



REPUBLIC OF SUDAN

National Council for Combating Desertification (NCCD)

Sudan National Drought Plan

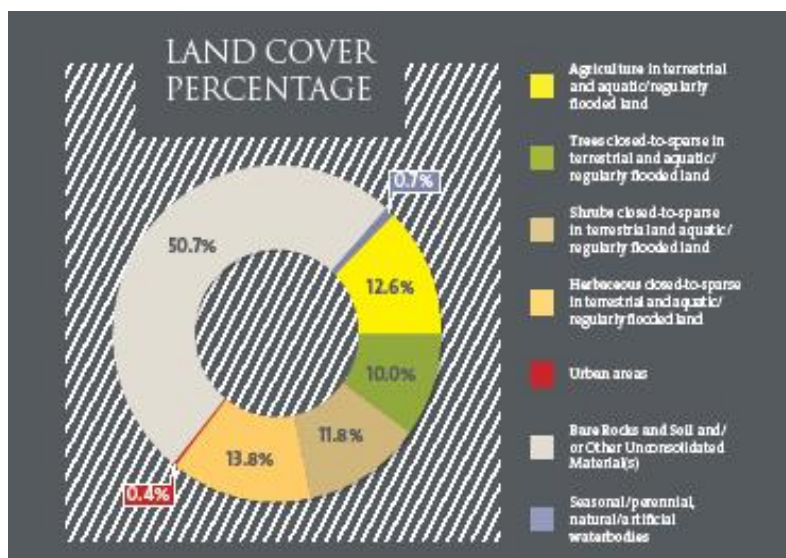
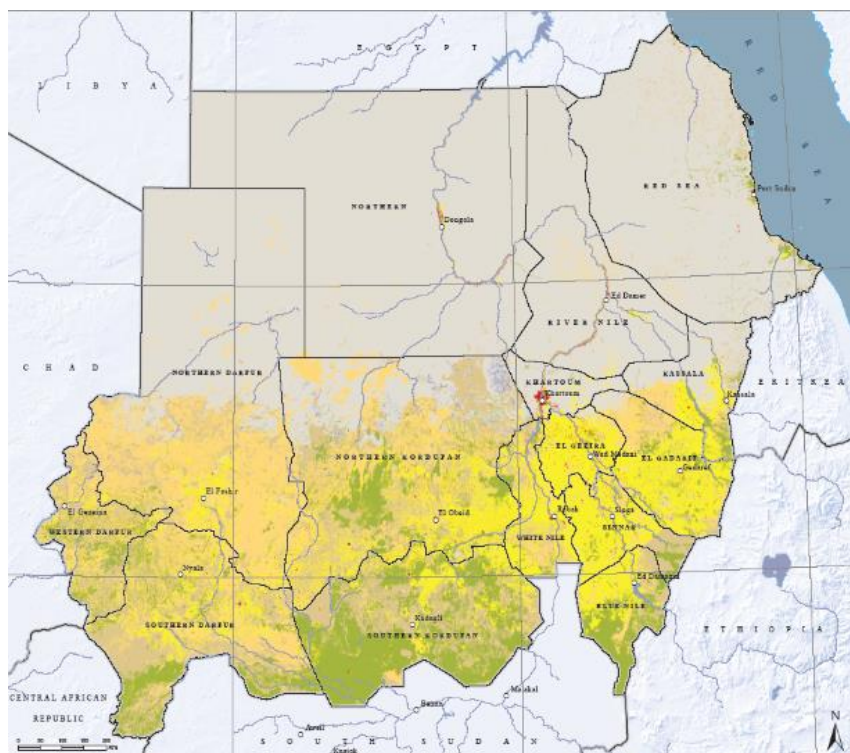
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Abbreviation

AfDB	African Development Bank
ARC	Agricultural Research Corporation
AREP	Agricultural Revival Executive Programme
ARRC	Animal Resources Research Corporation
BD	Biodiversity GEF Focal Area
BRICKS	Building Resilience through Innovation, Communication and Knowledge Services project
CAHWs	Community Animal Health Workers
CBO	Community Based Organisation
FAO	Food and Agriculture Organisation (United Nations)
GIS	Geographical Information Systems
HCENR	Higher Council for Environment and Natural Resources
HAC	Humanitarian Affairs Commission
HVC	Hazards, Vulnerabilities and Capacities
ICPAC	IGAD Climate Predication and Application Centre
IP	Indigenous People
IEM	Integrated Ecosystem Management
INRM	Integrated Natural Resources Management
IWRM	Integrated Water Resources Management
IGAD	Intergovernmental Authority for Development
IPCC	Intergovernmental Panel on Climate Change
I-PRSP	Interim Poverty Reduction strategy Paper
ISN	Interim Strategy Note
ICRC	International Committee of the Red Cross
IDNDR	International Decade for Natural Disaster Reduction
IDA	International Development Association
IFRCs	International Federation of Red Cross and Red Crescent Societies
IFAD	International Fund for Agricultural Development
IMF	International Monetary Fund
IUCN	International Union for Conservation of Nature
IUCN-EARO	International Union for Conservation of Nature, Eastern Africa Regional Office
LDC	Least Developed Country
LDN	Land Degradation Neutrality
MAF	Ministry of Agriculture and Forestry
MAR	Ministry of Animal Resources
MCIT	Ministry of Communications and Information Technology
MD	Ministry of Defence
ME	Ministry of Education

MFGC	Ministry of Federal Governance Chamber
MFA	Ministry of Foreign Affairs
MH	Ministry of Health
MHES	Ministry of Higher Education and Science
MI	Ministry of Interior
MIWRE	Ministry of Irrigation, Water Resources and Electricity
MSSD	Ministry of Solidarity and Social Development
NAP	National Action Plan
NAPA	National Adaptation Plan of Action
NCCD	National Council for Combating Desertification
NDMC	National Drought Mitigation Centre
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental Organisation
NIC	National Interim Constitution
OCHA	Office for the Coordination of Humanitarian Affairs (United Nations)
PPP	Public Private Partnership
RRC	Relief and Rehabilitation Commission
SADC	Southern African Development Community
SAP	Structural Adjustment Programme(s)
SMA	Sudan Meteorology Authority
UN	United Nations
UNICEF	United Nations Children's Fund
UNCBD	United Nations Convention on Biodiversity
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNDRO	United Nations Disaster Relief Office
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNEP	United Nations Environment Programme
UNHCR	United Nations High Commissioner for Refugees
UNISDR	United Nations Office for Disaster Risk Reduction
USAID	United States Agency for International Development
WB	World Bank
WCDR	World Conference on Disaster Reduction (17-24 January 2005, Kobe, Hyogo, Japan)
WFP	World Food Programme
WHO	World Health Organisation
WMO	World Meteorological Organisation

Map of Sudan - Land cover map of the Sudan¹



¹ Ministry of Agriculture and Forestry and FAO Project OSRO/SUD/620/MUL “Land Cover Atlas of Sudan” 2012 - <http://www.fao.org/3/a-be896e.pdf>

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Executive Summary

Historically, the Sudan government has responded to different disasters in a reactive way, with an emphasis on humanitarian action and recovery. There has been many attempts thus far to address disaster risk as a cross-cutting development issue that can support the achievement of the national strategic development goals and reinforce community resilience. The national constitution and supported legislations, policies and directives are set to conserve and protect the national resources of the country, whether human resources, natural resources, infrastructures, investment and national security. The Policy Framework for DRM in Sudan contains guiding and cross-cutting principles, toward main objective of “Secure and protect the lives, livelihoods and rights of people in urban and rural settings against disaster risks and ensure national commitment to political, social and economic development of all people of Sudan”.

The government system included different federal ministries that has been supported by specialised technical councils and agencies to ensure that the country and its national resources are protected and developed for the better welfare of the people of the Sudan. Each of the government structure has its mandates and responsibilities to address potential risks in their respective field of specialisation. The different efforts, actions and achievements will be reflected in achieving the planned development strategies and thus the sustainable development goals by 2030. However, the weaknesses or shortcomings in coordinating, harmonising and fulfilling the different mandates and responsibilities regarding potential risks may develop into disaster. Therefore, there is a need to have a national drought policy and plan to guide, follow up, monitor and ensure that any emerging potential drought risks are addressed timely, before it results in disasters.

The purpose of the Sudan National Drought Plan is for the government and UNCCD to begin with fairly clear ideas on what the critical issues of drought are and in which areas the government and UNCCD would be best prepared to provide different types of support. The National Drought Plan Scope is broad, encompassing outcomes and the extent to which programmes, project, soft assistance, partners’ initiatives and synergies among partners that will contributes to its achievement. The drought planning aims to identify progress towards results, precipitate decisions that would increase the likelihood of achieving results, enhance accountability and learning.

The Policy Framework for drought in Sudan contains guiding and cross-cutting principles, toward the main objective of DRM. Therefore, there is a need to recognize the existing economic consequences and potential future contributions of vulnerable communities to development and poverty alleviation efforts in the country. Consequently, the related political and policy processes needed to review the current disaster and drought policies and fully integrate gender mainstreaming and vulnerability to disasters into national and regional development programmes and plans. According to the constitution and the outcomes of the National Dialogue, the

governance system in the country has full participation and engagement of the different traditional institutions from the village level to the administrative units, to the locality, to the state and to federal levels. This is reflected in the composition of the village development committees, locality popular committees, state assemblies and national assembly, where the gender mainstreaming is reflected in the percentage provided for women in those governance structures. Similarly, the national development strategies included among others, the protection and development of risk-based drought and flood management, and livelihood support for diversification of incomes and employment opportunities, to enable vulnerable and poor members of the community (women and youth) to access productive activities, and be able to enter domestic, regional and international markets.

This is in line with the UNCCD Convention which contains references to women and girls, as it pertains primarily to increasing the participation and capacities of women to combat desertification and land degradation. However, in drought prone areas and rural context the role of women and children is very essential to contribute with human energy for livelihood activities and environment protection. The UNCCD obligated Parties to “integrate strategies for poverty eradication” in their efforts to combat land degradation. Given the well-established relationship between gender inequality and poverty, UNCCD implementation efforts would, therefore, benefit from clear engagement and women’s empowerment in the successful eradication of poverty and in measures addressing land degradation and desertification. The NDP formulated a special sections on gender and poverty issues.

The Sudan National Drought Plan (NDP) made use of the lessons learned from all previous work on combating desertification in the country and good experiences from neighbouring states in the East Africa and IGAD regions. The plan accommodated the new evolution in the political economy and human development in the country with special references to the drought prone areas. The NDP accommodated the lessons learned from the different pilot interventions by development partners and humanitarian assistance agencies in addressing drought issues. Those experiences included watershed management, water harvesting modalities, water conservation practices, selection of drought resistant trees, shrubs and field crops, rehabilitation of grazing grounds, women participation and engagement, pest and diseases control, livestock feed and management, drinking water distribution, and different spatial designs for control of wind and water erosion...etc. the NDP reviewed the institutional, human resources and budgetary challenges to achieve the intended goals and objectives in addressing land degradation, combating desertification and achieving land degradation neutrality targets.

1. BACKGROUND

Sudan context for drought and desertification:

Sudan is a large African country with an area of 1.87 million km². The majority of Sudan is a gently sloping plain covered by rangelands, pasture and dry forests. The north of the country is largely desert, shifting progressively to semi-desert, low rainfall savannah and high rainfall savannah towards the south. Rainfall varies, north to south, from 25-700mm and falls in 2-3 months between June and October, with temperatures ranging from 30-40°C in summer and 10-25°C in winter. The Nile water basin contributes most of Sudan's available surface water, transporting over 93 cubic metres of water per year on average, though only a fifth of this may be used in accordance with the 1959 water use treaty with Egypt. The following estimation of land cover in Sudan was released in 2012 by FAO, based on interpretative work by the Sudanese Remote Sensing Authority:

Table 1. Land cover classes in Sudan²

Land Cover Class	Area (ha)	%
Agriculture in terrestrial and aquatic/regularly flooded land	23,710,025	12.6
Trees closed-to-sparse in terrestrial and aquatic/ regularly flooded land	18,733,182	10
Shrubs closed-to-sparse in terrestrial and aquatic/ regularly flooded land	22,231,327	11.8
Herbaceous closed-to-sparse in terrestrial and aquatic/ regularly flooded land	25,982,720	13.8
Urban areas	730,331	0.4
Bare Rocks and Soil and/or Other Unconsolidated Material(s)	95,277,727	50.7
Seasonal/perennial, natural/ artificial water bodies	1,290,000	0.7
Total land	187,955,312	100

The most important disaster that threatens Sudan is drought. The total area considered as drought prone area is estimated at 690,000 sq. km, and this area produces 90% of the cultivated food crops and 85% fire wood. In recent history, the severe droughts affecting Sudan were in 1886, 1967-1973, and 1980 -1984. Successive years of drought in certain parts of the Sudan have caused severe shortages of food, social disruption, displacement, widespread health and nutritional problems. Episodes of drought vary in their intensity as it is expected in a country of a wide range of ecological zones. Local drought may extend for several years and therefore has direct negative impacts on natural resources and people livelihood. This has been the

² FAO land cover database Sudan, 2012

cause for internal migration and displacement, while pastoral communities adjusted their livestock herd structure/composition to reduce losses and adapt to the drought cycles and waves. The depletion of the natural vegetation is a direct cause for movement of top soil in form of dust storms and sand-dunes movement that resulted in soil degradation, damage to the fertile farming areas, growing crops, water sources, houses, and social infrastructures.

Understanding Drought: Meteorological, Agricultural, Hydrological and Socioeconomic Drought

Drought is among the most devastating of natural hazards – crippling food production, depleting pastures, disrupting markets, and, at its most extreme, causing widespread human and animal deaths. Droughts can also lead to increased migration from rural to urban areas, placing additional pressures on declining food production. Herders are often forced to seek alternative sources of food and water for their animals, which can create conflict between pastoral and farming communities (FAO, 2018)³.

In recent years, droughts have resulted in some of the most high-profile humanitarian disasters – including the recent crises in the Horn of Africa (2011) and the Sahel (2012) regions, which threatened the lives and livelihoods of millions of people. In the past, droughts were not always so disastrous and are often part of a regular climate cycle, as was the case in the Horn of Africa’s drylands and in the Sahel. However, the greater frequency of droughts and more erratic nature of rains in many countries, combined with underlying economic, social and environmental vulnerabilities have meant that droughts have an increasingly destructive impact on at-risk populations (FAO, 2018).

Drought Definitions and types

The review of the several studies devoted to the drought issues in the Sudan indicated that available definitions demonstrate a multidisciplinary interest in drought. It is useful to subdivide definitions into four types on the basis of disciplinary perspective namely meteorological, hydrological, agricultural, and socioeconomic

Based on AgriInfo, 2015, the following are definition, types and classification of drought

Definition:

Drought is generally defined as an extended period - a season, a year, or several years - of deficient precipitation compared to the statistical multi-year average for a region that results in water shortage for some activity, group, or environmental sector (NDMC, 2008). However,

³ FAO, Special Report - FAO Crop and Food Supply Assessment Mission to the Sudan, 15 March 2018.

dozens of more specific drought definitions are used around the world according to the lack of rain over various time periods, or measured impacts such as reservoir levels or crop losses. (UNISDR)⁴

Therefore, drought can be defined according to meteorological, agricultural, hydrological, and socio-economic criteria (FAO)⁵, as follows:

1. Meteorological, when precipitation departs from the long-term normal;
2. Agricultural, when there is insufficient soil moisture to meet the needs of a particular crop at a particular time. Agricultural drought is typically evident after meteorological drought but before a hydrological drought;
3. Hydrological, when deficiencies occur in surface and subsurface water supplies;
4. Socio-economic, when human activities are affected by reduced precipitation and related water availability. This form of drought associates human activities with elements of meteorological, agricultural, and hydrological drought.

Droughts have significant economic, environmental, and social impacts, both direct and indirect. Many economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. The web of impacts may become so widespread that it is often difficult to determine accurate financial estimates of damages.

Classification of Drought:

Drought on different basis is generally classified into three categories

A. On the basis of source of water availability:

Drought is classified into three types on the basis of water availability.

1. Meteorological drought:

The meteorological droughts mainly indicate deficit rain of different quantum. The IMP classified this drought as follows from the rainfall departure.

- i. Slight drought: When rainfall is 11 to 25% less from the normal rainfall.
- ii. Moderate drought: When rainfall is 26 to 50% less than the normal rainfall.
- iii. Severe drought: When rainfall is more than 50% less than the normal rainfall

2. Hydrological drought:

It is defined as the situation of deficit rainfall when the hydrological sources like streams, rivers, lakes, wells dry up and ground water level depletes. This affects industry and power

⁴ <http://www.un-spider.org/risks-and-disasters/natural-hazards/drought>

⁵ <http://www.fao.org/docrep/017/aq191e/aq191e.pdf>

generation. Hydrological drought is also defined as a deficit of water supply in time, in area or in both, with deficit magnitude and deficit duration taken into account (Yevjevich, 1967)⁶. A water supply deficit is defined relative to a specified water demand level.

3. Agricultural drought:

This is the situation resulted from inadequate rainfall, when soil moisture falls too short to meet the water demands of the crop during growth. Thus affects crop may wilt due to soil moisture stress resulting into reduction of yield.

B. On the basis of time of occurrence:

Drought differs in time and period of their occurrence and on this basis Thornthwaite⁷ delineated following three areas.

1. Permanent drought area:

This is the area generally of permanent dry, arid and desert regions. Crop production due to inadequate rainfall is not possible without irrigation. In these areas vegetation like thorny shrubs, xerophytes etc. are generally observed.

2. Seasonal drought:

It occurs in the regions with clearly defined as rainy (wet) and dry climates. Seasonal drought may occur due to large scale seasonal circulation, mainly happens during the months of May – October annually.

3. Contingent drought:

This results due to irregular and variability in rainfall, especially in humid and sub humid regions. The occurrence of such droughts may coincide with grand growth periods of the crops when the water needs are critical and greatest resulting into severity of the effects and therefore reduced productivity and production.

C. On the basis of medium:

On the basis of medium in which drought occurs. Mexico (1929) has divided the drought into two types.

1. Soil drought:

It is the condition when soil moisture depletes and falls short to meet potential

⁶ Yevjevich, V. M. (1967); An objective approach to definitions and investigations of continental hydrology drought. Colorado State university Hydrology Paper no. 23, Fort Collins, Colorado,

⁷ As reflected in Johannes J. Feddema, Article in Physical Geography, November 2005; “A Revised Thornthwaite-Type Global Climate Classification; University of Victoria 79 Publications 5,996 Citations.

Evapotranspiration of the crop.

2. **Atmospheric drought:**

This results from low humidity, dry and hot winds and causes desiccation of plants. This may occur even when the rainfall and moisture supply is adequate.

Purpose:

The purpose of the Sudan National Drought Plan is for the government and UNCCD to begin with fairly clear ideas on what the critical issues of drought are and in which areas the government and UNCCD would be best prepared to provide different types of support. This will help manage expectations and ensure clear focus during the early stages of planning for drought. While UNCCD may not provide support to national partners on all the identified problems, it is important to have a record of them for analytical purposes and as a possible basis for advocating for action by other agencies or individuals.

Scope:

The National Drought Plan Scope is broad, encompassing outcomes and the extent to which programmes, project, soft assistance, partners' initiatives and synergies among partners that will contribute to its achievement. The drought planning aims to identify progress towards results, precipitate decisions that would increase the likelihood of achieving results, enhance accountability and learning. The planning efforts will be addressing the following:

- *Progress towards outcomes:* This entails periodically *analysing* the extent to which intended outcomes have actually been achieved or are being achieved.
- *Factors contributing to or impeding achievement of the outcomes:* This necessitates *monitoring* the country context and the economic, sociological, political and other developments simultaneously taking place and is closely linked to drought risk management.
- *Individual partner contributions to the outcomes through outputs:* These outputs may be generated by programmes, projects, policy advice, advocacy and other activities. Their monitoring and evaluation entails analysing whether or not outputs are in the process of being delivered as planned and whether or not the *outputs are contributing to the outcome*.
- *Partnership strategy:* This requires the review of current partnership strategies and their functioning as well as formation of new partnerships as needed. This helps to ensure that

partners who are concerned with an outcome have a common appreciation of problems and needs, and that they *share a synchronized strategy*.

- *Lessons being learned and creation of knowledge products for wider sharing:* Partners may add additional elements where needed for management or analysis, while keeping a realistic scope in view of available capacities. Monitoring usually provides raw data that requires further analysis and synthesis prior to reporting for decision making. Using information gained through monitoring, programme managers must analyse and take action on the programme and project activities to ensure that the intended results are being achieved. Managers of programmes also monitor and document the contributions of soft development initiatives and strategic partnerships.

The goal of the National Drought Plan is to prepare the following at the national and state levels, namely (i) drought preparedness system; (ii) regional efforts to reduce drought vulnerability and risk; and (iii) a toolbox to boost the resilience of people and ecosystems to drought. The objective of this paper is to formulate/develop Sudan National Drought Plan based on the principles of risk reduction, namely solidarity, joint responsibility, non-discrimination humanity, impartiality, neutrality, co-operation, territorial sovereignty, prevention, and the role of the media, by informing and raising the public's awareness to the forecasting of drought disasters and the way they evolve.

Plan Development:

Introduction of the 10-Step process

The planning process established for the development of the National Drought Plan in Sudan is based and built on the following strategic and legal frame work

Policies:

- **The Forest Policies** indicates the role of the different actors in the development, conservation and management of forest resources (1986-2006).
- **Range Policy:** Encouragement of private sector investments, intensification of productions and integration of agriculture and animal production.
- **Wildlife Policy:** Conservation and sustainable use of biological diversity in an integrated approach.
- **Water Policy:** Efficient use of water for agriculture, in addition to more utilization of ground water for irrigation.

- **Higher Council of Environment and Natural Resources (HCENR):** Development and coordination of policies and long term plans for environment protection and sustainable development of natural resources.

Laws:

- Combating Desertification Law, 2009
- Conservation of Environment Law, 2017
- The 2002 Forests and Renewable Natural Resources Act.
- The Wildlife and National Park Act (1986). New wildlife draft legislation is prepared in 2013 to amend the 1986 legislation.
- The Range Act (2015)
- **The water resource act 1995** (Ministry of Irrigation and Water Resources embraced most of the sub-sectors in the country.
- **Environmental Protection Act (EPA)** (2001 Act) harmonizes the different sectors environmental laws.
- **Local Government Act 2003:** The Locality is entrusted, along with other functions, with agriculture, forestry, natural resources and animal wealth.

The National Drought Plan was also inspired and incorporated the following eight steps that are described in the Model National drought plan guidelines⁸ which modified from WMO and GWP (2014) National Drought Management Policy Guideline⁹:

2. Appoint a National Drought Plan Task Force.
3. Define the Goals/objectives of the drought plan.
4. Seek stakeholder participation.
5. Inventory /situational analysis.
6. Prepare/write the National Drought Plan.
7. Identify unmet needs and fill institutional gaps,
8. Communication/Education.
9. Evaluation.

⁸ Wilhite, D. A., 2011: Essential elements of national drought policy: Moving toward creating drought policy guidelines. Towards a compendium on national drought policy: Proceedings of an expert meeting, World Meteorological Organization AGM12, WAOB-2011, 96–107.

⁹ Modified from the 10 Step process” developed initially by the University of Nebraska and further updated to make it More generic is proposed for use in the framework of the Drought Initiative

The above steps process is one of the many approaches and not the only approach to assist nations to develop national drought policies. Its implementation requires political will and coordinated approach among diverse stakeholders engaged in the process. Political commitment, building strong institutions and appropriate governance, and cultivating stakeholder participation with special emphasis on a “bottom-up” approach including the communities (both in decision-making and implementation) are some of the institutional arrangements that are used to strengthen the process of developing a national drought policy. Furthermore, preparedness at all levels of government (individuals, community and decision makers, local and regional authorities) and having a legal or institutional framework with defined responsibilities and cross-sectoral collaboration are preconditions for a successful national drought policy process. The session also highlighted some of the current challenges to develop national drought policies including:

- (i) fragmented responsibilities for drought risk management,
- (ii) low priority given to drought by governments,
- (iii) challenges of gender mainstreaming in drought prone areas;
- (iv) weak drought risk governance capacities, and
- (v) Conflict on water use and excess water use.

Following the Model National Drought Plan guidelines, the key elements addressed in the plan includes:

- (i) Early Warning and Prediction
- (ii) Preparedness and Mitigation
- (iii) Response and Mitigation
- (iv) Communication

The generic 10-step planning process to formulate national drought policies, developed by Wilhite et al. (2011) focusing on the most relevant elements of each of the steps, which are as follows:

1. Appoint a national drought management policy commission;
2. Define the goals of a risk-based national drought management policy;
3. seek stakeholder participation;
4. Collect inventory data and financial resources, and identify groups at risk;
5. Prepare/write the key tenets of a national drought management policy;
6. identify research needs and fill institutional gaps;
7. integrate science and policy aspects of drought management;
8. Publicize the drought management policy and build public awareness;
9. Develop educational programmes for all age groups and stakeholders;
10. Evaluate and revise national drought management policy.

Source: Donald A. Wilhite (2011); University of Nebraska - Lincoln, dwilhite2@unl.edu

National Drought Plan Task Force

Appointment of National Drought Plan Task Force (NDPTF)

The National Drought Plan Task Force was established by the Ministerial Decree No 27 for the 2018 in 28th of August 2018 with the representatives from relative stakeholders as shown in the following table:

	Representative	TF
1	Dr. Abdelazim Mirghani Ibrahim (Focal point) National Council for Combating Desertification	President
2	Dr. Abdalla Gaafar Mohamed	(National Consultant)
3	Ministry of Environment, Natural Resources & Physical Development (Climate Change)	Member
4	Ministry of Environment, Natural Resources & Physical Development (Climate Change (Environment Department))	Member
5	Ministry of Federal Governance	Member
6	Ministry of Finance and Economy Planning	Member
7	Ministry of Agriculture and Forestry	Member
8	Forests National Corporation	Member
9	Central Bureau of Statistics	Member
10	Ministry of Animal Resources and Fisheries	Member
11	Ministry of Water resources and Electricity	Member
12	Ministry of Tourism, Antiquities & Wildlife	Member
13	Ministry of Health	Member
14	Ministry of Oil & Gas	Member
15	National Council of Population-SDG	Member
16	Ministry of Minerals	Member
17	Ministry of Higher Education and Scientific Research	Member
18	Ministry of information (Media)	Member
19	UNESCO chair for Desertification	Member
20	Humanitarian Aid Commission	Member

	Representative	TF
21	Sudanese Environment Conservation Society	Member
22	Sudan Meteorological Authority	Member
23	General Federation of Sudanese Woman	Member
24	Sudanese Federation of Businessmen and Employers	Member
25	DAL Group (private sector)	Member
26	Central Trading Company	Member
27	Ministry of Environment, Natural Resources & Physical Development (Legal Adviser)	Member

Task Force Mandate

1. The task force supervises/coordinates the plan development process by pulling together the necessary resources of the national government and integrating these resources from the various ministries, stakeholders and different levels of government in order to develop the plan.
2. The task force coordinates the implementation of the drought plan at all levels of government and with development partners and civil society. It is also tasked with the activation of the various elements of the plan during times of drought. The task force will enforce actions and implement mitigation and response programs or will delegate this action to governments at the sub-national level and development partners. They will also initiate policy recommendations to the political leaders.

NDP Main Objective

The National Drought Plan (NDP) is developed with the main **objective “to enhance livelihoods capacities and strengthen resilience of communities at risk of drought, and emergency preparedness”**. To achieve this objective, the NDP articulated around five major tasks, namely:

NDP key tasks:

The tasks of the NDP is to clarify and improve monitoring and early warning systems, and identify clear actions and responsibilities in responding to drought whenever it occurs. Therefore, the NDP provides outlining for the actions of the 3 pillars of drought management and risk reduction:

- Implement drought monitoring and early warning systems.
- Assess drought vulnerability and risk.
- Implement measures to limit impacts of drought and better respond to drought

Importance of National Drought Plan

The development of the national drought plan is feeding into the Sudan Disaster Risk Management Policy and associated strategy to reduce potential severe impacts of drought risk in drought prone areas in the country. This is in line with the Interim Poverty Reduction Strategy Paper (IPRSP) and its processes which is linked and complementary to the 3-Year Salvation Economic Program (2014-2016) and the 4-Year Development Plan (2017-2020). The 3-Year Salvation Economic Program (SEP), is an emergency plan to handle the economic adjustment in response to the economic realities following the independence of South Sudan and reduction of oil revenues. All of these plans are providing a foundation and road map for implementation of the full Poverty Reduction Strategy Paper (PRSP). Sudan as part of the COMESA launched its CAADP Compact and the National Agriculture Investment Plan (NAIP) and the government is progressing in reviewing all national strategies and policies to accommodate the Sudan with its new borders, climate change issues and climatic zones.

RELATIONSHIP TO OTHER PLANS AND POLICIES

National water laws, existing drought mitigation strategies and planning issues

The Sudanese different Acts relating to water include the Nile Pumps Control Act, 1939; the Nile Pumps Control Regulations, 1951; Civil Transaction Act 1984; Irrigation and Drainage Act, 1990; the Water Resources Act, 1995; the Groundwater Regulation Act (1998); and the Public Water Corporation Act (2008).

The Civil Transaction Act (Section 592) stipulates the following:

- Rights to develop and access water resources cannot be separated from rights which are exercised over the land, as long as permission is granted by the respective water authority whose job it is to ensure that the water point in question has no harmful side effects.
- Access to public water sources is given to all people, subject to the parameters listed by existing legislation. This access is ceded through the licensing of a contract.
- All water resources that are constructed are recognised as private property, and therefore access rights must be negotiated with the owner of the land on which these resources are found.
- In the event that a tenancy agreement is in place, a landowner will bestow the relevant rights of access to the tenant, including the right to use water.

The 1995 Water Resources Act, described as a major institutional reform, was concerned with the Nile and Non-Nilotic surface waters as well as with underground water. In that sense it supersedes the 1939 Nile Pumps Control Act that was confined to pumping from the Nile waters only. In terms of institutions, the Act in effect:

Dissolved the national Rural Water Corporation and Urban Water Corporation under the Ministry of Water Resources, Irrigation and Electricity, and replaced both of these bodies with the National Water Corporation, which functions as the main, centralised responsible body (changed to the Public Water Corporation following the 2005 CPA, and now the General Directorate of Water Supply under the Ministry of Water Resources). The mandate of the General Directorate of Water is to oversee nationally and internationally funded programmes and projects, to develop overall water policies and standards, and to provide capacity building for the water sector

- Allowed states to establish State Water Corporations as the lead authorities on water resources development, utilisation and management at the state level;
- Grouped all agencies and bodies working in the water resources sector under the Ministry of Water Resources, Irrigation and Electricity;
- Stipulated the establishment of the National Water Resources Council (NWRC), which is an advisory body to the Ministry of Water Resources, Irrigation and Electricity at national level, with representation from the state level. It is mandated to advise on the formulation of water policies, management of water resources, protection of water resources, regulation of drilling of boreholes and digging of wells, issuance of licenses for the abstraction of water from various sources, dealing with water disasters (droughts and floods), research, review of water related legislation, supervision of water abstraction from the Nile, non-Nilotic sources and ground water, and planning for long term water resources use and development.

The Act also stipulates that:

- The State has the right to the flow of water, its control, its use, and all that is related to water resources at state level.
- People have the right to use the water for various purposes in accordance with the provisions of the Act and any other pertinent Act.
- Anybody, public or private, who desires to abstract water, for any purpose, from the Nile, the Non-Nilotic systems and underground water must obtain a license from the Ministry of Water Resources, Irrigation and Electricity with the relevant bylaws and regulations that define the procedures and regulations for licensing.

The Groundwater Regulation Act (1998) mandates the Groundwater and Wadis Directorate as the sole government technical organ to explore, develop, monitor and protect wadis and groundwater, and to issue permits for constructing water points (Ali, 2009). The Public Water Corporation Act (2008) gives authority to central government for national planning and investment in the water supply sector, to promote water supply research and studies, and to set policy and legislation on water development (ibid) .

The Ministry of Water Resources, Irrigation and Electricity Objectives and responsibilities include:

- Setting national water resources policies, strategies and plans
- Assessing, observing and developing water resources to meet national needs
- Applying research in irrigation, hydraulics and water resources engineering aiming at efficient utilisation and management of water resources and promoting irrigation and drainage services including sedimentation, river morphology and training, banks erosion and aquatic weeds control
- Utilising Sudan's share of Nile Waters
- Developing the cooperation between the Nile Basin countries
- Exploring, assessing and evaluating non-Nile water resources
- Monitoring ground water basins
- Contributing to environmentally sound socioeconomic development
- Controlling and mitigating the effects of floods using hydraulic structures and modern flood forecasting techniques.

One of the major challenges in the water sector, however, is the lack of any link being made between water development and management to other natural resources issues; in effect, failing to recognise the fact that water functions as part of the broader environment, and therefore the fact that water developments have an impact on the wider natural resource base.

Nevertheless, the Desertification Control Unit is one of the structures of the Ministry of Agriculture and Forestry, under the General Directorate for Natural Resources, and the mandate of the Unit includes:

- Collecting scientific data and information covering areas of soil, water, rainfall, forests, range, animal resources, population and other information pertaining to desertification and drought;
- Updating the inventory of the implemented projects and those under implementation within the National Plan and its programme of action
- Preparing maps of the affected areas

- Monitoring and evaluating the implementation of projects within the National Plan and all other relevant projects
- Preparing the scientific information and the documents to be discussed in the Coordination Council according to the situation in the field
- Following-up the execution of the directives of the Coordination Council
- Searching for ways and means of obtaining funds, from local and international organisations, to implement the projects within the National Plan
- Updating the National Plan and Action programmes based on the most recent information and the analysis and evaluation of these data using Geographical Information Systems (GIS)
- Acting as a focal point for the International Convention to Combat Desertification and to update the Sudan Programme
- Formulating the general policies and programmes for combating desertification and curtailing the effects of drought
- Publishing the Desertification Bulletin to raise awareness
- Linking the various programmes in the affected areas
- Organising seminars, workshops and conferences on desertification and drought problems.

2. OVERVIEW OF DROUGHT IN THE COUNTRY

Historical Occurrences

Sudan, with an area of 1.87 million square kilometres, is endowed with 61 million hectares of arable land, 14 million hectares of natural pasture and 21 million hectares of forests. The main water resources in the country are the River Nile, seasonal water courses, ground water, and rainfall. Sudan is dominated by hyper-arid, arid, semi-arid and dry sub-humid ecosystems that were seriously affected by the recurrent droughts.

The country's total area (1.87 million km²), about 1.25 million km² (66.8%) is desert and semi desert; the remaining 0.68 million km² (36.8%) is divided between low rainfall savanna (300-500 mm of annual rainfall) and the rich savanna (over 500 annual mm rainfall) that extends extensively in the Republic of South Sudan. Sudan is a dry country exhibiting typical Sahelian zone with its characteristic of low level of rainfall, scarcity of water, and short agricultural season (3-4 month).

Most of disasters experienced by the Sudan are of ecological nature such as droughts, floods, desertification, pest and locust attacks...etc. Sudan has also been exposed to biological disasters such as disease outbreaks and other environmental health hazards. Drought is a

recursive phenomenon and frequent drought cycles extending over 2-3 years are common (IDDRSI, 2017).

Periods of drought have occurred throughout the history of Sudan. In most cases these have been followed by famine and outbreaks of disease. Apparently, drought is one of the most important natural disasters in Sudan not only for its substantial impacts on agricultural production, food security, livestock, but also it causes significant disturbances to the forest ecosystems. Recent observations showed that Sahara Desert is encroaching southwards at alarming rate due to vegetation cover degradation in semi-arid zones as a result of the drought (NAPA, 2007). Additionally, drought lead to increase in natural resources related conflicts and civil wars, expand shifting cultivation areas, and insecurity in land tenure (Sivakumar et al., 2007).

Together with other countries in the Sahel belt, Sudan has suffered a number of long and devastating droughts in the past decades. All regions have been affected, but the worst state, particularly in the Northern Kordofan state, North states, Northern and Western Darfur, and Red Sea and White Nile states. During the 20th century Sudan experienced major drought. The most devastating ones were in 1913, 1940, and 1954 which covered many parts of the country. In 1913 and 1940, about 1.5 million people were affected.

The earliest records revealed that, 1835-38 period is known as the "years of famine," particularly the year 1836, which is notable for widespread cholera that decimated a population already weakened by hunger (Hill 1970). The 1888-89 famine is considered to be the greatest famine, caused by two consecutive years of poor rains (Slatin Pasha 1896; Churchill 1899; Duncan 1952; Farwell 1967; Holt 1970) and by political instability and unrest. Hundreds of thousands of people died of hunger and disease. Rain was abundant the following year, but harvests were destroyed by locusts and other pests. The year 1913 also witnessed poor rains, but major famine was averted by importing corn and distributing it free (MacMichael 1934). These records indicate diversity in the spatial incidence of drought and famine, with frequent occurrences concentrated in the western and eastern regions of Sudan.

Years of 1935, 1937,1942,1949,1951, and 1957 identified by researched as years of severe drought in Sudan (Ibrahim 1985). Shepherd (1988) identified 1932, 1938, and 1949 as years of severe famine through investigation of famine files for the period between 1932 and 1950. Combining these two sources, one would speculate that 1913-14, 1927, 1932-34, 1937-38, 1942, and 1949 were the years of most severe localized or nationwide famine in the country in this century up to the end of the 1950s (Tasfaye et al 1991)

Examination of the mean annual precipitation for some of the most severely affected regions in Sudan revealed that most severe famines of the past two decades (1984-85, 1973-74, and 1965-66) were associated with the worst multiple-year droughts (*Patrick, et al 1991*).

The drought problem intensified gaining momentum towards eighties where, severe drought caused food shortage, loss in livestock and displacement of large number of population to the outskirts of towns. The rainfall in 1983 and 1984 was the lowest in records in the 20th century (Brown and Wolf, 1985) This drought was wide spread in Sahelian Africa affecting 30 countries in the whole continent where the death toll in Ethiopia, Sudan and Chad exceeded a million victims (Gregory & Walling, 1987). It was the biggest disaster during which 4.5 million in Darfur, Kordofan and Red Sea didn't have enough food and 10 million abandoned their homes (Timberlake, 1985). In other places, there has been a disastrous dry spell mid production season, and in parts of the west and east, water is becoming very scarce. Pasture across northern Sudan is reported to be very poor (*Margarel, et al 1990*).

The 1984-85 famine was the outcome of a long process of drought and desertification, absent or misplaced public food and agricultural policy, and insufficient public response (*Tesfaye, et al., 1991*). The severe drought of 1984 was the culmination of a prolonged period of low rainfall that intensified after the end of the 1970s (Tesfaye et al 1991). According to Nicholson (1985), rainfall deficits for 1981 through 1984 equal or exceed those of the early 1970s in all Sahelo-Saharan, Sahel, and Sudan zones. Hulme (1984) also concluded, on the basis of observed rainfall data in the arid zone of Sudan, that the years from 1979 to 1983 were as dry as 1969-73. Recent findings (Eldredge et al. 1987) on western Sudan reveal that dry conditions have persisted in Northern Kordofan and Northern Darfur provinces since 1966.

Yagoub et al. 2017 investigated the drought cycles in Sudan by using characteristics of Standardized Precipitation Index (SPI) during 1961-2013 to provide valuable information for better adaptation and mitigation of consequences of drought to create a strategically good planning. Their study compared the effectiveness of SPI on a long-term scale of (1, 3, 12, 24, 36 and 48 months lead time) drought conditions. They found that, SPI 12-month showed high frequency of droughts in 1966 - 1968, 1974, 1984 - 1985, 1991 - 1992, 2000 - 2003, 2005 - 2006 and 2010. A high frequency of an annual-SPI mild drought was found in: Port Sudan, Dongola, Shendi, Khartoum, Alfashir, Geneina, and moderate drought in: Port Sudan, alfawadi, Karima, Abuhamed, Atbara, Gadarif and Edduim; severe drought in: Aroma, Kassala, Wad Medani, Edduim, Elobeid, Zalinge and Geneina; and extreme drought in: Gadarif, Singa, Abunama, Edduim, Elobeid, Alfashir and Zalinge.

The increasingly-intensified desertification and recent climatic change have stimulated detailed studies of precipitation and temperature records in many areas of the world including Sudan. The recent study carried out by *Yagoub et al. 2017* showed that temperature is increasing and

precipitation is substantially decreasing in Sudan and drought has increased dramatically in the last two decades consistent with the increased temperature and reduced precipitation.

Drought year:

The year is considered “drought year” when less than 75% of the normal rainfall is received. Drought prone area: It is defined as one in which the probability of “drought year” is greater than 40%.

Socioeconomic drought

The Socioeconomic drought identified and classified by many studies and scientists as a type drought. This type of drought is related to demand and supply goods and services, such as drinking water, food, and energy are impacted or threatened by shifts in hydrological and meteorological changes. Usually this kind of drought takes a long time to become severe and equally long time to recover from it.

Drought Impacts: By sectors

Droughts are a natural event that we cannot prevent but we can take measures before and during a drought to reduce the impacts on people, business and the environment.

Impacts of drought on biodiversity

Droughts have negative impacts on biodiversity. For example, droughts and sustained high temperatures can cause habitat and species degradation and loss, leading to a decrease in biological productivity (see for example Anderegg et al., 2013)¹⁰. The reduction in biological productivity caused by droughts can lead to a lower vegetation cover that increases albedo¹¹, and to reduced water recycling, thus decreasing precipitation and rain fall. Reduced vegetation cover also leads to soil exposure to wind erosion and further reduction of productivity.

¹⁰ Anderegg, W. R. L., j. m. Kane and L. D. L. Anderegg (2013). Consequences of widespread tree mortality triggered by drought and temperature stress. *Nature Climate Change* 3 (2013), 30–36.

¹¹ Albedo is a measure of the reflectivity of a surface. The albedo effect when applied to the Earth is a measure of how much of the Sun's energy is reflected back into space. Overall, the Earth's albedo has a cooling effect. Drought condition positive or negative effect shall vary with location. In oceans it may have positive effect, whereas in deserts it may have negative effect.

Ecosystem degradation, caused by droughts together with other factors, can aggravate the impacts of droughts, as the degradation process reduces the capacity of ecosystems to buffer its impacts. When an ecosystem collapses, its buffering ability and other vital ecosystem services are lost (Munang et al., 2013)¹². Hence, environmental degradation can also impact livelihoods of people and reduce their resilience to droughts. Nevertheless, reduced vegetation increases soil erosion and the siltation of water bodies both within and beyond drought affected areas, which leads to a reduced availability of water (Tabacchi et al., 2000)¹³. Degradation of soil, including loss of soil structure, loss of soil carbon, loss of soil biodiversity and the ability to retain moisture leads to a reduction in yields (FAO, 2005). Droughts also lead to a reduced availability of non-timber forest, shrubs and range products such as wild fruits and vegetables.

Impacts on Natural Resources

Climate changes, successive droughts, population pressure and chronic food shortages are the major threats in many parts of Sudan. The drought in North and Western Sudan, North Kordofan and Darfur, Kassala State and some parts of the rain-fed areas in central Sudan are influencing agriculture, forestry, livestock, water resources and human health (NAPA, 2007). In the case of central Sudan, however, the eighteen recorded years of drought within the last half century are certain to have had a major influence on the vegetation profile and soil conditions where, the livestock prices decrease during drought periods, indicating disposal of assets on a large and widespread scale. (UNEP, 2007). *Yagoub et al. 2017*¹⁴, concluded that, drought conditions may dramatically degrade natural vegetation cover, crops' production, and livestock production consistent with the currently observed losses in many areas of Sudan. They also confirmed that, losses in agricultural production occurred in Sudan in 1984, 1991 and 2000, those were the years of highest drought intensity.

The total area considered as drought prone in Sudan is about 69,000 sq. Km and this area produces 90% of the cultivated food crops and 85% of the fire wood. Over 70% of the 39 million Sudan's population lives in rural areas, depending on agriculture and livestock for livelihood. Sudan history of drought is so frequent, such as 1906 famine, 1984/5 famine and different droughts during the seasons of 1989, 1990, 1997, 2000, and 2011.

¹² Munang, R., i. Thiaw, k. Alverson, j. Liu and z. Han (2013). The role of ecosystem services in climate change adaptation and disaster risk reduction. *Current opinion in environmental sustainability* 5 (2013), 1-6.

¹³ Tabacchi, e., L. Lambs, h. Guillo, A.-m. Planty-Tabacchi, e. Muller and h. Decamps (2000). Impacts of riparian vegetation on hydrological processes. *Hydrological Processes*, vol. 14, No.16-17, pp. 2959-2976.

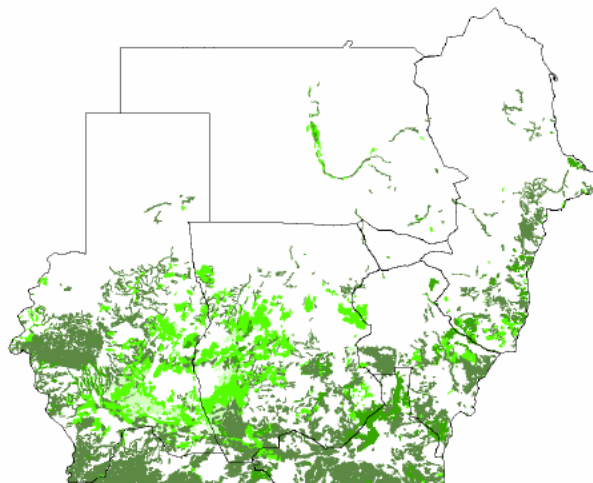
¹⁴ Yousif Elnour Yagoub, Zhongqin Li1, Omer Said Musa, Muhammad Naveed Anjum, Feiteng Wang, Zhang Bo. 2017. Detection of Drought Cycles Pattern in Two Countries (Sudan and South Sudan) by Using Standardized Precipitation Index SPI. *American Journal of Environmental Engineering* 2017, 7(4): 93-105
<http://www.agriinfo.in/default.aspx?page=topic&superid=1&topicid=417>

The findings of the study conducted by Tesfaye et.al¹⁵. 1991 to trace the effects of drought on production, markets, consumption, and nutrition, focusing on the 1984-85 famine, its origin and aftermaths are briefly reviewed below:

- Rainfall levels have declined in Sudan during the past three decades: mean annual rainfall declined by 6.7 percent between 1960-69 and 1970-79 and by 17.7 percent between 1970-79 and 1980-86. Furthermore, year-to-year fluctuations in rainfall around a trend line seem to have increased, especially in arid and semi-arid zones. For example, coefficients of variation increased, on average, from 16 percent in the 1960s to 21 percent in the 1970s and 32 percent in the 1980s in western Sudan. The decline in rainfall levels has resulted in low growth in cereal production, largely because of short-run effects on yield, as evident from a comparison of growth estimates with and without the drought year of 1984. Cereal production is also marked by considerable and increasing year-to-year fluctuation. Yield variability has been strongly associated with variability of rainfed crops. Drought-production relationships show that a 10 percent drop in annual rainfall from mean levels implies a 5.0 percent drop in cereal production and a 3.7 percent drop in yield at the country level. Sorghum yield and, consequently, production are shown to be more affected than millet by declines in rainfall. A 10 percent drop in annual rainfall results in drops of 7.3 and 3.0 percent in sorghum and millet production, respectively.



Sudan Forest Cover 2011



¹⁵ Tesfaye Teklu, Joachim von Braun, Elsayed Zaki, 1991. Drought and Famine Relationship in Sudan: Policy Implications, Research Report 88, International Food Policy Research Institute

- Markets for cereals are thin and very responsive to production changes where, cereal prices increased more than three times in the main famine year of 1984-85 compared with 1982-83. The related time-series analysis in such study shows that, under the prevailing trade and market-structure conditions, a 10 percent drop in production led to an approximate 26 percent increase in real prices of cereals in the same year.
- A 10 percent reduction in stocks (calculated at mean values) increased prices by 8 percent. Trade and aid contributed little toward mitigating the price effects of the drought-driven production fluctuation. The terms of trade between domestic cereal and livestock changed drastically as a consequence of the drought in the 1980s, a 10 percent drop in cereal production resulted in an 18 percent increase in the cereal and livestock terms of trade. Domestic terms of trade between cereals and cash crops, such as groundnuts and sesame, increased by 2 to 3 times as a consequence of the drought-related declines in cereal production. These combined production and price effects resulted in food-entitlement failure for large segments of the rural population. Although considerable relative differences prevailed between regions, the general food price movement during the food crisis in 1984-85 spread all over the country, thereby spreading the burden of the crisis to the poor in non-drought and urban areas.
- In 1984, there was a particularly large drop in per capita food availability despite measures to mitigate consumption shortfalls, such as increased food aid, imports, and off-take from public grain reserves. The drop varied by region and the impact by type of household. Adjustment pressures to drought-induced price and income changes are much greater for the low-income households, particularly for those in drought-prone areas. This applies also to child nutritional welfare in these households. The combined production and price effects translated into nutritional deterioration. Deficiencies in rural health services also played a key role in this context. As the recurrent drought had stripped many rural households of their asset base in the early 1980s, the main drought in 1984 immediately translated into a drastic nutrition problem. Many families were left with no ability to cope.
- Assessment of child nutritional status in the post famine period of 1986-87, based on a large sample survey, shows a sizable presence of child undernutrition, with significant variations across regions, locations, and seasons. The combination of lack of food at the household level and acute diarrhoea in children results in life-threatening nutritional deterioration of large proportions of preschool children.
- The 1984-85 crisis uprooted large segments of the rural population and resulted in depletion of their assets and in stress migration into urban areas.
- The evidence of the 1984-85 famine confirms that drought is a major determining factor in famine in Sudan. Decline in the level of rainfall and its increased variability substantially undercut the food entitlement of large segments of the population through production and employment effects.

Sudan is affected by the fluctuation in magnitude and distribution of the precipitation during the rainy season, with repeated dry spells during the cultivation season that have negative effects on food production and people's livelihoods and therefore, the food security situation in Sudan is reported to be deteriorating in a number of years during the last decade (Sudan CPP, 2012). FAO estimated that one out of three Sudanese suffered from food deprivation in 2009, which is the Millennium Development Goal (MDG) indicator on hunger reduction. This figure is again based on the 2009 Sudan NBHS data. The prevalence of undernourishment was 31% and 34% for urban and rural populations respectively. This is mainly attributed to the rainfall variability, high food prices, and the long decades of conflict and unrest. Food insecurity is the most common manifestation of such situations.

In the 2011/12 production season, and due to the drought cycle that hit the Horn of Africa, food production shortages were combined with insecurity in South Blue Nile, South Kordofan, some areas in Darfur, and Abyei, resulting in food insecurity¹⁶ and escalating food prices due to inflation (ranging from 18 to 37.2% in the first half of 2012)¹⁷, and local currency devaluation. The eastern region (Red Sea and Kassala States) and western regions (Greater Darfur and North Kordofan) of the country recorded poor to below average harvests, which has exacerbated the food insecurity and malnutrition cases among the vulnerable groups of the rural communities, particularly the displaced pastoral groups (Sudan CPP, 2012)

The erratic and low precipitation during drought years has resulted in deepening the water table, which in-turn made access to drinking water for human and livestock a problem. This is in addition to the crowdedness around water points, which can make people and livestock vulnerable to diseases and epidemics. This competition over meagre water resources may hatch into poor hygiene and contaminated water, particularly for vulnerable members of households, i.e., children, the elderly, and women.

Drought impact on crop and livestock production

Drought impacts on crop production and livestock show remarks decreasing in yield of both food and cash crops, recording of yields for the period 1953/54 to 2004/05. Result show that the yield in mechanized rain fed in 1983/84 was dropped to 12 kg/feddan in White Nile comparing to 334 kg in 2003/04 good rainy season. Millet which yields a minimum of 200kg in a good rainy season, showed only 8 kg/ feddan in North Kordofan State.

¹⁶ Sudan Food Security Outlook, Oct. 2011 – March 2012, www.fews.net/sudan

¹⁷ Ministry of Finance and National Economy; inflation rates continued to increase and June 2012 recorded an inflation rate of 37.2%

Land sat STM map of 1983/84 showed that the semi desert (455,000 sq. km) and some parts of the northern fringes of the low rainfall wood land savannah were severely affected by drought and environmental degradation. Range and pasture administration report noted that 177 million feddans of range lands area is considered as severely degraded lands. (Abdelrahman, 2008)¹⁸.

Recently as reported in Sudan food Security Outlook February to September 2016 (FEWS NET, 2016), as of February 2016, more than 3.5 million people in Sudan face Stressed and Crisis acute food insecurity. Most of these populations are in conflict-affected areas of Darfur, South Kordofan, West Kordofan, and Blue Nile States, with additional pockets of stressed populations in drought-affected areas of Kassala, North Kordofan, North Darfur, Red Sea and White Nile States. About 55 – 60 percent of the current food insecure population is in Darfur and 12 percent in South Kordofan. Crisis of acute food insecurity is mainly among internally displaced persons (IDPs) in repelled-controlled areas of South Kordofan and IDPs in Darfur due to conflict.

The June to October 2015 rainy season began 20 to 40 days late in many parts of Sudan, and was followed by below-average rainfall and significant dry spells during August/September, particularly in key surplus-production areas such as Gedaref, Kassala, Sennar, White Nile, West Darfur, and South Darfur States. According to the findings of the 2015/16 annual Crop and Food Supply Mission (CFSAM) report, staple food production in Sudan was about 25 percent below the recent five-year average, and about 55 percent below 2014/15 levels, when the production was almost double the five-year average.

In fact, drought occurrence has imposed heavy losses to the water resources in the country, the agriculture, the livestock, the rural environment and the ecosystem as well as the socioeconomic fabric of the rural society. For example, the abrupt decline in rainfall caused a complete drying off of the surface drinking water resources and decreased the water output from boreholes and wells. This caused water to drop in most of the valleys. Consequently, the otherwise green valleys were converted into arid zones. This all had direct or indirect effect on the livestock sector, since, more than 68% of the livestock herds consist of sheep and goat therefore they are the most affected due to lack of area for grazing and drinking water. People derive their livelihood from livestock in the form of food, income, organic fertilizer, as a form of investment, power for ploughing their fields and for traditional ceremonies such as

¹⁸ Mohamed Elamin Abdelrahman, 2008. The development of alternative and supplementary livelihood system to reduce pressure on land based resources in Sudan dry land

weddings. Climate change affects natural resources (such as water sources, land and pastures), biodiversity and livestock health. This has a direct effect on livestock production and livestock systems and as such it is depleting the livelihood assets of the people especially those residing in the rural areas as it will worsen their poverty status making them more vulnerable to all sorts of external shocks such as diseases and drought.

Geographical Extent of Drought and Desertification in Sudan

The drought affected and desertified area in the country is confined to the mentioned ecological zones which fall between latitude 10°-18° N. Sudan is one of the Sudano-Sahelian countries that have been seriously affected by drought and desertification since the late sixties to the present. This has its lasting imprints on natural habitats, means of livelihood and socioeconomic fabric of the societies. The magnitude of desertification in Sudan was assessed by assimilating the existing information through the use of Geographical Information Systems (GIS). The indicators used were:

- Land Use.
- Geomorphology.
- Human settlements.
- Soil and drainage pattern and
- Rainfall distribution.

Accordingly, five classes of desertification were identified: Very Severe, Severe, Moderate, Slight and Very slight (Table 1). The maps produced by NDDCU show rainfall fluctuations. The most striking result is the shift of the rainfall isohyets during the period 1930 – 1990 from north to south, indicating an increase of the area under more arid conditions. The results in below table, show that the area affected by desertification between Lat. 10° – 18°N is approximately 1.26 million km², which is about 67.2 % of the country's total area.

Table reflecting Areas at Risk to Drought in 1995 between Lat. 10-18 N

Desertification Classes	Ecological Zones	Rainfall (mm)	Area in (000Km ²)	% to Zone Area	% to Sudan Area
Very Severe	Desert	0-100	307	24.4	16.4
Severe	Semi-Desert	100-300	414	32.9	22.1
Moderate	Low Rainfall Savanna	300-800	513	40.6	27.4
Slight	Montane Vegetation	600-800	0.8	0.1	0.0
Very slight	Higher Rainfall Savanna	>800	25	2.0	1.3
Total			1,259.8	100	67.2

Zone: 10° – 18°N, Zone area = studied affected Area (10° – 18°); Source: E.M. Salih (1995).

Hence it is an urgent necessity to initiate operational programmes to address drought issues, control desertification and mitigate drought particularly under moderate and severe conditions, amount to 927,000 Km².

The Sudan National Action Programme to Combat Desertification (SNAP), 2018:

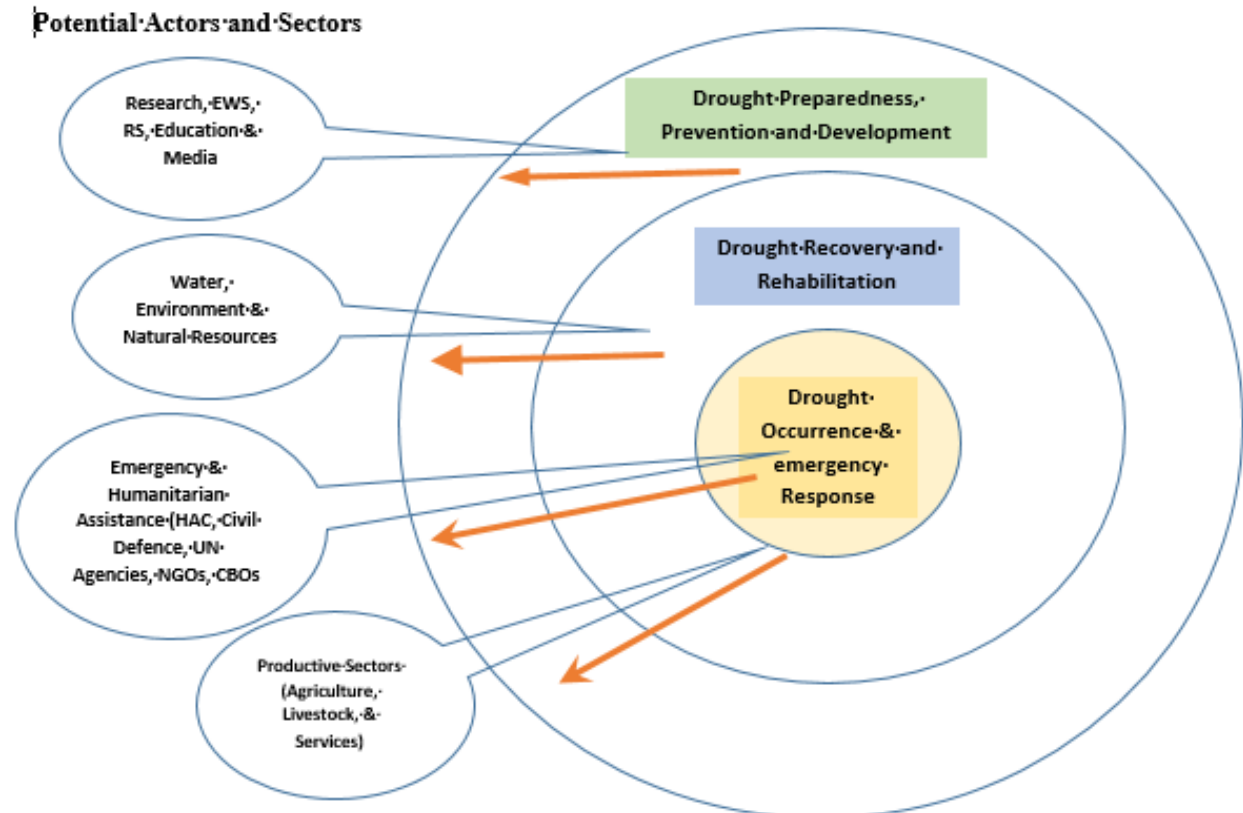
The SNAP includes:

- a) Prevention measures implemented in productive drylands that are not desertified.
- b) Corrective measures implemented in productive drylands that are moderately affected by desertification.
- c) Rehabilitation measures implemented through comprehensive programmes

The outmigration of strong members of the rural communities for gold mining contributed further to the low productivity of crops and livestock. The erratic rainy season has a push effect on the human resources of the rural rainfed areas to urban settings, where the urban population has increased tremendously over the last decade, while urban poverty has become a feature in main towns. This is further exacerbated by the new emerging income opportunities in the gold mining areas, which are more attractive to young members of the rural communities since it pays better than seasonal rainfed cultivation. Food production and food security in rural rainfed areas are associated with repeated risks of long dry spells, localized floods (water

erosions), localized pests infestations,...etc., that many times, have caused damage, loss and depletion of basic assets of rural households.

3. Organization and Assignment of Responsibilities



Assignment of Responsibilities

National Civil Defence Council

The National Civil Defence Council (NCDC), as a response mechanism, is the main decision making body during emergencies and adopts the disaster response management policies for the Country. The main duties and responsibilities of the NCDC are:

- Coordination of plans and civil defence operations between different authorities at the federal level.
- Targeting national efforts towards disasters management and reduction of effects.
- Approval and monitoring of national plans for civil defence.
- Approval of annual budgets for the programme.

Other mandates of NCDC include:

- Establishment of similar institutions for civil defence at the states' level and specifying their authorities and mandates.
- Establishment of any other relevant additional administrations to support the programme.
- Acceptance or rejection of funds that may constitute financial support to the programme.
- Submission of budget proposals through the Minister to the specified authorities.
- Specification and determination of banks and banking channels to run the programme activities.
- The NCCD submits an annual statement of the council accounts to the -- Minister and an annual report of the auditor general.
- Approval of payments as recommended to beneficiaries (volunteers).
- With consultation with the Minister the NCDC issues the necessary regulations, decrees and orders whenever needed.

The civil defence act has specified the duties and responsibilities for the minister of the Interior as follows:

- Issues directives for meetings and agenda
- Chairing and directing the NCDC meetings, and moreover take actions to dissolve those meetings.
- In case of equal votes, the Minister has the balancing vote.
- In case of absence, the Minister nominates his representative to chair meetings.
- The NCDC submits budget proposals to the Minister who will raise it to the concerned authorities.

A Central Operations Chamber is linked to National Council for Combating Desertification (NCCD) and is comprised of technical experts from different Ministries. The main role of the Central Operations Chamber is to implement decisions and policies endorsed by the NCCD). Each state has its own Operation Chambers which are chaired by the State Governor and linked to the Central Operations Chamber. Each State prepares its own Contingency Plan, in consultation with the Line Ministries at the States' levels, Civil Societies and NGOs and related stakeholders. These plans of actions, with their estimated budget and needs are forwarded to the Central Operations' Chamber review by the Technical officials from the line Ministries and submission for approval by the NCCD. The law has affirmed the necessity of coordination between the NCCD and the related bodies as the following:

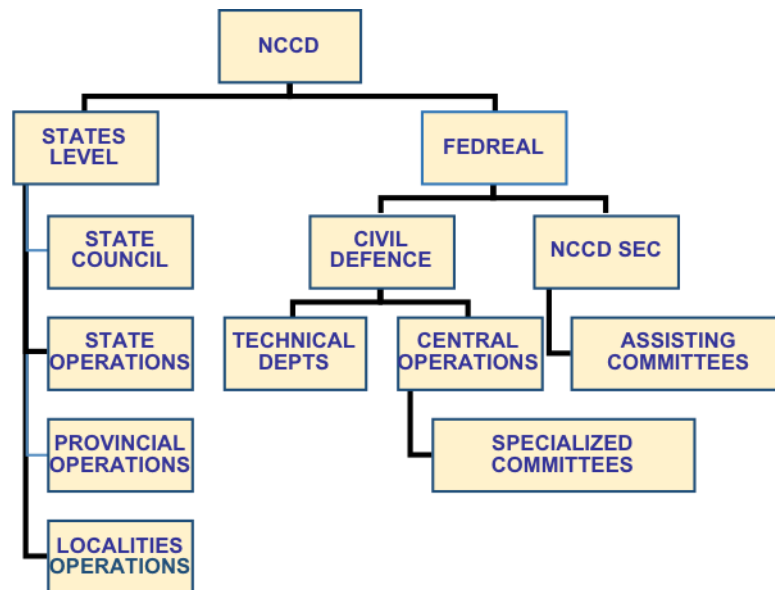
- Should fully coordinate and cooperate with the NCCD and Executive Organ.
- Executive Organ should formulate necessary plans to involve those institutions in civil defence operations, those plans include:
- Plans targeting predicted disasters.

- Plans targeting ongoing disasters.
- Plans targeting precautions to be considered after the disaster.
- Plans should specify roles and means of coordination.

The National Council for Combating Desertification (NCCD)

The figure below shows the organizational structure of NCCD

Fig. 1: The organizational structure of NCCD



Key Stakeholders and Partners in the National Drought Plan Processes

Partnership is needed at the national level to facilitate effective use of resources for combating desertification and mitigation of drought. The three main categories of stakeholders involved at the national level are:

- a Government and its various entities.
- b Natural resources users and other civil society sectors and NGOs.
- c External partners consisting of developed country parties, United Nations
- d (UN) agencies, non-governmental organizations (NGOs), multilateral and regional financial institutions.

Explanation of operating environment

Sudan is a low-income country facing significant domestic and international constraints and large macroeconomic imbalances despite efforts made toward macroeconomic stability and growth. Following the shock of the secession of South Sudan five years ago, policy adjustments helped to contain the fiscal deficit, slow money growth, manage inflation, and support economic recovery. Institutional reforms strengthened tax collections and public financial management, and social spending increased. Despite these efforts, however, large macroeconomic imbalances, triggered by the loss of three-quarters of oil exports, continue to constrain growth prospects, along with uncoordinated policies, internal conflicts, and the U.S. sanctions. Domestic and international efforts to end internal conflicts have yet to bear fruit, and the humanitarian situation in certain regions of the country remains seeking humanitarian interventions. The economic sanctions and the withdrawal of correspondent bank relations deliberate on trade, investment, and growth. Together with the absence of progress toward debt relief has limited the access to official external financing.

Sudan has suffered from prolonged years of conflict, volatile security situations, political transitions, an unsustainable debt burden, economic and financial sanctions and fragile relations with the international community, all of which have constrained the country's broad-based growth prospects and poverty reduction efforts. Sudan's poverty rate is estimated in 2012 at 46 percent, indicating that some 15 million people are poor. The poverty rate is significantly higher in rural areas (58 percent) than in urban areas (26 percent), and varies markedly across states, from 26 percent in Khartoum state to nearly 60 percent in conflict-affected states such as North Darfur, South Kordofan. Other social indicators exhibit the same pattern.

The context for environment and natural resource management in the country is also changing: there are new demands on land, from gold mining; the petroleum sector, the rapid transition to

market economy; and domestic and foreign agribusiness investors. This is besides the need to relocate the internally displaced population IDPs and a population of returnees from the South particularly in the White Nile State which has witnessed an influx of refugees from South Sudan since December 2013. This situation makes Sudan highly vulnerable to the impacts of climate change.

The natural resources of the country are inadequately managed and the potential of transforming these resources into broad base socio economic development has to be realized. Land degradation is recognized as national serious issue. Manifestations of the problem include reduced land capability, soil erosion, sand dune destabilization, deforestation and depletion of grazing resources are widespread. Land degradation has disastrously impacted food security and incomes of the rural population. Increasing scarcity of fuel wood and water add to the workload of women. The resultant resource scarcity has also resulted in rising stakes over land and other natural resources across the country with far reaching implications on land tenure regimes, access to resources and relations between social groups.

Issues associated with the fragile environmental governance in terms of legal frameworks, policies and institutional structures and in particular the multiple and parallel systems of natural resource management and governance that exist, the ambiguous and confused land laws together with the distortion of power between the federal and state governments have created an environment in which resource rights are not well managed and in which conflicts can emerge and play out in a destructive manner. Diffuse of governance arrangements have also contributed to environmental degradation, reduced resilience to drought, increased vulnerability to environmental disasters and the effects of global climate change.

Agricultural and natural vegetation are most affected by drought complexity and least understood of all disasters. Therefore, the country used the emerging technologies like remote sensing, GPS and GIS mapping and modelling, for the whole the country since 1996 when FAO established Afri-cover program that aim to detect and monitor the dynamic change of natural resources. The Afri-cover program was updated again in 2011, and it was linked to the food security department – ministry of agriculture and cooperated with remote sensing authority to allow systematic review for natural resources situation affected by different factors especially drought. Drought indicators maintain the integrity of satellite information, natural resources in-situ measurements and field data from extension of the ministry of agriculture are main parameters to track the manifestation of drought through predict and model the current and future trend that promote use of emerging technologies on the effect of drought and strengthen the national drought early warning system

Government institutions responsible for rural development and natural resource management suffer problems of confused and overlapping roles and mandates and adherence to culture of integration, coordination and information sharing is minimal. Commitment to participatory planning processes is also limited with the top-down approach remains a prevalent practice. Years of underfunding and lack of articulated training and capacity development plans together with the loss of skilled personnel to brain drain and the humanitarian sector dominated by the influx of the international and national associated mainly with the crisis in Darfur have created critical human resource capacity gaps; mechanisms for oversight, accountability and quality control are weakly constituted. Information gap is also acute and available information is widely fragmented and scantily organized. Realizing the scale and magnitude of the rural development and natural resource management in the country existing government institutions, needs to be equipped to deal with the development challenges or to ensure sustainable rural development and natural resources management in the country.

Technical capacities

A technical capacity has witnessed accumulation of a huge wealth of knowledge and experiences through previous disaster year. There has been limited development of significant cadre of scientists, engineers, and professionals on related disciplines, some natural hazards have been mapped at suitable scales. Some technical capacities are built in for scattered institutions where installed physical capacities for monitoring, analysis, and dissemination of information are performed. Some representative examples of such capacities are shown below.

Technical capacities of the some partner institutions

Institution	Capabilities
Ministry of infrastructure and Urban development	Design of disaster-resistant construction, engineering first response training programs for engineers, architects and masons,
Department of civil defence	First disaster response mechanism Has a cadre of Medical First Responders, Rescue personnel and Collapsed Structure , search and rescue training equipment, country-wide networks, warehouses with emergency supplies
Ministry of Federal Governance Chamber and Locality Development Offices	Focal points on DRR in the Locality, information management system, networking, locality emergency plans
Ministry of Health	Rapid Response Teams for epidemic outbreaks, Emergency health profile, Disaster Health Working Group,
Academic Institutions	Researches on aspects of hazards, risk assessment, training capacity,

Institution	Capabilities
Ministry of Agriculture and Forestry	Damage assessment capacity, experiences of responding to hazards such as draught
NGO's	Capacity building, training , awareness, relief operations
Ministry of Solidarity and Social Development	Welfare of women, children, orphans, aged, homeless, war victims, supervises programs of poverty alleviation and programs related to social development
Humanitarian Aid Commission	Coordination of humanitarian aid, organizing international and national assistance, mobilizing national and international resources for humanitarian crises, supervising the NGOs
Ministry of International Cooperation.	Coordination and cooperation between Sudan and the International and Regional organizations focusing mainly on agreements for the provision of aid to disaster affected population

4. DROUGHT MONITORING, FORECASTING, AND IMPACT ASSESSMENT

Drought Indices

Drought indices are important since they simplify complex relationships and provide a good communication tool for diverse audiences. They are a quantitative assessment of anomalous climatic conditions such as intensity, duration and spatial extent. They also provide a historical reference (probability of recurrence) that can be used for planning and design applications.

Drought indices could involve a single index or parameter, multiple indices or parameters, or a composite index. Many examples of drought indices are used in Sudan, including mean rainfall compared with a 30-year period of record, number of days since a significant rain, the Standardized Precipitation Index (SPI), the Palmer Drought index (PDI)¹⁹, stream flow indices, composite indices and indices based on remotely-sensed data.

Current Monitoring, Forecasting and Data Collection

The famous drought of 1983/84 initiated the government to establish the Relief and Rehabilitation Commission in 1985, which reflected the importance of early warning system and therefore created an early warning unit with technical support from FAO and UNDP. Since then the EWU continued collecting weather data in close partnership with the Sudan Meteorological Authority and Ministry of Agriculture and produce early warning signals and weather forecasts. The coordination structure included all related stakeholders and partners from the government

¹⁹ PDI is a measurement of dryness based on recent precipitation and temperature.

structures, UN agencies and NGOs. The coordination for EWS is composed of Sudan Meteorology Authority (SMA), Remote Sensing Authority (RSA), Humanitarian Aid Commission (HAC), Financial Institutions (Banks and Insurance Companies), Ministry of Agriculture and Forestry, Ministry of Animal Resources, Ministry of Water Resources, Irrigation and Electricity, Rainfed farmers and Pastoralists Associations, NGOs, CBS and Gender Unions, and local communities cooperation. This is reflected in the different working groups and taskforces formulated and continued to operate such as flood taskforce, drought taskforce, weather watch group...etc.

A drought-monitoring system is important since it allows for early drought detection, improves response (by being proactive), ‘triggers’ actions within a drought plan, is a critical mitigation action and forms a foundation of a drought plan. The components of a drought-monitoring system include timely data and information acquisition, synthesis/analysis of data used to ‘trigger’ set actions within a plan and an efficient dissemination network (web, media, extension, etc.). Potential drought monitoring system products and reports can include historical analysis (climatology, impacts, magnitude, and frequency), operational assessments (cooperative data, Standardized Precipitation Index (SPI) and other indices, automated networks, satellite and soil moisture data, media and official requests) and also predictions/projections (SPI and other indices, soil moisture, stream flow, seasonal forecasts, Sea Surface Temperature SST’s). Components of a drought early warning and information system involve monitoring and forecasting, tools for decision makers, drought risk assessment and planning, and education and awareness.

The science document noted that a National Drought Management has several key elements:

- Promoting standard approaches to vulnerability and impact assessment,
- implementing effective drought monitoring and early warning systems,
- enhancing preparedness and mitigation actions,
- implementing emergency response and recovery measures that reinforce national drought management policy goals, and
- Understanding the cost of inaction.

Implement Drought Monitoring and Early Warning Systems

The Sudan Meteorological Authority (SMA) has a mandate from the Government of Republic of Sudan to monitor all the meteorological activities in Sudan. No agency or institution is entitled to carry out such activities without a proper liaison with SMA. The mandate of the Sudan Meteorological Authority is the provision of Meteorological information and services for the

safety of life, protection of property and conservation of the natural environment to ensure growth of the economy, poverty alleviation and eventually for the sustainable development of the nation. The SMA is working to fulfil the national, regional (ICPAC), Arab League-Environment Administration (Secretariat of Meteorology) and international obligations under various conventions such as WMO, ICAO, IOC/UNESCO, IMO, JCOMM (GCOS); FAO and WFP etc. The adequacy of the observation network of the key stations in the targeted states of NAPA project and the Project of Climate risk finance for sustainable and climate resilient rainfed farming and pastoral systems. SMA is a major partner leading the EWS group. SMA role is to provide the weather information and forecast for the issuing the Weather Index Insurance for smallholder farmers, pastoralists as end users, Banks and Insurance & reinsurance Companies and climate risk is mainly focusing on drought and floods as the most dominant extreme events..

Drought Indices:

Agricultural drought indices are based on remotely sensed data due to the availability of the synoptic coverage of satellite remote sensing data. Although drought is a complicated natural phenomenon, it can be monitored and simulated by a simplified drought index, which is an individual quantitative number for assimilating a huge amount of environmental data²⁰. A large variety of indices have been proposed that have allowed researchers to detect anomalies in the intensity, continuity, and spatial extent of droughts. These indices also simplify the communication of valuable information to the managers and policymakers for necessary actions. Various drought indexes for various classes of droughts have been established to monitor and simulate multiple drought statuses at a local and global scale. Satellite platforms allow for the acquisition of frequent, and in recent times, high-resolution, near real-time spatial data, which was not possible before. Theoretically, the drought indices based on remote sensing data have been divided into four main categories. Firstly, the indexes are used to monitor vegetation conditions, which are based on reflective data such as the vegetation condition index (VCI). This index was used to estimate the impacts of drought on vegetation. Secondly, the indices are employed to monitor and assess environmental conditions based on thermal data such as the temperature condition index (TCI), which is utilized to determine temperature-related vegetation stress. Thirdly, drought indices involving soil moisture information were mainly based on microwave remotely sensed soil moisture information, such as the Microwave Integrated Drought Index (MIDI) and the Standardized Soil Moisture Index (SSI), and the Soil Moisture Agricultural Drought Index (SMADI). Lastly, the environmental stress monitoring indexes are

²⁰ Wilhite, D.A.; Hayes, M.J.; Knutson, C.; Smith, K.H. Planning for drought: Moving from crisis to risk management. *J. Am. Water Resource. Assoc.* **2000**, *36*, 697–710.

based on the combination of thermal and reflective data, such as the vegetation health index (VHI).

Working with regional partners, SMA are collecting and extracted many indices for drought detection from the Moderate Resolution Imaging Spectro-radiometer (MODIS) dataset products, such as the Normalized Difference Drought Index (NDDI) and Vegetation Drought Index (VDI). Many other drought indices that have been developed, for example, the Drought Severity Index (DSI), are also derived from MODIS, in order to detect and monitor global drought events. This index combines the sensitivity of the ratio between evapotranspiration (ET) and potential evapotranspiration (PET) with NDVI using the simplicity of basic mathematic calculations. The ratio of ET/PET can be used as a good indicator for soil moisture. However, the recent trends in the development of crop production are well explained by rising evapotranspiration (ET) and potential evapotranspiration (PET). The Normalized Difference Vegetation Index (NDVI) likely reflects vegetation responses to dryness conditions.

Proposed Areas of Intervention at National Level²¹

The proposed programme will further meet the goals of the Comprehensive Africa Agriculture Development Programme (CAADP) of eliminating hunger, increasing economic development and reducing poverty through agriculture by implementing its four key pillars, namely: (i) Sustainable Land and Water Management; (ii) Infrastructure for Market Access; (iii) Increasing Food Supply and Reducing Food Insecurity; and (iv) Agricultural Research, Technology Development and Dissemination.

From the major challenges identified by the desk study, the priority areas of intervention will include: (1) Rehabilitation and development of water resources ; (2) Development of livestock infrastructures to improve access to local and export markets, and livestock health management; (3) Rehabilitation and development of rangelands and sustainable natural resources areas; (4) Strengthening of policy, legal and institutional frameworks to manage agricultural production, particularly the livestock, agriculture and fishery sectors; and (5) Community and institutional capacity strengthening, with special focus on women and youth, and conflict resolution management. Within the framework of the Ending Drought Emergencies programme, the priority interventions are framed within the following six components:

²¹ This is forecasted plan for long term development programme (15 years programming interventions).

5. DROUGHT RISK AND VULNERABILITY

National drought management relates to disasters that are triggered largely by natural hazards. However, the causal interrelationship between disasters triggered by natural hazards and those triggered by human-made factors, such as conflict, which is of particular concern in Sudan. Historically, the Sudan government has responded to disaster in a reactive way, with an emphasis on humanitarian action and recovery. There has been little attempt thus far to address drought risk as a cross-cutting development issue that can support the achievement of the national strategic development goals and reinforce community resilience. The situation of vulnerable people is now aggravated by evolving, complex threats such as climate change, new patterns of marginalisation, demographic growth and a rising proportion of older people, unplanned urbanisation, high levels of violence, involuntary migration, emerging infectious disease and the growing burden of non-communicable disease, environmental degradation, and insecurity of access to food, water, and natural resources. Proactive national drought management is also of increasing significance in the face of climate change (the implications of which are still not yet clear), but which may mean increased occurrence of extreme drought disasters. Adaptation to climate change is grounded in the national systematic ongoing national drought management as part of the overall development objectives. The Government of Sudan will ensure and build the national capacities to mitigate against, prepare for and respond to drought disasters nationwide and across all levels – household, community, locality, state, national, regional and international.

The national constitution and supported legislations, policies and directives are set to conserve and protect the national resources of the country, whether human resources, natural resources, infrastructures, investment and national security. The government system included different federal ministries that has been supported by specialised technical councils and agencies to ensure that the country and its national resources are protected and developed for the better welfare of the people of the Sudan. Each of the government structure has its mandates and responsibilities to address potential drought risks in their respective field of specialisation. The different efforts, actions and achievements will be reflected in achieving the planned development strategies and thus the sustainable development goals by 2030. However, the weaknesses or shortcomings in coordinating, harmonising and fulfilling the different mandates and responsibilities regarding potential drought risks may develop into disaster. Therefore, there is a need to have a national drought policy and national action plan to guide, follow up, monitor and ensure that any emerging potential drought risks are addressed timely, before it results into disasters.

Drought Risk Areas in various administrative areas

The Policy Framework for drought in Sudan contains guiding and cross-cutting principles, toward main objective of “Secure and protect the lives, livelihoods and rights of people in urban and rural settings against disaster risks and ensure national commitment to political, social and

economic development of all people of Sudan”. Therefore, there is a need to recognize the existing economic consequences and potential future contributions of vulnerable communities to development and poverty alleviation efforts in the country.

Consequently, the related political and policy processes needed to develop appropriate drought policies and fully integrate vulnerability to drought disasters into national and regional development programmes and plans. According to the constitution and the outcomes of the National Dialogue, the governance system in the country has full participation and engagement of the different traditional institutions from the village level to the administrative units, to the locality, to the state and federal levels. This is reflected in the composition of the village development committees, locality popular committees, state assemblies and national assembly, where the gender mainstreaming is reflected in the percentage provided for women in those governance structures (35%). Similarly, the national development strategies included among others, the protection and development of risk-based drought and flood management, and livelihood support for diversification of incomes and employment opportunities, to enable vulnerable and poor members of the community (especially women and youth) to access productive activities, and enter domestic, regional and international markets.

The Drought Risk and Vulnerability Assessment and GIS Mapping

The Sudan report for Land Degradation Neutrality reflected the degraded land due to drought cycles and depletion of the natural resources bases. The report indicated that there are different trends of land degradation according to the location in the state and the class of landcover. The group of experts in the formal workshop discuss the status of the land degradation and identify the following items which are very useful in the assessing of LD in the ground by the field visit:

Degradation in the grass and shrubs:

- Change the plant composition from palatable plants to non- palatable or toxic plants
- Complete removal of plants

Degradation in forest:

- Creeping of sand dunes on cities and farms,
- Poor productivity of the forest sector,
- Hurricanes
- Disappearance of tree species and other appearance.

Degradation in cropland:

- Lack of production in the rain sector,
- Soil degradation and
- Emergence of some invasive plants,

- Creeping sand

Degradation in wetland:

- Lack of wild life,
- Lack of fitness for growth and germination of trees and grasses,
- Soil hardening

Identification of possible land degradation hotspots

As a result of the assessment of land degradation trends and drivers, geographically areas exposed to land degradation trends were identified as so-called LDN hot spots. Twenty five (25) different LDN hotspots were identified in Sudan and located in different ecological zones and exposed to different direct drivers of land degradation. Figure 2 and 5 shows different hotspots in different landcover class and different geographical location. The hotspots were selected according to the declining of productivity in each landcover class. The food insecurity phase and the increase of population were additional reasons to select the mentioned hotspot. Further assessments in selected areas - especially if they included protected areas - are required to fully understand the historical and current drivers behind observed land degradation dynamics using additional indicators approved by the working group (LDN NC), data sources, including field assessment and consultation visits. LDN hotspots may become a priority for action to achieve LDN through LDN transformative projects.

The LDN Baseline:

The indicators are computed primarily using **global** data sources but is was recommended to be enhanced by national data sources, field surveys, assessments and ground measurements. The establishment of the LDN baseline in Sudan is supported **GIS Unit in the Ministry of Environment, Natural Resources and Physical Development (MENRPD)** under the supervision of the LDN Country Consultant. The MENRPD is engaged in the LDN target setting process and it is a part of the LDN national working group by representative. Sudan use the default data to set their LDN baseline, with some consideration of national data in the food insecurity and distribution and projection of the population from Sudan CENSUS 2008. The LDN baseline was technically validated by relevant stakeholders, including the LDN national working group and a national workshop prior to endorsement by Government at the highest possible level.

Maps of LDN Base Line

Fig. 2: Land Cover / Land Use 2000-2010

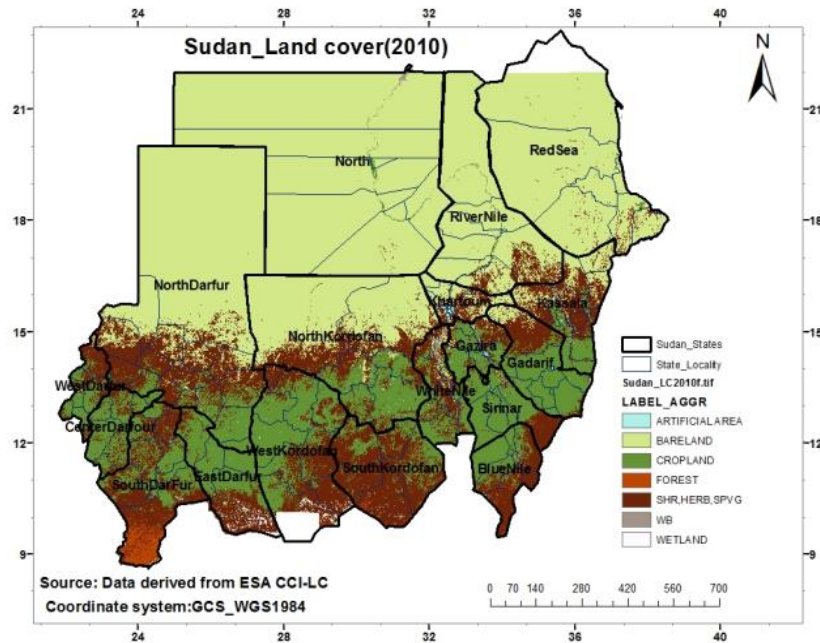
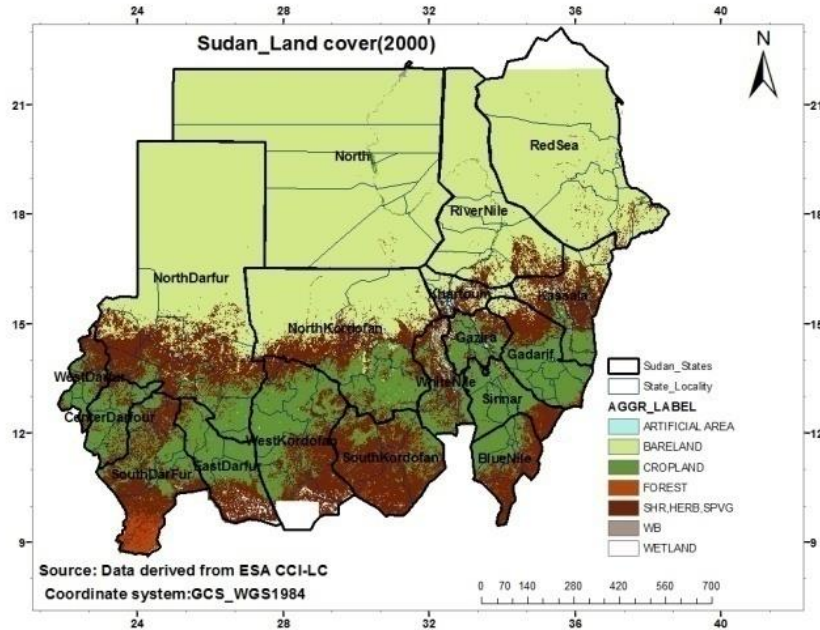


Fig 3: Sudan soil organic carbon in 2000-2010

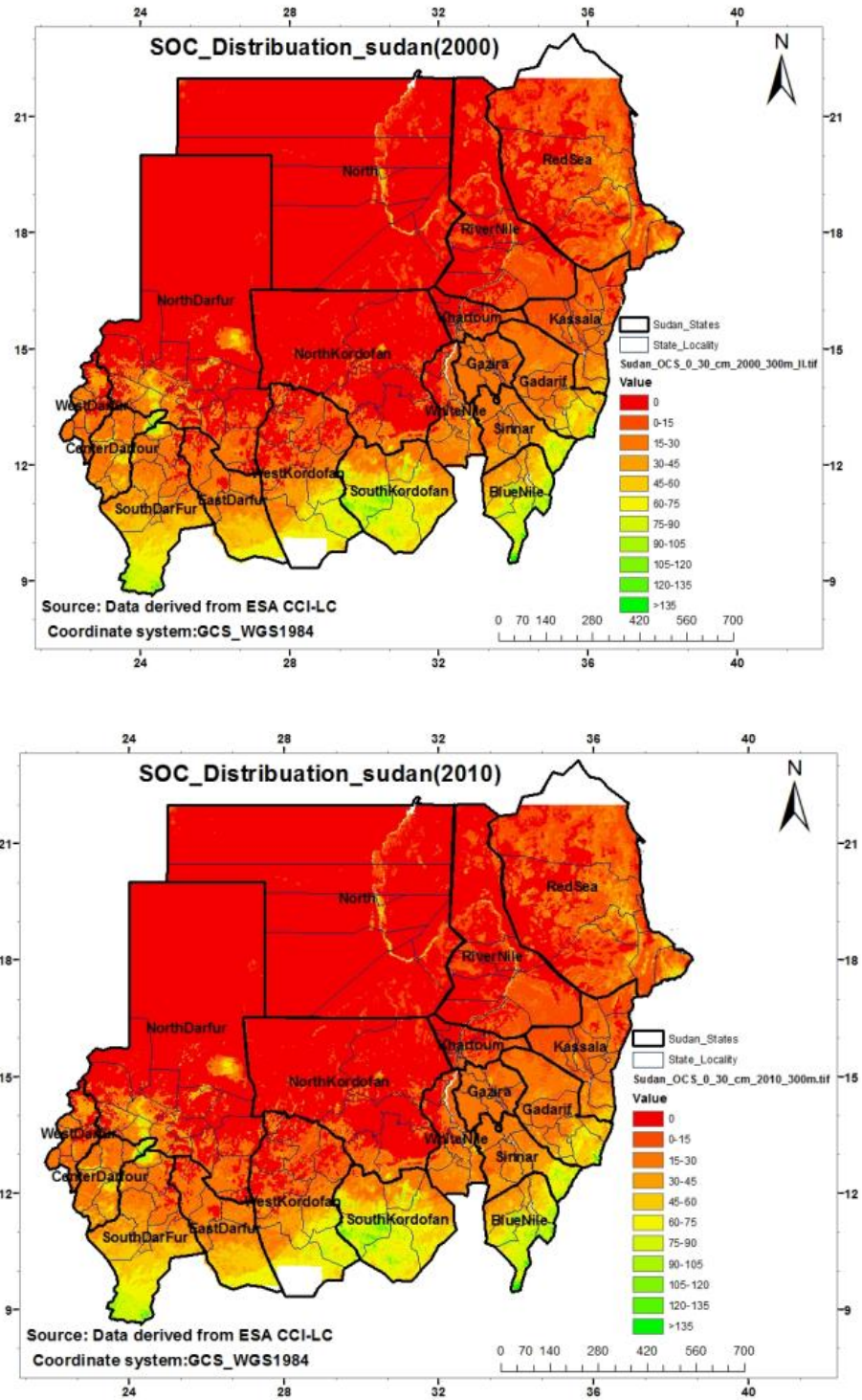
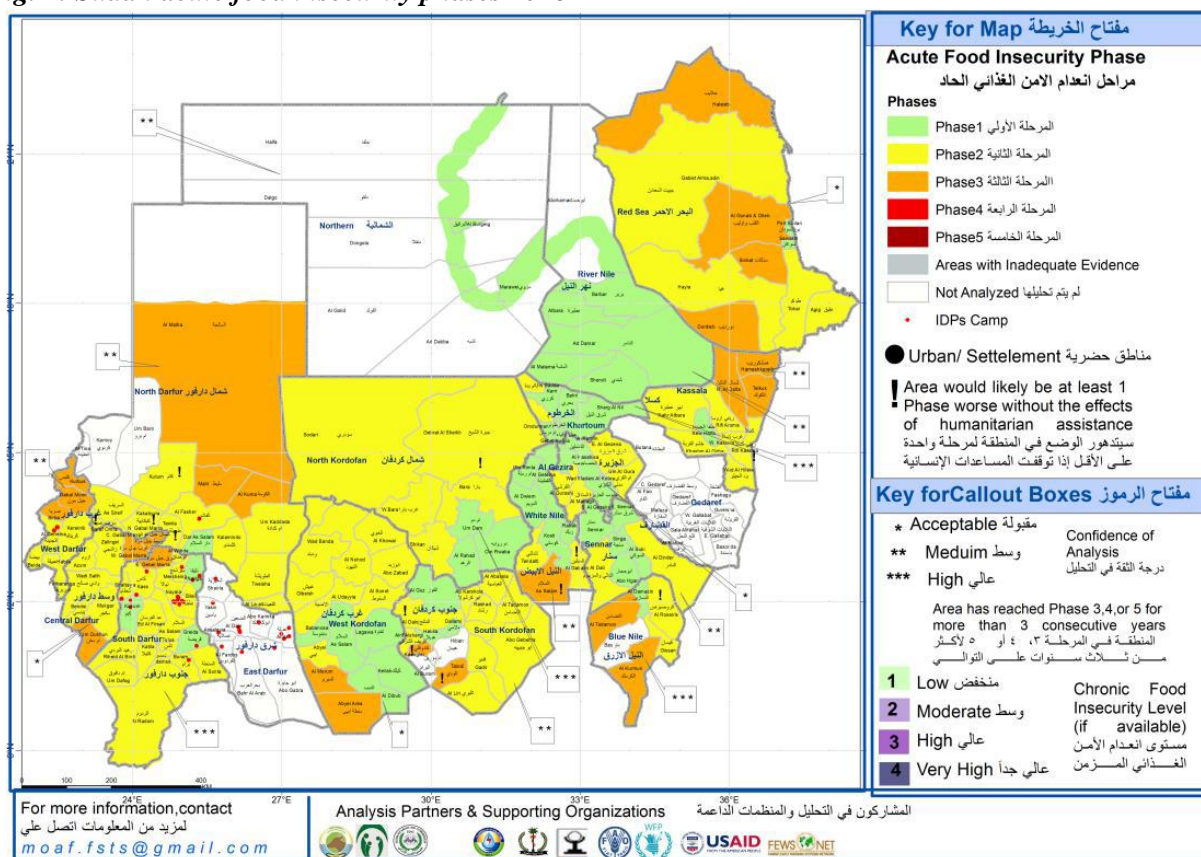


Fig. 4: Sudan acute food insecurity phases 2016



6. CROSS-CUTTING ISSUES

Gender mainstreaming on planning and implementation of activities related to Drought in Sudan

The significance of the roles that women play in economic and social development at the local and national levels and women's roles as change agents have gained considerable attention in recent years. Historically, Sudanese women obtained the right to vote, equal pay & pension for equal job and right of election in 1953, 1964 and 1964 respectively. They were the first to hold judiciary, ministerial & governor posts in Africa¹.

Climate change stresses in Sudan and relation to gender mainstreaming

Gender mainstreaming is the process of assessing the implications for women and men of any planned action including legislation, policies, strategies, plans or programs in all areas and at all

levels. The strategy of gender mainstreaming is defined in ECOSOC agreed conclusions 1997-2 as: the process of assessing the implications for women and men of any planned action including legislation policies or programs in all areas and at all levels, it is a strategy for making women as well as men concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programs in all political, economic and social spheres, so that women and men benefit equally and equality is not perpetuated. The ultimate goal is to achieve gender equality (United Nations 2012)

In Sudan, gender is enjoying different roles and situations from well politically and economically empowered groups in central Sudan to marginalized ones in war and conflict areas (Badri 2001). However, accurate statistics or proven researches on situations of gender in the Sudan as general are not sufficient (Tayseer 2017).

Women in the Sudan, particularly rural women, have generally been assigned by nature, culture, and tradition to be bearers of children as well as the providers of food and other essentials for their families. According to FAO, women represent 49% of the farmers in the irrigated sector and 57% in the rainfed traditional sector in Sudan. Women in the rainfed sector are primarily subsistence farmers but they also work as seasonal wage labourers in the rainfed mechanized sector, and as hired or unpaid family labourers in the irrigated sector. Although women play a crucial role in agriculture, contributing to both the GDP and to household food security, their contribution to agriculture and the overall economic development process continues to be undervalued. Women in Sudan carry out a major portion of agricultural activities and bear almost the entire burden of household work, including water and fuelwood collection and food processing and preparation. According to a Ministry of Agriculture baseline survey of the rainfed traditional sector, both men and women participate in land clearance and in the preparation, harvesting, transporting and marketing of crops, while women carry out most of the planting, weeding and food processing. In the livestock sector, men have the primary responsibility for cattle and sheep raising, while women participate in milking and processing milk products. Both men and women are involved in raising goats and poultry. In fisheries, women participate in processing and marketing. In the agro-forestry sector, women participate in all aspects of the work and have the major responsibility for seedling preparation and weeding. Men and women are sometimes responsible for different types of trees. FAO also indicated that Data from a participatory rural appraisal (PRA) of irrigated areas indicates that at the household level, women are responsible for a wide range of decision making in farming activities, even when the husband is present.

According to Shami, at least 87% of Sudan's female labour force was concentrated in agriculture. Of these, 78%-90% were involved in the traditional subsistence sector, whereas only 10% are involved in the modern sector (Massoud, 2001). Subsistence (family labour) farming is primarily

unpaid labour that limits the economic participation of the worker. The majority of family labour is performed by women and children (Haleh, 1985). Haleh also stated that, family labour is based on kinship relationships where the norm dictates a sense of communal labour. Paid labour is based on a contractual understanding between the farmer and worker and primary limitation to gender equality in Sudan is the necessity of obtaining the credit which is needed to manage a farm.

Although women play a crucial role in the agricultural cycle, their role has not improved as a result of technology in the agricultural sector. It tends to concentrate on the production of cash crops, and most of women are not encouraged to participate in this activity and there is an inconsistency between the policy goals in agricultural improvement and the resulting demise of women farmers (Khalid, 2011). Recent study on gender mainstreaming in Sudan under climate change stresses by Tayseer 2017 revealed that, previous studies on climate change stresses are used to manifest the importance of policy improvement especially gender policy within institutions involved in natural resources for better management under climate change stresses. The same study concluded that establishment of gender research units within academic institutions is necessary. Those units can be platforms to source and develop knowledge about the role of gender in climate change adaptations, and they also can be linked to decision making processes within institutions involved in natural resources and agriculture, where gender policies, could be developed and applied.

Gender mainstreaming Institutions in Sudan

In Sudan natural resources, agriculture and environment sectors are managed through Agriculture Research Corporation, National Forest Corporation, Federal Ministry of Agriculture and Livestock, High Council of Environment and Natural Resources, Ministry of Environment and Physical Development, as well as, some nongovernmental organizations (Nimir and Elgizouli 2010). Climate changes stresses on Sudan is also adding an eager necessity to consider developing of gender policies among involved sectors (Tayseer, 2017).

Institute of Women, Gender and Development Studies

In Sudan the Institute of Women, Gender and Development Studies (IWGDS) which is located within Ahfad Women University is the only academic institution that is responsible for providing academic degrees on gender and development in the country now.

The institute aims to promote the integration of gender studies as university courses at Ahfad and other universities and to advocate for gender mainstreaming in development and influences policies. However, the institute is challenged by the shortage of disaggregated data and analytical

studies which help to understand the causes of discrimination, differences and opportunities for different groups specifically for rural women and men (Tayseer, 2017)

Gender Mainstreaming and Agricultural Unit

As stated by Tayseer, 2017, in the Ministry of Agriculture gender main streaming is represented on Gender main streaming and Agricultural Unit. The unit consists of 4 units, policy formation unit that is responsible for securing of gender integration on development policies to achieve food security and development. Unit for projects evaluation and monitoring which work to conduct projects according to relative advantages for each state in Sudan, a proposal would be designed and presented to funding agencies. A research unit responsible for designing studies and research based on disaggregated data, and finally a training unit provides training on concepts of gender and gender integration on development. In Gender mainstreaming and Agricultural Unit, the staff is committed to women empowerment and gender equality through training sessions carried out by the unit for its employees. However, the Ministry of Agriculture does not have its own gender policy. The staff of the unit only works as technical expertise to conduct surveys or trainings demanded from other institutions or organizations but they do not have the resources or the strategies within the Ministry of Agriculture to design their own surveys or trainings.

Agriculture Research Corporation ARC

“Agriculture Research Corporation is the institute that is responsible for conducting researches, baseline surveys, and research experiments on areas of agriculture, livestock and fisheries. The corporation has branches according to the administrative division of the Sudan. When the actor was asked about the relevancy of the corporation to gender she replied that the corporation has focal persons for gender integrations on projects. Moreover, there are training on gender concepts conducted for staff of the corporation but those training are not conducted on continuous or established manner and mostly are conducted to satisfy donors. She further mentioned that researchers on experimental fields in Agriculture Research Corporation need to understand the social background of the communities in form of base line surveys that have gender dimension or gender data. In this manner, researchers would know the needs and recommendations of members of local communities. Accordingly, researchers can implement experiments considering the communities’ needs. She considers the gap on gender within Agriculture Corporation is represented on the lack of understanding the concepts of gender mainstreaming within the staff of the corporation as well as within community members where experiments are conducted. According to her, if a gender research unit should be established within education

institutions, the gender focal persons in ARC could be the contacts with the unit to coordinate training of staff within the corporation. Particularly, there is an immediate need for training on design of researches based on gender needs” (Tayseer, 2017)

Forest National Corporation (FNC)

Forests management is coordinated by the National Forest Corporation FNC, however the relevancy to gender is based on the staff combination and role of gender in forest management at community level. In FNC, the women represent 70 % of the staff working and some of them entitled leadership positions, therefore, there is need to train the women and men within FNC on gender mainstreaming, on planning and budgeting of projects and programs conducted by the corporation. At community level women are involved on management of forests through collecting of wood and non-timber products, so those women, need to be trained on how to maximize their economic benefit from these activities. At the Gum Arabic Belt area, women are participating on gum harvesting, cleaning and organized in form of Community Based Organizations, therefore, those CBOs need to be trained on microfinance projects, management of nurseries and concepts of gender. FNC can be the link to training centres and institutions through Department of Extension within the corporation” (Tayseer, 2017).

In Sudan context, as it showed the gap on establishing of a solid gendered mainstreaming policy within natural resources, environment and agriculture sectors, is due to firstly, the lack of gender experts and lack of knowledge on gender concepts, specifically, on gender analysis and gender research methodology (Tayseer, 2017). So, there is a need for referable gendered policies that are developed within government institutions and according to these indicators, a proper gendered analysis can be conducted for future implemented activities.

Gender Inequality Index

Human Development Indices are relative classifications across the 187 countries denoted as very high, high, medium (each with 47 countries) and low (with 46 countries). The 2013 United Nations Development Programme (UNDP) report ranks Sudan as the #129 country out of 147 on the gender inequality index, which is in the low human development quartile. This index ranking is a calculation of maternal mortality rate, adolescent fertility rate, females in the national parliament, population with at least a secondary education, and the labour force participation rate. Finally, it can be concluded that gender mainstreaming planning in Sudan is not deeply rooted yet, more training programs on gender mainstreaming are needed to be conducted for both government and non-government institutions at different scaling and levels.

Gender Mainstreaming Recommendations

Women's traditional natural resource knowledge is important for managing disaster risk and climate change adaptation. Women's indigenous and local knowledge is important for adapting crops and cropping systems in the face of encroaching drought and other potentially disastrous climate variations (FAO, 2001). Women's knowledge of their surroundings and of natural resources can be essential for recovery from the impact of a natural hazard. Therefore, the involvement of women is influential in increasing resilience to climate variability, particularly when considering decision-making, training, market access and finance strategies, availability of and access to resources, and improvement of overall living standards and reduction of poverty.

To strengthen and enhancing women's engagement and empowerment in drought contexts this report recommends that national governments and the international community take the following action:

1. Promote women's participation in formal and informal decision-making structures and governance processes related to climate change, drought, natural resource management in the country
2. At planning stage working with environment and related natural resource management Institutions can help increase women's participation in decision-making at the national and local levels.
3. Support is needed for overcoming the structural, social and cultural barriers to women's formal and informal political participation in drought planning and implementation stages
4. More effort is needed to ensure that, women are represented in relevant decision-making bodies, including through the use of quotas and soliciting inputs from a broad range of women's groups and networks when elaborating drought and natural resource management policies.
5. At the Drought Plan Implementation, remove barriers and create enabling conditions for women to access to credit, technical support and benefits from natural resource utilization is crucial to improve women's economic empowerment and productivity
6. The social and political environment that gives different genders different situations in Sudan need to be more researched and analysed
7. Gender mainstreaming as a policy of planning has to be introduced, developed and legitimated through establishment of gender research Institution in academic organization related to agriculture and natural resources management i.e. faculties of agriculture, forests, animal production, and etc.

Government and other non-governmental actors should promote an active and visible policy of mainstreaming a gender perspective in all policies and programs related to drought so that, before decisions are taken, an analysis is made of the effects on women and men respectively.

7. DROUGHT COMMUNICATION AND RESPONSE ACTIONS

The Government of Sudan ratified the UNFCCC on November 1993. Sudan fulfilled its commitment under the UNFCCC by submitting its Initial National Communication (INC) in February 2003 and NAPA in July 2007. The INC process included climate change climate change vulnerability studies in three priority socio-economic sectors including agriculture, water resource management, and public health, with a particular focus on vulnerable groups in distinct ecological zones in urgent need of adaptation activities. The NAPA process identified 32 priority adaptation initiatives in the agriculture, water and health sectors to reduce the increasing vulnerability of the rural communities to current and future climatic risks. The efficacy of these measures has already been validated by stakeholders in areas determined to be highly vulnerable to recurrent climatic shocks. There are also a number of Governmental programmes and policies containing measures to address the root causes of growing rural vulnerability. The HCENR coordinated the first climate change-related activities in Sudan, Sudan's First National Communication under the UNFCCC, a multi-year effort to develop the country's first greenhouse gas inventory, an initial assessment of the vulnerability of water resources, agriculture, and public health to climate change; and an analysis of greenhouse gas mitigation strategies. (1998-2003).

Drought Communication Protocol

A good internal communications plan will involve all relevant stakeholders, facilitate effective communications, and organize response protocols. It should also address all roles and lines of communication and/or responsibility. The plan should clearly outline how information will flow across and through the organization and to its external stakeholders. Several key stakeholders play a role in ensuring reliable access to drinking water, including the utility staff and management. Other internal stakeholders are municipal staff and elected/appointed government officials.

Declaration of Drought Conditions

The SMA through its collaboration with regional specialised institutes and organisation, follow up the monitoring of weather factors and early warning system to formulate a projection for the rainy season in the country, usually in May month. The forecast depends on the Standardized Precipitation Index (SPI) and other indices, automated networks, satellite and soil moisture data, media and official requests) and also predictions/projections (SPI and other indices, soil moisture, stream flow, seasonal forecasts, Sea Surface Temperature SST's). The probability of drought occurrence, if it exceed 65 – 70%, is therefore used as a guide for formulating the mitigation measures for the drought event. Such measures include the concentration of main crops mix in rainfed and irrigated sectors for national food and nutrition security planning. However, these are sectoral preparedness measures, while the SMA and EWS continued their

close monitoring of the development of the rainy season and weather factors to adjust or confirm the earlier projections and forecast.

Those early warning signals are shared with the specialised council related to environment, agriculture, economics and social welfare to make the necessary alerts to the Ministerial Cabinet, its high level committees and vulnerable states. However, in accordance with the Sudan Disaster Risk Management Policy and strategy, The President of the State is the sole position in the government that can declare a disaster whether it is drought, flood, epidemics...etc. at the National level. However, as drought can be localised to certain geographical or ecological zone, the NDP propose that according to the technical assessment by the locality working groups and endorsement of the state, the state should obtain consent from the Federal Governance Chamber to declare drought condition.

Communication and Coordination Guidelines

The Regional Water Efficiency and Conservation Committee should be established from staff of regional and state levels water facilities along with representatives from the Ministry of Water Resources, Irrigation and Electricity. The Committee should meet to develop regionally consistent water shortage response stages and year-round water conservation measures (the group was initially called the Regional Conservation Work Group). After their initial work was done, the group expanded its focus (and changed its name) to include both year-round water efficiency and drought-related water conservation. The group shared information about outreach and education and water conservation programs and discussed how to improve water resources management and communication in the country with special focus on drought prone areas and hotspots identified by the LDN report. During this collaboration, the group should investigate the current water resources, developed a useful list of potential projects, and developed a prototype regional website to aggregate water supply status information that is currently available.

Drought Response Actions

Existing Initiatives

The Interim Poverty Reduction Strategy Paper (IPRSP) and its processes are linked and complementary to the 3-Year Salvation Economic Program (2011-2013) and the 5-Year Development Plan (2012-2016), both of which are under preparation. The 3-Year Salvation Economic Program (SEP), is an emergency plan to deal with the adjustment to new political and economic realities following the independence of South Sudan and reduction of oil revenues. The new 5-year Plan (2012-2016), a successor to the Five-Year Plan (2007-2011), will provide a foundation and road map for implementation of the full Poverty Reduction Strategy Paper (PRSP). Sudan as part of the COMESA is in the final processes for launching its CAADP Compact, which is currently under preparation. However with separation of South Sudan as an

independent country, the government is planning to review all national strategies and policies to accommodate the Sudan with its new borders and climatic zones.

In all development and humanitarian planning and intervention, the development partners from NGOs, CSOs and regional institutions is well acknowledged by the government and their engagement in the implementation arrangements helped in identifying activities and tasks and areas to focus their involvement. For example, the Sudanese Red Crescent has worked with the ministry of water resources for flood early warning systems together with their active participation in delivery of emergency assistance. Many NGOs participated and engaged in the formulation of development policies such as the IPRSP, UNDAF, and CPF...etc.

The government of Sudan has formulated integrated policies for the revival of the agriculture sector, reflected in the Agricultural Revival Executive Programme (AREP), but its full implementation is constrained by the political and economic context of the country that has been associated with political tension and insecurities. The Agricultural Revival Program has targeted the following key indicators, in line with the CAADP pillars to achieve its goal in five years (2007-2011):

- Creating an appropriate environment for a sustainable development of agricultural production;
- Producers and institutions capacity building;
- Development of support services;
- Development and modernization of agricultural systems;
- Protecting and managing natural resources;
- Implementation of quality control and safety measures on agriculture products;
- Establishment of international partnerships.

8. DROUGHT MITIGATION AND PREPAREDNESS

Existing Drought Mitigation Strategies and Planning Issues

The current disaster risk system in the country mainly focused on the response activities that are needed after the disaster occurs. The response involves interventions and measures that are taken during and/or immediately after a disaster occurs and therefore, such actions are directed towards saving lives and livelihoods and dealing with the immediate physical damage caused by a disaster. Most of the interventions are focusing on provision of shelter, food, sanitation, health issues, education...etc. This is an immediate result of the level of vulnerability of the affected communities or groups to the potential hazards and risks associated to the habitat. Therefore, this vulnerability corresponds to the incidence of poverty in the country.

Strategy to mitigate drought (or how to overcome the drought):

1. Preventing and recycling of excess runoff
2. Use tillage to absorb and hold maximum moisture.
3. Timely weed management to control water loss by evapotranspiration (ET).
4. Planning for suitable cropping system.
5. Selection of short maturing and drought tolerant varieties and crops.
6. Contingency crop planning for abnormal weather situation.
7. Management of various inputs to suit the climate.
8. Conserving the soil moisture by agronomic practices like mulching.
9. To apply irrigation.
10. Optimizing of plant population to reduce evapotranspiration (ET).
11. Timing of foliage to reduce evapotranspiration (ET).

Disaster Risk Reduction (DRR) is the systematic process of application of policies, strategies and practices to minimise vulnerabilities and disaster risks through preparedness, prevention and mitigation of adverse impacts of hazards within a context of sustainable development. DRR approach should be mainstreamed and integrated into the strategies and operations of every sectoral ministry rather than being left to be implemented by one Ministry. Such challenges would need to develop the Sudan DRM directions and institutions to engage in multi-sectoral risk reduction investment and drought mitigation measures including early warning system and setting the operation procedures.

This can be achieved through close collaboration and cooperation of the different technical institutions and agencies working on drought issues to work in harmony and coordinated system to effectively build the country resilience against potential drought risks. The coordination should be oversight by one institution to ensure effectiveness, efficiency and harmony. In addition, there should be a clear division of roles and responsibility to collaborate and harmonise the different actions for building drought resilient communities and institutions. The following tasks are considered for drought risk mitigation:

- a) Rehabilitation and development of water and arable land resources in the drought prone areas of the Sudan, to increase water availability for human, animal, agriculture, and energy use;
- b) Improvement of livestock productivity through improvement of livestock health management and development of infrastructure and enhance the access to domestic and export markets;

- c) Rehabilitation and development of natural resources such as forest and rangelands to ensure its sustainable management to enhance availability of their products (wood and forage) in a sustainably managed environment, using public-private partnership and community partnership approaches and contribute to peace building and conflict resolution and to minimize natural resources-based conflicts;
- d) Build the Capacity of targeted individuals and institutions responsible for water resources and agricultural products' value chain development, including the review of related policies so as to address the land tenure issues, water use and food production systems in the country;

The Government of Sudan has endorsed and implemented many projects and programs in the field of climate change and for combating desertification, but the scale of implementation remains far below the actual needs of the country to address the problem of drought and climate change. The country's plans and strategies that the Sudan is progressing in their implementation are integrated in the Land Degradation Neutrality Programme (LDN), and as follows:

- National Strategy for Adaptation to the Effects of Climate Change (NAPA)
- National Adaptation Plan (NAP)
- Intended Nationally Defined Contributions (INDCs)
- National Appropriate Mitigation Actions (NAMAs)
- REDD+ National Strategy
- National Action Plan for Desertification 2006 – Updated 2018

Drought mitigation activities and progress already achieved

The ongoing projects related to drought mitigation funded by international organization:

- 1- Project of rehabilitation of the Gum Arabic belt (Kordufan - Darfur)
- 2- Rehabilitation of Grassland for Carbon Stock Project (North Kordufan)
- 3- Projects of tree belts in the River Nile and Northern States
- 4- Natural Resource Development Project - IFAD (Greater Kordofan)
- 5- Wadi Al-Kwa Project - UNEP (North Darfur).
- 6- Adaptation projects to climate change impacts
- 7- Sustainable Natural Resources Development Project (African Great Green Wall Project).
- 8- REDD+ Programme (under RPP)
- 9- The Drought Resilience and Sustainable Livelihoods Programme - Project (Gadarif, Kassala and White Nile).

10- Integrated Carbon Sequestration Project in Sudan

9. NATURAL RESOURCES MANAGEMENT

The occurrence of drought event in the arid and semi-arid areas, which represents almost 60-70% of Sudan land, has a severe damage to the natural resources base. The recovery from repeated droughts could be irreversible due to the harsh conditions of those areas bordering the Great Sahara. Therefore, the early preparedness and building resilience of the natural resources base in those areas will preserve the environment and reduce the casualties and losses of livelihood assets and natural resources base. The most critical resource is water, moisture and vegetative cover. The below is a review of some of the critical ones in the Sudan.

Water resources development

This component will focus on the development and establishment of infrastructure for water harvesting and supply to make water available for human consumption, agriculture, and livestock in a sustainable manner. Given the trans-boundary nature of the water resources in the region, the component will also support enhanced regional water basin cooperation and coordination.

The priority is to *make water available for human consumption, agriculture and livestock* through (i) investment in water storage and other related infrastructures such as small to medium size dams, water harvesting systems, boreholes, sub-surface and sand dams; (ii) Rehabilitation and upgrading of existing irrigation schemes, emergency water supply systems; and (iii) Protection of water reservoirs and conservation of water catchment areas.



Enhanced regional cooperation and coordination through the establishment of reliable water information systems across water basins in the country. Activities will include (i) Studies on feasibility of multipurpose water schemes, underground water resources and improved water management technologies; (ii) establishing reliable hydro-meteorological and hydro-geological networks for continuous water resources assessment in the different basins; (iii) Rehabilitating or

replacing aging infrastructure for water resources monitoring; (iv) Establishment of common water information monitoring and information sharing network system; and (v) review of policies and institutional frameworks to ensure the active role and involvement of traditional institutions in water management.

Pasture and land development

Rainfall shortages, delays and intermittent dry spells throughout the rainy season have also increased the likelihood of intercommunal conflicts among herding communities and livestock losses in 2015. Losses will increase food insecurity among vulnerable sheep, cattle and camel farming families in affected localities by reducing their access to meat and milk, as well as income to meet their basic needs. According to FEWS NET, pasture and water are likely to be less available than usual from now through to March 2016, both due to the seasonal decline and the below-average rainfall. This will lead to deteriorating livestock body conditions, disruptions and changes to seasonal livestock migration patterns, and increase the risk of crop destruction by livestock and resource-based conflicts in eastern, central, and western Sudan. These impacts could extend into the 2016 dry season (March – May) when pasture and water are normally very limited, which could lead already weakened livestock to suffer increased morbidity and mortality, further threatening the livelihoods of vulnerable pastoral families, especially among the poorest.

There are different interventions and pilot project aiming to promote tree plantations; rehabilitation and improvement of pastures, rangelands and grazing areas, and demarcation of livestock routes to ensure protection and regeneration of palatable pasture species. The priority interventions could be summarized as follows:

- Rehabilitation and maintenance of pasture in the various ecological zones and adoption of rational use to ensure sustainability and continuous access to markets;
- Ensure the effective role of traditional institutions, voluntary and public organization in the pastoral resources management
- Promotion of appropriate sustainable communal rangeland management practices and technologies;
- Land use planning to guide the investment opportunities in this sector and options for strategic partnership, making use of the recent maps produced by ministry of agriculture in collaboration with ACSAD²² for the 3 eastern states; another reference for use could be the land cover map of Sudan produced by SIFSIA/MoA/Remote Sensing Authority in 2012.

²² Arab Center for the Study of Arid Zones and Dry Lands (Syria)

- Development of rangeland monitoring structure and support establishment of fire-lines for protection of natural grazing areas;

Securing access to natural resources

One of the priority components of the Agricultural Revival Executive Programme (AREP) is the protection of natural resources through the development of forests, pastures, range lands, re-establishment of the vegetative cover and the development of the Gum Arabic Belt to combat desertification. Community inclusion and participation (including women and youth) in planning for the rehabilitation, development and management of rangelands and forests in the drought prone areas will ensure ownership and therefore form the security and sustainability for continuous regeneration of these important resources. Such an approach should be supported by technical assistance and technologies to ensure range re-seeding, bush control and clearing, fire-lines implementation to ensure protection of natural vegetation, development of grazing areas, soil and water harvesting and conservation. Such efforts should be supplemented by activities, for provision of energy saving equipment to enable women participation and empowerment.

On the other hand, the re-opening of livestock routes is critical for seasonal movements of livestock to ensure the regeneration of pasture. While recognizing the importance of re-seeding to recover denuded areas, the regeneration of pasture can only be guaranteed if the area is protected from being accessed by livestock and humans in certain seasons of the year.

Environmental management (including renewable energy and biodiversity)

Many of the current interventions are seeking to conserve the indigenous genetic resources of main crops species and livestock breeds and ensure their protection through establishment of genetic resources banks for the potential breeds in the country. Therefore, the priority intervention focuses on conservation of local species of dry land plant species, livestock breeds, and ecosystem conservation in potential areas.

Promotion and support to production of energy saving technologies and policies to reduce trees cutting and promotion of use of alternative sources of energy such as biogas and solar energy. The priority interventions are as follows:

- Effective control and management of charcoal production and marketing, through organised and planned cutting of firewood from replacement operations of the aged reserved forests and promote use of efficient energy saving stoves;
- Formulate and enforce a very strong legislative framework to guide the charcoal production and marketing;
- Promote investors to invest in energy supply (solar and electricity generation) for rural areas and pastoral communities;

- Support the capacities of civil societies and organisations to enable communities use alternative sources and methods to access safe energy and technologies

Market access and trade

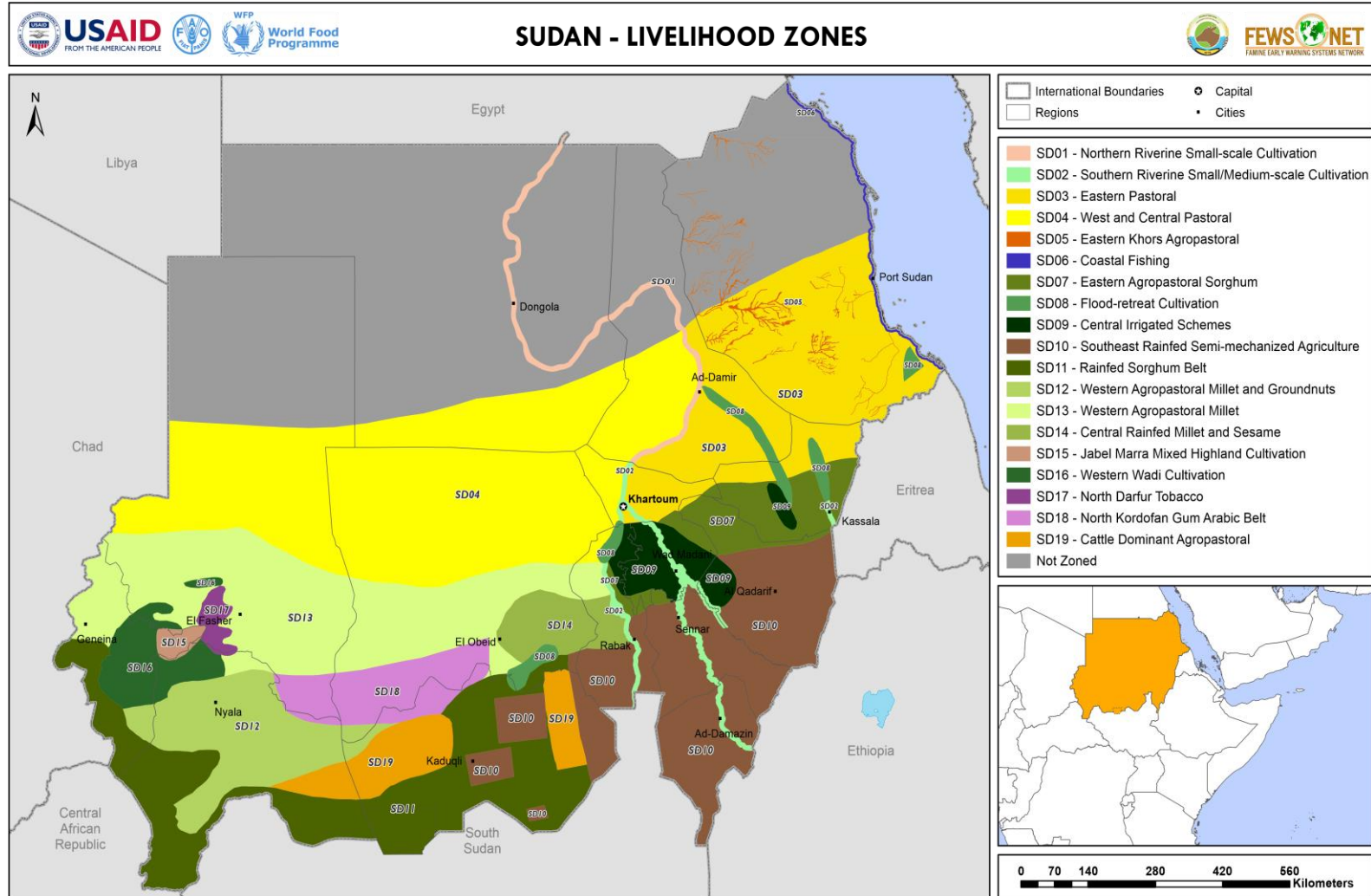
This component addresses issues related to trade, processing and marketing of products, including policy aspects, livestock mobility for trade, roads and transport, trade/marketing infrastructure, trade finance, trans-boundary disease control, and sanitary and Phyto-sanitary measures and standards. Activities under this section would be a shared responsibility through PPP partnership between private sector and investors with the Ministry of Trade, Industry, Cooperatives, and MAR. The activities will be geared towards the improvement of infrastructure for livestock marketing and value addition along the value chain. The activities envisaged include: (i) developing feeder roads to improve access to livestock and other goods markets; (ii) construction of quarantine stations, establishment/ improvement of stock routes, provision of livestock feed, supported by integrated services centres/outposts; (iii) construction of slaughterhouses/abattoirs, livestock based product processing units and markets; (iv) development and implementation of a branding programme for identification and traceability of livestock in the country; (v) access to mobile phones by producers and traders and (v) formulation of appropriate policies and legislations that will enhance community participation in marketing and export.

Market development

The AREP calls and support states for the development, rehabilitation and sustainable management of rural infrastructures, such as feeder roads, livestock markets, value added facilities and storage capacities. In this regard, the government encourage the formation of market association and empower communities and private sector to participate in the operation and maintenance of those structures, to ensure sustainability through a cost recovery mechanism. The set-up of public employment programmes could contribute to build and maintain critical infrastructure, while providing employment opportunities, also to women and youth. Therefore, priority intervention includes, institution strengthening and capacity building of cooperatives for trade, local livestock marketing outlets to enhance more off take and value chain development. In order to secure the pastoral mobility for trade, the following are priority interventions:

- Secure availability of integrated services of water, fodder, commercial feed, and pasture along stock routes to markets, including cross-border routes;
- Encouragement of CAHWs and PPP for provision of veterinary services and essential livestock drugs on consistent basis to active CAHWs' engagement.

Fig. 1: FEWS-NET: Livelihood Zones in Sudan



Securing livestock mobility (MAR)

The priority interventions for securing livestock mobility include:

- Strengthen local Government capacity for legislation of livestock routes and the provision of integrated services along the routes;
- Improvement of access to pasture, feeds and grazing grounds for livestock along the seasonal, commercial livestock routes and improved access to national and regional roads' network;
- Encourage private sector investment and community participation in roads' sector including construction of feeder roads in pastoral areas;
- Strengthen the role of traditional institution in the management of livestock mobility, and the domestication of the African Union pastoral policy framework
- Improve quarantine system and network structure;
- Make adequate provisions for pasture, water and disease treatment facilities along the demarcated livestock routes

Securing financial transaction (microfinance policies of the Central Bank of Sudan)

The current policies of the ARP are calling for promotion of rural finance and savings services/schemes to support rural and pastoral communities and establish micro-finance institutions in rural areas. The IGAD's EDE can learn from the lessons and experiences gained in Sudan for provision of microfinance facilities in rural areas, such as the MDTF projects that tested new modalities for provision of rural finance to producers groups and communities.²³ This can also build upon the Central Bank of Sudan/Ministry of Agriculture/WFP F2M activity which provides loans to small holder farmers through farmers' associations.

Trans-boundary disease & SPS measures and standards (Ministry of Animal Resources, Fisheries and Rangelands)

Support animal vaccinations against epidemic diseases and provision of essential drugs, in addition to support of regular inspections by Veterinary staff. Capacity building of veterinary staff to integrate animal health services, marketing and certification systems/services, SPS Standards and other regional and trans-boundary requirements. Priority interventions include:

²³ The financial model of the village development committees, supported by the MDTF Project titled "Improving livestock production and marketing – A Pilot.". The second model is the seed fund for the gum arabic producers' association supported by the MDTF Project for Revitalizing the Sudan gum arabic production and marketing.

- Development, rehabilitation and sustainable management of export quarantine centres;
- Establish and maintain quarantine infrastructure throughout the commercial livestock routes with facilities for pasture, water, treatment crash, tick control, a laboratory for disease diagnosis and office
- Improve food safety (sanitary and Phyto-sanitary standards);

Livelihood and basic services support

This component includes interventions aimed at support to livelihoods in drought-prone regions and states for sustainable food production and nutrition at the household level, including increase incomes and decent employment opportunities, with particular attention to youth, women and vulnerable groups, and provision of productive services, social safety nets, education, health care, drinking water and sanitation facilities. Activities under this section would be coordinated between ministries of agriculture, social welfare, trade, finance, education, health, industry, youth and federal affairs. Priority interventions identified includes:

Livestock production and health (MAR)

Planned interventions focused on establishment and maintenance of livestock watering points, vaccination services, promotion of pastoralist mobile and boarding schools, strengthening CAHWs networks for knowledge sharing, mapping disease control zones and developing disease surveillance structures. Priority interventions include:

- Strengthen institutional frameworks to secure access to land and water for pastoralists (including for women and youth);
- Support the decentralized and public private partnership for delivery of veterinary services;
- Strengthening diagnostic capacities for major contagious and epidemic diseases such as anthrax, foot and mouth disease (FMD), Contagious Bovine Pleural Pneumonia (CBPP) and HS; special attention should be given to trade sensitive diseases and diseases of significant livelihood importance such as PPR and Newcastle
- Formulation of appropriate policies for harmonization of veterinary and animal health regulations and facilities in borders states and regions;
- Scaling up success models of pilot interventions for improving livestock production and productivity, and encourage public-private partnership (PPP) for provision of veterinary services and livestock markets.
- Institutional capacity building and training of communities on public-private partnership models and encourage an entrepreneurial approach in support to improve pastoral livestock production;

- Promotion of public-private partnership (PPP) modality for provision of balanced feed, feed supplements, and grasses to ensure sustainable milk production
- Provide door-step veterinary services and breeding facilities using CAHWs/CLDWs and trained technicians;
- Develop training manuals to empower communities to access and use livestock market information systems, including access to mobile phones and SMS messages.

Agriculture production and productivity (MAF)

The planned strategy for the agricultural production in drought-prone areas is targeting the sustainable soil and water management, and support to agriculture technology transfer and extension services. The priority interventions include support to production of drought resistance seeds and short maturing varieties of main food staple crops. Priority interventions include:

- Strengthen institutional and legal frameworks to secure access to arable land and sustainable water sources for drought-prone communities (including for women and youth);
- Support the decentralized and promotion of public-private partnership for provision of production inputs, including short-maturing and drought resistance varieties;
- Strengthening plant protection services for main pests and diseases in drought prone areas;
- Formulation of appropriate policies for rural finance, grain stores and seed banks in drought-prone areas;
- Scaling up success models of pilot interventions for crop productivity increase, and encourage public-private partnership (PPP) for provision of access to markets' outlets.
- Provide agricultural extension and technology transfer packages for drought-prone communities on appropriate field practices, water harvesting and management.
- Train youth farmers' in agro-business, farm management skills, rural marketing, post-harvest loss minimization methods, etc.

Fisheries development (MAR)

The main aim of the AREP is to set standards to ensure quality for in-land and marine fish catch and marketing. The priority interventions include:

- Provision of fishing equipment to local communities as well as cold chain facilities;

- Promotion of fish farming and fish pond technology;
- Promotion of aquaculture development;
- Review and update the current legislation to set standards and quality control;
- Upgrade and organize the marketing system along the value chain

Income diversification

The development and expansion of value addition to main products from rural and pastoral areas in the drought-prone areas in the country, such as those products from acacias and natural forests, including gums and resins, honey, dairy and milk by-products. This intervention focus on training and capacity building of rural women and youth on simple technology development, business management and development, book-keeping, to empower pastoral and agro-pastoral women and young people and support income diversification. Restocking and fattening activities for small ruminants by women groups proved to contribute to income diversification in rural development projects. The main priority interventions could be summarized as follows:

- Scaling up of successful farm/small-scale technologies, such as processing, storage facilities and post-harvest conservation to reduce losses and ensure good quality of products;
- Identify and establish rural infrastructure needed for the development of the animal and plant products of economic value
- Establish processing, value addition and marketing systems for some of the drylands products of economic value;
- Strengthening gum Arabica production and marketing could double the production;
- Develop best practices for the production, post-harvest handling, processing and marketing of drylands products to improve quality and regular supplies.

National Water Resources Monitoring and Impact Assessment

Rainfall

Summer is the main rainy season, extending from May to October, with precipitation ranging between less than 50 mm in the extreme north to more than 1200 mm in the extreme south. Rainfall, however, is characterized by significant variations in distribution as well as in timing and location thereby magnifying the risks of localized crop failure. To avert this risk, mechanized rainfed production schemes have been spread over substantial area of central Sudan. Apart from agriculture, the rains replenish the underground reserve and provide the scattered

(wadis) and water points with annual quantities to support the enormous wealth of livestock and wildlife.

Nile water

Sudan is a meeting point of river tributaries that emanate from the Ethiopian plateau and the region of the Great Lakes. The Blue Nile with its tributaries, Dinder and Rahad, flows from the east annually providing some 54 m.c.m. The Atbara tributary adds another 12 m.c.m. On the other hand, Bahr el Jebel commences from Lake Victoria with permanent rains, but the greater part of the runoff is lost in the swampy area known as (*Sudd*) in southern Sudan, bringing only about 15 m.c.m. at Malakal. The Sobat River, which joins the White Nile at Malakal, flows from the Ethiopian plateau and is fed from tributaries inside and outside the Sudan. About 8 m.c.m. of its runoff (estimated at 13 m.c.m.) are lost in the *Sudd* area of Sobat and Mashar. Almost all the water flow of Bahr El Ghazal River (estimated at 14 m.c.m.) is lost in the *Sudd* area of Bahr El Ghazal basin, leaving only 0.5 m.c.m. to join the White Nile at Lake No. The big variation in the Blue Nile and River Atbara flow between the high river during the flood season and the low river during the months from March to May has necessitated the construction of dams to store water for irrigation and for the generation of hydroelectric power. At present, there are three dams: Sennar (1 m.c.m.), Roseires (3.4 m.c.m.) and Khashm El Girba (1.3 m.c.m.). However, the accumulated silt in the dam lakes has reduced the storage capacity by 25% in Roseires dam and by 40% in both Sennar and Khashm El Girba dams. Thus, heightening the Roseires dam to increase the storage capacity to 7.3 m.c.m. and constructing Seteit Dam across upper Atbara River to install additional storage capacity for irrigation projects are being seriously considered by the Sudan Government.

Sudan is now utilizing about 14.6 m.c.m. of its share of the Nile water for irrigation, of which 9.5 m.c.m. are from the Blue Nile, 1.7 m.c.m. from River Atbara, 1.8 m.c.m. from the White Nile and 1.6 m.c.m. from the River Nile. The heightening of Roseires Dam and the construction of the new dams will enable the country to fully utilize its share of the Nile water, which stands currently at 20.5 m.c.m. at Sennar (18.5 m.c.m. at Aswan) according to the Nile Water Agreement of 1959. During the early eighties, Sudan and Egypt launched a joint project to excavate the Jongli canal and bypass part of the *Sudd* region, thereby sparing some 4 m.c.m. to be divided equally between the two countries. However, the project was hampered by the civil strife, which started in 1983.

Seasonal Surface Non-Nile Waters

These include El Gash seasonal river which has an annual runoff of 600 million cubic meters (m.c.m.) and Khor Baraka with 500 m.c.m., in addition to about 40 smaller river lets or wadis scattered all over the central plain, providing about 6.7 m.c.m., which are so far not utilized with

the exception of about 0.16 m.c.m. used for domestic purposes. This has been made possible by constructing 63 barrages across the wadis to store 130 m.c.m. and by digging 840 (hafirs) to store about 26 m.c.m.

Underground Water

The water bearing rock strata comprise the Nubian Sandstone, the Um Ruwaba Series and the basement complex which cover, respectively, 28.1%, 20.5% and 9.1% of the total area of the Sudan. The preliminary surveys of the underground reserve quote the figure of nine m.c.m. However, there is need for more research to ascertain the actual figures for the reserve and the replenishment rate. At present, only about 1.3 m.c.m. underground reserves are utilized, of which about 0.45 m.c.m. are used for domestic purposes, while about 0.85 m.c.m. are used to irrigate about 67,200 ha.

Almost all the drainage systems flow into the Nile system. The Blue and White Niles, Bahr el-Ghazal and Bahr el-Arab perennial streams are fed by natural reservoirs located beyond the Sudanese boundaries. Other streams, including the Atbara and the Dinder and Rahad, which make appreciable contribution in summer to the Nile, dry up into disconnected pools, or disappear under their sandy beds during the dry season, or end up in inland deltas. Other occasional, intermittent streams radiating from the highlands during the rainy season, rarely if ever reach the Nile.

Public Institutions in the Water Sector

Name	Sectors	Activities
Ministry of Water Resources and Electricity (MWRE)	Water	Policy and strategy
Higher Council for Environment and Natural Resources (HCENR) child of: Ministry of Environment, Forestry and Physical Development	Environment, Natural resources	Policy and strategy
Dams Implementation Unit (DIU) child of: Ministry of Water Resources and Electricity	Dams	Infrastructure development
Public Water Corporation (PWC)	Municipalities	Operation and maintenance
Rural Water Corporation (RWC)	Rural water infrastructure	Infrastructure development, operation and maintenance
Land and water research centre (LWRC)	Natural resources	Research
Hydraulic research station (HRS)	Irrigation	Research

Public Water Supply

Water facilities in Sudan depend on adequate water resources to meet the needs of over 40 million people. The majority of this water supply comes from River Nile and tributaries but there

are some areas that are supplied with water from seasonal streams, water harvesting structures and underground water resources. Drought can significantly reduce the availability of water supply by reducing groundwater recharge and reservoir levels, with potentially significant effects on households and different processing plants and businesses. Multi-source supply systems, often using both surface and groundwater resources, have increased resilience to drought, particularly to shorter drought periods.

Effective water resources and drought management starts with planning, both in the long-term and short-term. It is a requirement for all water facilities to have a statutory drought plan which describes the actions they will take in the event of a drought. Most water facilities will plan to carry out a wide range of measures to help reduce the risk of drought and to make sure supplies remain resilient. These include:

- investing in new sources and supply mains;
- maximising river abstractions and conserving reservoir storage;
- transferring bulk supplies between water facilities;
- moving water between supply zones to balance risk;
- planning capital investment for severe drought scenarios;
- working with other water facilities and abstractors to identify new opportunities to share water.



Managing demand is as important as increasing supply. There are number of measures water facilities us to help manage demand:

- reinforcing existing water efficiency activities with new campaigns and improving communications with customers
- reducing leakage below target levels
- targeting domestic metering in areas of water stress as a long term plan
- managing water pressure in the supply system in drought affected areas
- working with business customers to help reduce their demand
- Introducing temporary use bans.

Development of New and Alternative Water Sources

Resilience as a long term objective

It can no longer be assumed for all drought prone areas (DPAs), as it was more than thirty years ago, that all basic infrastructures for water, natural resources and livelihood are accessible and competent for drought resilience and drought-resistant livelihood. There is a long overdue requirement for rural livelihoods to improve the ways to cope with drought events and waves. After almost every drought wave, the government, affected communities and development partners goes out for building better the damaged areas and basic infrastructures to stand future disasters. But what are the requirements for improving living conditions and livelihood assets, and how can they be achieved; and are there other resilience strategies to be considered for the achievement of drought

The use of CAADP as an overall framework (both for public policy and development assistance) was essential for harmonizing national policies with those at regional levels. Improved coordination of development interventions to ensure their effectiveness, build institutional capacity for efficient service delivery and ensure sustainability also appears as key priorities in the government development documents. This has been reflected in the formulation of the National Agricultural Investment Programme (Sudan NAIP). However, the challenge that the HoA confronts, is how to adjust the many policies, strategies, and programs at the member states and the regional levels to effectively deliver a sustainable development impact. As a result, IGAD worked with its member States to launch a “Drought Disaster Resilience and Sustainability Initiative”, otherwise called the “Ending Drought Emergencies (EDE)” initiative, aimed at “improving livelihoods and enhancing resilience of drought-prone communities in the Horn of Africa (HoA)”. The initiative led to the preparation of a Common Programming Framework at country and regional levels with the support of the Technical Consortium (TC) established from the development partners in the region. IGAD, its Members States, and partners have also launched a Regional Platform for Drought Resilience and Sustainability in order to build inclusiveness and synergies, and to provide for effective collective action.

Achievements on water harvesting in the period (2010-2016)

During the period from 2010 – 2016, the DIU implemented 741 project distributed in all states of the Sudan and include dams, excavations and wells, harvested 125.5 million m³ of rain water which has been added to the number of other water services projects.

Detailing of these projects are summarized as follows:

1. Excavations: The implementation of 448 Haffirs with total capacity of 25.15 million m³
2. Dams: The implementation of the 28 dam (17 new and 11 rehabilitation) with a total capacity of 89.175 million m³.
3. Wells: The implementation of the number of 277 wells. (In 2016 alone, the number drilled amount to 200 wells in various states of Sudan and annual production it is estimated at about 14.4 million m³).

Water Conservation Practices/ Public Education Awareness and Outreach

To build the national drought mitigation plan, the water sector strategy has established a Dam Implementation Unit to oversee the development of water resources away from the River Nile, with the following main objectives:

- i. To increase the minimum per capita share of domestic water to be in line country strategy and MDGs in terms of water supply (quantity) and sanitation (quality);
- ii. Enhance animal and agricultural production through improved water access;
- iii. Conserve and protect the environment;
- iv. Supporting national security and promotion of peace and stability by developing border areas and lessening conflict over water within Sudan and with bordering countries.

Legislation and Land Use Planning

Land tenure insecurity has resulted from the imposition of formal law that does not recognize individual rights to unregistered land. State authorities have considered unregistered land to be state land and thus available for the state to transfer to private commercial interests, the military, land speculators, and elites without regard for customary rights. Although the Comprehensive Peace Agreement (CPA) of 2005 required the development of laws to incorporate customary laws and practices, local heritage and international trends and practices, the investment bureau and state authorities continues to issue new long-term leases over community lands to commercial interests (both national and international) without consultation with local communities or their consent.

As a result, smallholders and pastoralists have been evicted from land and denied access to natural resources in favour of private investors, land speculators, industries and foreign investors. Sudan is among the global “hotspots” for such large-scale land acquisitions. According to a 2014 study by the World Bank, from 2004 to 2013, Sudan transferred nearly four million hectares of land to foreign private investors, more than any other country surveyed. As such, Sudan has established itself as number two, second to Saudi Arabia, within the region in attracting foreign direct investment (FDI). The large-scale investments in land, water, and other natural resources, have created wide range of disputes for mobile livestock herds and pastoral communities. The granting of land without undertaking the relevant socio-economic studies and public consultations to ensure the social, environmental and economic feasibility of a given project seems to be one of the greatest problems. Furthermore, the lack of coordination and sharing of information between existing land regulating agencies, has created gaps in the current maps and master plans of land use, ownership and allocation.

10. RECOMMENDATIONS AND IMPLEMENTATION ACTIONS

What should be done, by when and by who?

Priority Implementation Actions

The repeated occurrence of droughts, associated with insecurity due to conflicts in some parts of the country, has pushed stakeholders and humanitarian actors to focus more on saving lives and put more effort to rebuild the depleted household assets and basic infrastructures and resources. This has an indirect contribution to the vicious circle of poverty, as development and investment interventions may not be able to flourish in such a context. Consequently, the perception of marginalization persisted among rural communities of drought prone areas of the country, due to limited interventions of new development projects, whether for food production, health, educational services, climate change or energy programmes. Humanitarian actors should always incorporate early recovery aspects in their programmes and strive to build resilience and self-reliance of the affected population. Such programmes can be pivotal in linking emergency and early recovery and development.

The increase of productive capacities is a means to achieve improved livelihoods and greater resilience. The improvement of livelihoods and the development of economic sectors in the drought prone areas of the country are directly associated with access to and availability of enough, quality, and sustainable water sources in those areas. The development of the water sector, associated and supported by clear land tenure policies, will have a positive impact on people's settlement, food security, as well as open more opportunities for the development of value addition processes, income generating activities, and markets. The livestock sector constitutes the rural livelihood gear for food production, credit, savings, and nutrition for vulnerable households, and therefore, should be the focus for water interventions. This should be accompanied by human development interventions, and supplemented by provision and access to grazing areas and palatable feeds, disease control, veterinary services, and a network of rural infrastructures such as feeder roads, communication, and markets.

Overall Drought Recovery Strategy

- The Government of Sudan has continued to adopt risk-reduction and management, as well as people-centred approach to drought recovery with the vision of strengthening the resilience of the population and promoting sustainable development. The goal of this SNAP is not only to promote recovery from the current drought but also to encourage the adoption of land neutrality approach and measures that mitigate the impact of future drought events. This is in line with the Government's National Disaster Risk Management Policy (NDRMP) recently formulated.

- The NDRM Strategy is in the process of formulation to build the blocks for implementing the policy. This is complementary to and builds on the National Adaptation Plan (NAP) (2015) that the Government has developed in collaboration with the UN system. Such strategic alignment between the NDRM and the NAP ensures that there are no critical overlaps between the two plans and that no gaps remain uncovered.
- The Government of Sudan and its partners recognize that recovery has to be a multi-sectorial and multi-pronged effort. Therefore, interventions will be planned and implemented simultaneously in all those sectors and aspects of life that have been affected by the drought according to the level of impact of the event.
- Accordingly, the NDRM and people-centred approach has manifested in a 6-pillar Recovery Strategy that underpins the sector needs analysis and recovery strategies. The six pillars include:
 - i increased productivity in agriculture and irrigation development;
 - ii improvements in food security, nutrition and health services;
 - iii enhancement in people's capacity to withstand risk and build resilience;
 - iv strengthening of water resources management and enhancement of water supply;
 - v strengthening of DRR and drought resilience; and
 - vi integration of gender concerns into all recovery interventions.

Future Updates and Revisions

The Government should assess and update the existing policies, legislation, regulations, and institutions to ensure that they accommodate the new geographical area of the country. This should also review and assess the land governance and legislation in Sudan, to ensure they are sufficient and benefit the country and local communities, and strengthen these frameworks where necessary. The processes for land acquisition and all associated investments activities must be transparent to ensure accountability.

Key next steps will likely include:

- a) programming review of existing interventions and programs in each of the assessed areas to determine optimal utilization of existing resources and identification of financing gaps;
- b) coordination towards drought recovery programming to ensure harmonization between agencies involved in needs planning and execution;
- c) prioritization of needs between and across sectors, districts and over time based on objective impact proportionate criteria through a comprehensive drought recovery framework, and;
- d) setting up a program level monitoring and evaluation framework for recovery with clear results indicators and progress benchmarks.

What should be done, by when and by who?

Priority actions	When	Responsible Institution	Remarks
Promotion environment, climate change and drought awareness among all parties at different levels.	Continuous process	All sectors	This is part of the national strategic plan that should adapted by each state
Promotion and rational management of rural water sources through proper distribution of water points, (hafirs) and boreholes.	Continuous and reviewed on annual basis	Ministry of Water Resources, Irrigation and Electricity	Dams' Unit in coordination with Ministry of Agriculture and Forestry and Ministry of Animal Resources
Increasing the storage capacity of ground water through the construction of dams, terraces, and water harvesting techniques.	Continuous and reviewed on annual basis	Ministry of Water Resources, Irrigation and Electricity	Dams' Unit in coordination with Ministry of Agriculture and Forestry and Ministry of Animal Resources
Compilation of information and data on natural resources surveying, land use mapping and establishing natural resources information bank.	To cover all drought prone areas by 2020	High Council of Environment and Natural Resources	In close coordination with relevant sectoral ministries and institutions
Improvement and rehabilitation of degraded rangelands through reseedling, nurseries, enclosures, and rehabilitation of vegetation cover especially in the marginal areas between latitudes 10° and 18° N.	Continuous process	Range and Pasture Directorate, Ministry of Animal Resources	In close coordination with Forestry National Corporation
Development of forest cover and afforestation through dune fixation, shelterbelts, community forests, enclosures and greening of public utilities and rehabilitation of gum Arabic belt.	Continuous process	Forestry National Corporation	FNC to reach the target of covering 20% of country area with trees

Priority actions	When	Responsible Institution	Remarks
Concentration on vertical expansion of agricultural production to decrease pressure on natural resources through integrated research programmes.	Continuous process	Agricultural Research Corporation	In close coordination with rural development programmes
Capacity building, training and scientific research to support sectoral institutions, academic, NGOs, public organizations, trade unions and land committees in all affected local communities.	Continuous process	Researches and academic institutions	This should be formulated in close coordination with productive sectors institutions
Protection of the Nile basin and its tributaries against gullying and sand encroachment.	On-going	Ministry of Water Resources, Irrigation and Electricity	This should be coordinated with Forestry National Corporation and Research Institutions
Promote and enhance poverty alleviation programmes through encouraging alternative livelihoods, and enhancing the use of traditional and intermediate technologies and rural industries.	On-going	Ministry of Agriculture and Forestry and Ministry of Social Solidarity and Social Development	Making use of the lessons learned by pilot interventions and project to scale up success stories
Development and provision of energy alternatives and optimizing energy use through use of biogas, solar and wind energy and utilizing of agricultural residues, molasses blocks, electricity and expanding use of improved stoves.	Continuous process	Ministry of Energy and States in drought-prone areas	Making use of the lessons learned by pilot interventions and project to scale up success stories
Establishment or creation of state-level benchmarks and indicators to monitor the progress in drought monitoring and combating desertification.	By end of 2019	National Council for Combating Desertification	In close coordination with the Academia, Sudan Meteorology Authority and EWS institutions

There is a need to conduct preliminary studies to assess the economic, technical, social, and environmental impacts of all large-scale land investment projects prior to implementation. Impacts on the livelihoods of local communities, their employment, and the environment should be carefully appraised. The land users and rights holders of the land should be identified and consulted throughout this process, and should be sufficiently compensated where the investment leads to their displacement.

The government should provide incentives to encourage FDI to invest in subsectors that have the potential to create jobs and infrastructure, decrease poverty, maintain biodiversity and increase food security. It worth noting that the specific policy priorities for famine prevention derived from the quantitative analysis include

1. Promotion of sustainable growth in the traditional rainfed agriculture through expansion of rural infrastructure; provision of labour-intensive public works programs; input supply, with scope for private-sector involvement; adaptive research, technology, and extension; and protection of the environment; and
2. Emergency preparedness and relief with buffer stocks for price stabilization, improved relief management and early warning systems, strengthening of rural health and sanitation, and comprehensive legislation for famine prevention.

11. Concluding Remarks

Drought is among the most devastating creepers of natural hazards as it has direct negative effectives on food production, disturbing livestock production and biodiversity, depleting pastures, damage trees cover, disrupting markets, and causing widespread human and animal deaths. Consecutive droughts is a direct cause for displacement and migration from rural to urban areas, placing additional pressures on declining food production. Herders are often forced to seek alternative sources of food and water for their animals, which can create competition over meagre natural resources that can results in conflict between mobile pastoral and settled farming communities.

During the last five decades, droughts have resulted in some of the most high-profile humanitarian disasters – including the recent crises in the Horn of Africa (2011) and the Sahel (2012) regions, which threatened the lives and livelihoods of millions of people. Droughts were not always so disastrous and are often part of a regular climate cycle, and rural people formulated their coping strategies to cope with drought cycles, but during the two decades its occurrence increased and out of ten years 4 to 6 years are drought years. With climate change, the geographical coverage of drought also changes, as there has been localised drought over different parts in the country and the region, as was the case in the Horn of Africa's drylands and in the Sahel. However, the greater frequency of droughts and more erratic nature of rains in

many countries, combined with underlying economic, social and environmental vulnerabilities have meant that droughts have an increasingly destructive impact on at-risk populations, especially women and children. Therefore, the malnutrition cases continued to be recorded at alarming level as a proxy indicator of food insecurity.

This National Drought Plan is calling to bring together all human, financial and technical resources of different levels of stakeholders and actors to start a proactive sustainable development in drought prone areas and therefore achieve land degradation neutrality and contributed to settlement, poverty alleviation and food security. The effectiveness and efficiency of the Drought Taskforce, which representing all segments of the community, women and youth groups, local societies and stakeholders is the key success factor for achieving the intended goals and make progress towards combating desertification and drought. This plan included the capacity building needs and women empowerment needed particularly in rural communities of the drought prone areas.

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Endnotes:

ⁱ The Sudanese women took many position throughout the history of the country, examples as follows:

- The first woman in the country's supreme court was Justice Ihsan Mohamed Fakhry,
- The first woman State Governor was Mrs. Agnes Lukudu, Governor of Eastern Equatoria 1991,
- The first Sudanese woman Minister without portfolio was Mrs. Nafisa Ahmed El Amin in 1971,
- The first Sudanese woman Minister with portfolio was Dr. Fatima Abdel Mahmoud 1973,
- Women in current National Assembly (Parliament): 78 =25% of seats,
- Women Ministers in current cabinet (2013): Five: Social Care, HRD & Labour, Parliamentary Affairs, Education and Information,
- Women Supreme Judges: 78,
- Women Attorneys, Councillors: 254 (40% of sector),
- Women police officers :10% of force,
- Women lawyers: 41% of total,
- Women in Education: 69%,
- Female university students: 67%,
- Female diplomats: 7%
- Sudanese Women Union branches: 27,000.