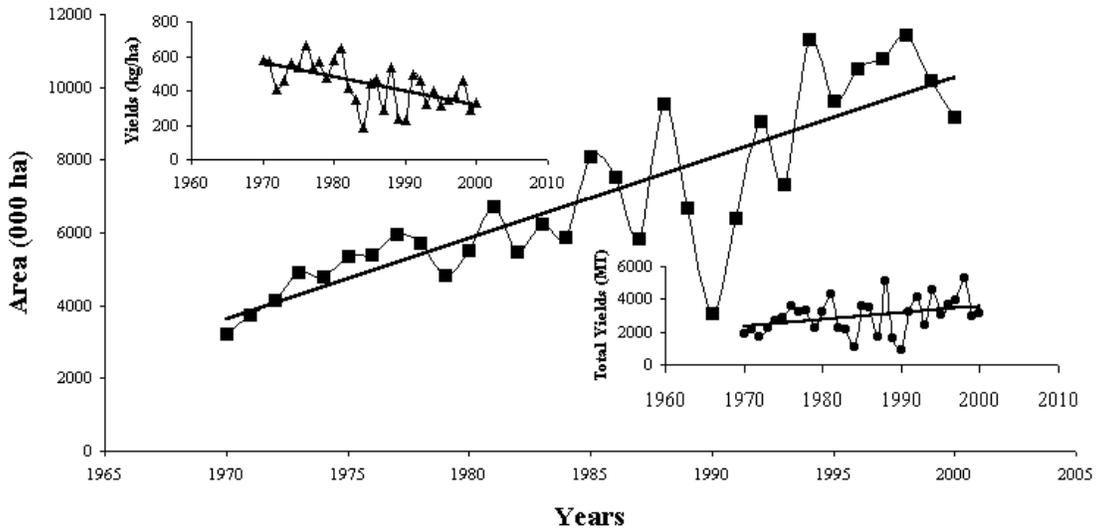


Fig.4. Increases in rainfed agricultural areas, total yields and decline in land productivity in the Sudan. (Data source: AAS, 2001).

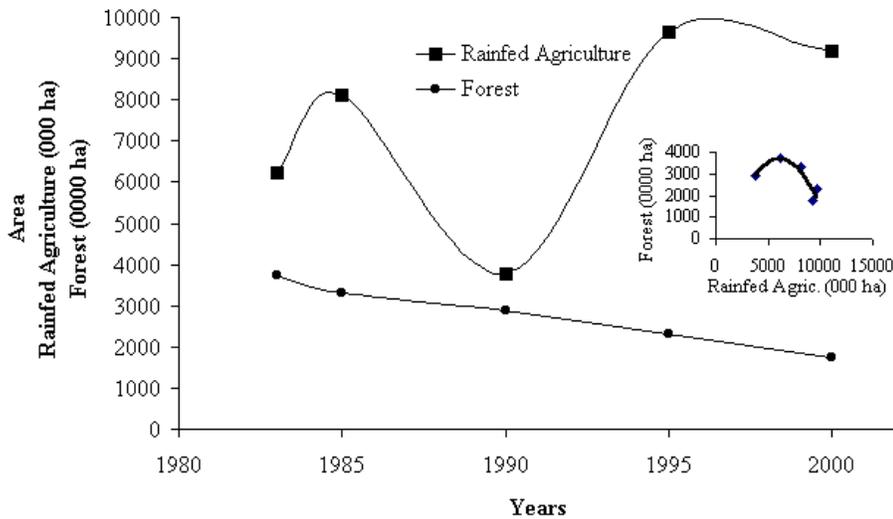


Fig.5. Increases of rainfed land and decreases of forests from 1983 to 2000 in the Western-Central-Eastern regions of the Sudan. (Data source: World Bank. 1986: AAS. 2001)

The impact of climatic conditions on the rainfed agriculture in the arid and semiarid zones (dry farms) is mainly attributed to high variability of rainfall in time and space. Crop yields in the rainfed areas are generally correlated with seasonal rainfall. **Fig. 6A** shows the yields of sorghum, millet, sesame, groundnuts, cotton and sunflower for the

period 1970-2000. Referring to rainfall deviations from the normal in Western, Central and Eastern Sudan (**Fig. 6B**), it is evident that the lowest yields in 1984 and 1990 seasons, have coincided with the lowest rainfall during the two seasons. However, the impact of rainfall on crop yields is not always dependent upon seasonal total rainfall. Equally, rainfall distribution within the season has very significant implications on the yields. This has direct inferences and implications on the food security of the country due to the fact that the rainfed agriculture in Sudan is the major supplier of sorghum and millet the major Sudanese staple food.

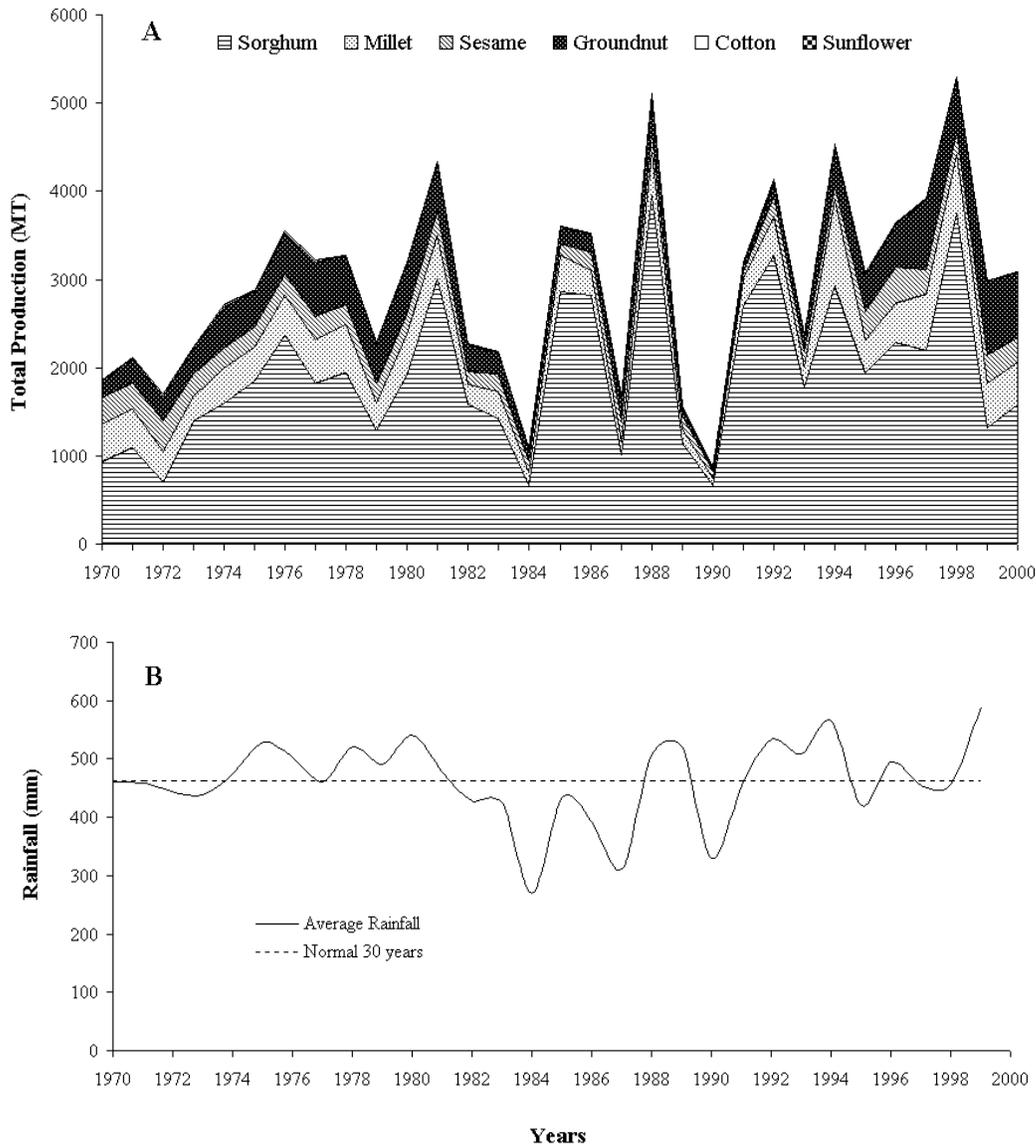


Fig. 6. Total production in rainfed sector (A), and rainfall (B) in the Western-Central-Eastern regions of the Sudan during the period 1970-2000 (Data source: AAS, 2001; Met. Dept., 2000).

2. Sudan and Climate Change:

In an attempt to address climate change and related issues, Sudan has already implemented and completed a number of activities. Sudan ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1993, and submitted, with the assistance of the UNDP/Global Environment Facility, its Initial National Communication (INC) the same year. The Higher Council for Environment and Natural Resources (HCENR), the Government of Sudan's National Focal Point for the United Nations Framework Convention on Climate Change (UNFCCC), plays an advisory policy-making role with regard to climate-related initiatives within the Government. The HCENR is also the national executing agency for the National Adaptation Plan of Action (NAPA) project through the National Execution Modality (NEX). However, Sudan has actively participated within the international community as follows:

- Signed the UNFCCC in Rio1992 and ratified in November 1993.
- Active member, attending all sessions and participation in many UNFCCC activities.
- Active member of the IPCC, a number of experts selected as lead authors in different publications.
- In August 2004, with the support of the Global Environmental Facility, UNDP launched the National Adaptation Programme of Action (NAPA) for Climate Change.
- October 2004 the instrument to ratify the Kyoto Protocol has been signed by the president.
- Chairing 77 & China 2009.

In line with its commitment to the UNFCCC, every four years Sudan is reporting on the national progress on issues related to climate change. In order to develop a strategy for an effective climate change response addressing the long-term local and environmental concerns, capacity-building of the relevant institutions must be undertaken. With the help of the UNDP a project was lunched in September 2007 that addresses the need to ensure the availability of policy related information to support the integration of climate change issues into national development plans; the availability of a national Greenhouse Gas (GHG)

inventory for all possible source/sink categories; the development of a system to ensure this national GHG inventory is kept up-to-date; improved scientific knowledge; and a clear understanding of Sudan's vulnerabilities and adaptation responses to current and future climate change. Nevertheless, the overall objective of the project is to undertake a highly consultative and participatory process of needs assessment to prepare and submit the Second National Communication on Climate Change to the Conference of Parties in accordance with guidance of the UNFCCC, and to strengthen Sudan's capacity to fulfill its commitments to the UNFCCC on a continuing basis.

The project's specific objectives are:

- To prepare an up-to-date national Greenhouse Gas (GHG) inventory and the establishment a national system for regularly updating the GHG inventory.
- To elaborate a programme to mitigate GHG emissions.
- To strengthen the national technical and institutional capacity and institutionalize the National Communications process.
- To increase scientific understanding of vulnerability and adaptation to future climate change in Sudan.
- To prepare the Second National Communication of Sudan and its submission to the COP.

During the course of the project the following achievements were accomplished:

- Two technical teams of experts were established, one on vulnerability and adaptation assessment and the other on greenhouse gases inventory and mitigation;
- Stockholm Environmental Institute was recruited to provide technical backstopping and conducted two training sessions in October. The first sessions resulted in the training of 50 participants in preparation of the Green House Gases (GHG) inventory. The second training session benefited 47 participants who were trained in vulnerability and adaptation approaches, methods and tools for vulnerability and adaptation assessment. In addition, hands-on training on the water and evaluation planning system model was provided.
- Technical teams for GHG inventory comprising 27 national experts were

established with 5 sub-teams representing the following sectors: energy, industry, agriculture, waste, and land-use change and forestry. Data availability and gaps for the GHG sources and sinks were identified.

2.1 General Achievements:

Since 1993 ratification, the government of Sudan through its Higher Council for Environment and Natural Resources (HCENR) has attained the following achievements:

- A national climate change process has been established with active participation from all relevant stakeholders.
- Awareness has been created within the participating institutions and among the public through media and public events.
- Technical capacities are being built within relevant institutions to deal with climate change issues.
- Very useful partnership created with Sudanese Educational and Research Institutes.
- Cooperation and communication links established with other international institutions and parties.
- Establishment of a coordination unit for UNFCCC implementation and DNA for SDM with participation of all relevant institutions.
- Capacities building that include training, workshops, publication, lectures etc.
- Studies that included scenarios.
- Impact of climate change on agriculture, water and health sectors in Greater Kordofan.
- Good practices to adapt to climate change in North Kordofan, North Darfur and Red Sea States.
- Vulnerable areas and sectors to climate change and adaptation options in 5 states study.
- Inventory of GHGs in 5 sectors study.
- Mitigation options to climate change in Energy, Industry, Forestry and Agriculture sectors study.

- Policy options to integrate climate change issues into national development plans study.

3. National Adaptation Program of Action (NAPA) Activities:

The NAPA activities were prepared under the work frame of LDCs program of the UNFCCC. The following objectives are targeted:

- Communication of urgent and immediate needs for adaptation to be finance through the LDC fund.
- Integration of climate change impacts and adaptation into national development planning.
- Hence, a NAPA project was developed and launched in January 2010.

The project partners are the HCENR, UNDP, MIC, and the state governments of Central Equatoria state, River Nile state, Gedarif state, South Darfur state and North Kordofan state. Five areas were identified in these states as shown in **Fig. 7**.

The five zonal focal areas were selected in five states on the basis to represent the ecological zones of the country. The targeted sectors by the project are: Agriculture, water and human health. Hence, the activities in the five states will be as follow:

- Awareness raising, capacity building, introducing climate change problem and its consequences on people livelihood and development and the need for adaptation strategy.
- Identification of the most vulnerable areas (communities) and systems (biological, socio-economic) and the non-climatic factors that increase vulnerability.
- Identification of the urgent and priority adaptation needs for the most vulnerable areas and systems.
- Review of current policies and institutional framework related to the integration and implementation of the NAPA, and needs for improvements.



Fig. 7. Five ecological zones identified by the NAPA project in five states.

Special attention will be given to the Central Equatoria State to achieve the following:

- Training of local experts from the targeted sectors and civil society on climate change and its impacts, UNFCCC, related work in Sudan.
- Introductory workshop for all stakeholders, on climate change impacts and adaptation and the need to develop an adaptation strategy.
- Rapid vulnerability assessment (survey and interviews) involving local people in affected areas, conducted by some of trained local experts.
- Mini workshop to identify the priority adaptation needs and discuss the policies and institutional issues related to the NAPA integration and implementation.

In general the NAPA project involves:

- Wide participation from all stakeholders including the government, research, universities, civil society, local and tradition leaders.

- Enabled comprehensive review and discussion of the State's reports prepared by the local experts at the different stages of consultations.
- Enabled identification of urgent and immediate adaptation needs through working group sessions.
- Attended by and received high political support from the governments of the 5 States.

4. Climate Change Research Activities:

Other research projects addressing the issues of climate change adaptations and mitigations in the country have been developed and can be summarized as follows:

4.1 Ongoing Research:

4.1.1 CarboAfrica Project: *Quantification, understanding, prediction of carbon cycle, and other GHG gasses in Sub-Saharan Africa*

This is a regional project with a main goal aiming at setting up a GHG fluxes monitoring network of Africa using a multidisciplinary integrated approach, in order to: Quantify, Understand, and Predict, GHG emissions in Sub-Saharan Africa and its associated spatial and temporal variability. Hence the overall objectives of the project are:

- High level outreach within the global scientific community of the project's achievements;
- Contribution to sustainable development in sub-Sahara through provision of relevant data and technical assistance;
- Education and training to help African countries participate in international debate on climate change/variability;
- Education and training to EU students on opportunities in Africa and foster collaborative projects

The specific objectives of the projects are:

- Consolidate and Expand Terrestrial Carbon and other GHG Fluxes Monitoring Network of Sub-Saharan Africa.
- Provide an Analysis of the Requirements to Establish a Terrestrial GHG Monitoring Systems for Sub-Saharan Africa

- Understand, Quantify and Predict the GHG Budget for Sub-Saharan Africa and its Associated Spatial and Temporal Variability
- Assess the Current Land Use Change and Evaluate the Potential for Carbon Sequestration in Sub-Saharan Africa in the Context inter alia of the Kyoto Protocol.

CarboAfrica's consortium constituted 16 organizations from five different EU member countries: (France, Germany, Italy, Sweden, United Kingdom), 3 African countries: (Congo, South Africa, Sudan) and FAO.

The project has 7 work packages, these are:

- Wp1: Long-term observation systems & data integration and consolidation (Agricultural Research Corporation, Sudan).
- Wp2: Process understanding of carbon fluxes of Sub-Saharan African Ecosystems (Agricultural Research Corporation, Sudan).
- Wp3: Model-data integration for up-scaling to region and continent (Agricultural Research Corporation, Sudan).
- Wp4: Fire-Climate-Carbon cycle interactions on regional & continental scale.
- Wp5: Communications and capacity building.
- Wp6: Evaluation of a sustainable sequestration potential in relation with CDM.
- WP7: Project Management.

The project is expected to accomplish the following outputs:

- Fully operational Carbon monitoring network within key regions;
- Carbon/Climatic/soil/vegetation data & public-domain database;
- Thematic maps & remotely sensed products of Sub-Saharan Africa, harmonized & geo-referenced;
- Fire mapping and emissions;
- Models tested & validated, from region to continent level;
- Standards and protocols;
- Web & electronic dynamic tools;
- Communication & capacity building activities;
- Sub-regional seminars, scientific conferences, training courses

- Production of national and regional carbon strategies;
- Training on the Kyoto Protocol and CDM opportunities;
- Final plan for using and disseminating knowledge.

4.1.2. Managing Risk, Reducing Vulnerability and Enhancing Productivity under a Changing Climate:

It is a regional four-year project funded by the Climate Change Adaptation in Africa (CCAA) program of the International Development Research Centre (IDRC) and the Department for International Development (DFID) launched in 2007 and being executed by the Tanzanian Sokoine University as lead institute with partners from Research, Education and Meteorological institutions of Sudan, Ethiopia Kenya and Tanzania in addition to ICRISAT and other NGOs. The overall aim of the project is to develop and avail innovative strategies for mitigation of, recovery from, and resilience to climate-induced crises affecting smallholder farmers in the Greater Horn of Africa. As development of such systems requires establishment of a knowledge base that facilitates a well-defined action process by fostering greater understanding of the linkages between climate-related events and vulnerability under different social, political, and economic contexts; development of robust decision making tools for improved strategic and tactical decision making; and formulation of guidelines and mechanisms for multi-stakeholder consultations. The project pursues the following specific objectives.

1. Expand the overall knowledge base on climate variability and change; its impacts and associated physical and economic vulnerabilities.
2. Develop and avail appropriate decision aids that support strategic and tactical decision making in designing/selecting appropriate responses to manage risks, reduce vulnerabilities and capitalize on opportunities created by variable climate.
3. Assess the impacts of climate change on vulnerability of agricultural systems and the adequacy of the current management options and adaptation strategies to effectively meet the challenges from changing climate.

4. Enhance the operational and technical capacity of national institutions to develop and disseminate regularly updated climate knowledge, products and adaptation plans. The project is expected to deliver the following outputs;
 - 1- The overall knowledgebase on impacts of climate variability and associated physical and economic vulnerabilities, enhanced.
 - 2- Decision aides that support strategic and tactical decision making in selecting appropriate responses to manage risks and capitalize on opportunities created by variable climate, developed and availed.
 - 3- Impacts of climate change on vulnerability of agricultural systems assessed and the adequacy of the current management options and adaptation strategies to effectively meet the challenges evaluated.
 - 4- Operational and technical capacity of national institutions to develop and disseminate regularly updated climate knowledge, products and adaptation plans enhanced.

4.2. Up-coming Research

4.2.1. Climafrica Project: Climate change predictions in Sub-Saharan Africa: impacts and adaptations:

The project will be funded by the EC-FP7 (The project will be realized through the cooperation of 18 scientific institutes (9 European and 8 African institutes) and the FAO (Food and Agriculture Organization of the United Nations).

The specific objectives of the project are:

- Develop improved forecasting models on seasonal to decadal climatic scales, especially relevant to SSA
- Assess climate impacts in key sectors of SSA livelihood and economy, especially water resources and agriculture
- Evaluate the vulnerability of ecosystems and civil population to inter-annual variations and longer trends in climate.
- Suggest and analyze new suited adaptation strategies, focused on local needs.
- Develop a new concept of 10 years early warning system, useful for food security, risk management and civil protection in SSA.

- Analyze the economic impacts of climate change on agriculture and water resources in SSA and the cost-effectiveness of potential adaptation measures.

The project consists of 8 work packages as follow:

- Effects of past climate variability on ecosystem productivity and water cycle
- Feedbacks between climate variability / changes and the land surface. Improving modeling seasonal to decadal climate predictions.
- Analysis of climate impacts on key ecosystem services (water, agriculture).
- Development of a medium-term Early Warning system for food and water vulnerability and adaptation strategies.
- Socio-economic implications of climate change impacts and adaptation measures in Sub-Saharan Africa.
- Regional case studies in Africa.
- Project Management
- Dissemination and exploitation of project results

5. Gaps related to climate change adaptation and mitigation in Sudan:

Table (1) summarizes the identified gaps related to climate change and variability in Sudan in terms of nature, importance and required time span for coverage.

Table 1. Knowledge and research Gaps related to climate change adaptation, mitigation and variability in Sudan

No.	Item	Nature	Importance	Time span
1	Risk/vulnerability assessments/mapping	Desk studies/field surveys	Very high	Short/long
2	Met Stations coverage/data	Hard & Software	High	Medium/long
3	Improved cultural practices (rainfed sector)	Research	Very high	Short/medium
4	Improved varieties (rainfed sector)	Research	Very high	Medium/long
5	On farm water use efficiency (irrigated sector)	Research	Very high	Short/medium
6	Climate downscaling models	Capacities	Very high	Short/medium
7	Crop simulation models	Capacities	Very high	Short/medium
8	Water resources assessment	Desk studies	Very high	Short/medium/long
9	Out scaling good practices	Technology transfer	Very high	Short/medium/long
10	Policies	Capacities/analysis	Very high	Short/medium/long
11	Awareness	Media	Very high	Short/medium/long
12	Community participation	Socioeconomic/ governance	Very high	Short/medium/long
13	Private sector (insurance, networking, information exchange etc)	Services	Very high	Short/medium/long
14	Coordination/cooperation	Institutional	Very high	Short/medium/long
15	Early warning (flood/drought)	Institutional/capacities	Very high	Short/medium/long

6. Identified priorities (*not in order*)

- Formulating policies and programs to address the impact of climate change with a bottom-up approach and the associated socio-economic benefits.
- Mainstreaming adaptation into country developmental programs (all sectors).
- Documenting indigenous knowledge systems on coping mechanisms to climate variability.
- Communicating information on weather forecasting to rural communities as adaptation strategies to climate variability.

7. Strategies

- 1- Capacity building on climate change scenarios and risk analysis.
- 2- Public awareness on climate change issues and implications.
- 3- Crises management;
- 4- Diversification of livelihood
- 5- strategic food and crop storage reserves
- 6- Infrastructures and communication facilities.
- 7- Technology transfer.
- 8- Afforestation and reclamation of marginal and waste lands with proper incentives for public and private sectors.
- 9- Combat desertification and land degradation.
- 10- Sustainable and integrated water resources management including generous spending on water storage facilities.
- 11- Urban development and industrialization that takes climate and environmental issues on board (climate-proof projects).
- 12- Active participation and involvement in regional and international forums and research support related to climate change adaptation and mitigation.
- 13- Utilization of cost-effective-environmental friendly alternative energy sources with proper incentives and penalties.

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