A Tool for Institutional and Policy Evidence-Based Analysis of Agriculture Water Management (AWM) in Sudan

Final Report

July 2015

List of Abbreviations

Abbreviation	Full name
ARC	Agricultural Research Corporation
AWM	Agricultural water management
CAADP	Comprehensive African Agricultural Development Programme
DIU	Dams Implementation Unit
FAO	Food and Agricultural Organization
FNC	Forests National Corporation
GAIW	General Administration for Irrigation Water
GM	Green Mobilization
GIS	Geographical Information System
GPS	Global Positioning System
GSE	Groundwater survey equipment
HCNER	High Commission for Environment and Natural Resources
HRC	Hydraulics Research Centre
IPRSP	Interim Poverty Reduction Strategy Paper
JICA	Japan International Cooperation Agency
LRC	Livestock Research Corporation
MA&F	Ministry of Agriculture and Forests
MAI	Ministry of Agriculture and Irrigation
MFNE	Ministry of Finance and National Economy
MLRFP	Ministry of Livestock Resources, Fisheries and Pastures
MWRE	Ministry of Water Resources and Energy
MWRIE	Ministry of Water resources, Irrigation and Energy
NAPA	National Adaptation Program Action
NCWR	National Council for Water Resources
NLC	National Land Commission
RS	Remote Sensing
SMAARI	State Ministry for Agriculture, Animal Resources and Irrigation
SMAR	State Ministry for Animal Resources
TWRO	Technical Water Resources Organ
UNEP	United Nation Environment Programme
WUAs	Water Users Associations

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Executive Summary

This study is commissioned by FAO under TCP/INT/3404 to support and foster improved agricultural water management through effective implementation of the CAADP compact and post-compact process refining and aligning national agricultural water development strategies to national strategies food security strategies and programmes.

Sudan is a water scarce country. According to the 1959 Nile Water Agreement between Sudan and Egypt the country is allowed to withdraw 20.5 billion cubic meters of the River Nile and tributary inflows measured at Sennar. Sudan was able to utilize the river water resources by irrigating almost 44% of its 2.01 million hectares developed irrigated agricultural schemes. This low percentage reflects the extent of the challenges facing Sudan in Agricultural Water Management (AWM) of its scarce water resources.

This study aimed to provide evidence-based analysis for interventions that prioritize and facilitate scheduling of investments in Sudan's National CAADP Investment Plan (Sudan-NAIP). The study mapped the institutional setup, legislation and policy framework of AWM in Sudan; diagnosed, using FAO method, the effectiveness of the institutions, laws and policies in AWM; and identified strategic commitments and key actions to improve AWM in Sudan.

Most AWM activities are implemented by public institutions namely the Ministry of Water Resources, Irrigation and Electricity (MWRIE), the Ministry of Agriculture and Forests (MA&F) and the Agricultural Public Schemes Managing Boards. Other supporting institutions included the Hydrology Research Centre, the Agricultural Research Corporations, the High Council for Environment and Natural Resources (HCENR) and the National Council for Water Resources (NCWR).

The Ministry of Finance and National Economy (MFNE) is the overseeing institute for allocation of annual general and development budgets to AWM. The State Ministries for Agriculture, Livestock and Irrigation and the State Ministries of Physical Planning and Finance are responsible for planning and implementation of AWM at state and locality levels.

Sudan developed legal frameworks and laws governing AWM in Sudan. Among the acts and lows governing water resources and AWM are the Irrigation and Drainage Act, the Water Resources Act, the Gezira Law, the Gash Delta Act and others.

Among the strategies and plans governing AWM are the National Strategy for Water Resources, the Green Mobilization, NAPA, IPRSP I and the Comprehensive Food Security Plan. These strategies and plans incorporated AWM policies that emphasized common shared interest areas of increasing the share of Sudan from the Nile River and from underutilized rains (100-700 mm/year). The policies also aimed to involve the farmers and the private sector in planning and policy formulation, research, water users associations (WUAs) for better AWM in the irrigated schemes.

The various strategies, plans and policies related to AWM aimed to establish a mechanism for continuous assessment of water resources throughout data collection, storage, analysis, dissemination and monitoring stages. They also aimed to coordinate and establish networks among line ministries and agencies, and between the different departments within ministries and agencies to avoid fragmentation of stakeholder mandates and responsibilities and waste of efforts and funds.

However, these AWM strategies, plans and policies could not achieve all targets mainly due to undefined roles and overlapping responsibilities of the ministries. The relatively ineffective management of production corporations, and poor economic incentive to farmers and civil service staff were attributed to poor allocations of the development and general budgets. Most of these budgets were allocated towards the construction of irrigation and hydropower generation infrastructures with insufficient allocations to water harvesting irrigation infrastructure in rural areas.

The institutions concerned with water harvesting programs, especially for small producers in agriculture, are fragmented with poor coordination which resulted in ineffective policy implementation and dependency on international organizations and NGOs. The FAO, IFAD, WFP, UNEP and UNDP provided technical and financial support to capacity building, carrying out of situation analysis in area of water related policy-making and management.

The study proposed actions for mitigating the challenges such as increased investment on human and institutional capital of staff, farmers, and private sector to improve planning, policy formulation, community leadership capacities and skills.

The study recommended the revision of the present laws, acts and regulations and the proposal of new ones to support AWM in Sudan. The study also recommended the provision of a full AWM technical supporting package to a pilot project in a selected block in the Gezira Scheme and in Abu Habil Water Harvesting Scheme in North Kordofan.

Overview of Agricultural Water Management in Sudan:

The term Agricultural Water Management (AWM) involves the management of scarce water resources in form of rainfall, rivers and streams and groundwater use for drinking and irrigation purposes. The responsibility of AWM extends beyond the supervision, implementation, maintenance, conservation and monitoring of water infrastructure development programs and projects into capacity building, research and technology transfer, dissemination of information and knowledge.

The AWM structural and non-structural interventions deals with irrigation and drainage infrastructure, soil and water conservation, and water harvesting in the first case; and deals with legislations, policies, institutional capacity building, knowledge generation and dissemination, research and technology transfer, public awareness other related activities in the second case ((FAO, 2006) and (FAO, AgWA).

The annual water resources of Sudan include the annual flows of the River Nile and tributaries, the rainfall and the Wadies and Khors running streams and the renewable groundwater resources. Reliable data indicate the right of Sudan to withdraw up to 20.5 billion cubic meters annually measured at Sennar from the 1959 Nile Water Agreement between Sudan and Egypt but are not reliable on available water and use from rainfall, running streams and renewable ground water charges. However, all these water resources are shared with neighbouring countries, which raises the question of future availability of water resources for development and use in Sudan.

The AWM systems in the irrigated sector in Sudan consist of gravity, pump, flush and flood irrigation and drainage types. The Nile and its tributaries supply 93percent of irrigation water of which the Blue Nile supplies 67percent. The gravity water management system depend Sinnar, Rosaries and Khasm El Girba dams across the Blue Nile and the River Atbara. The pump irrigation schemes from the River Nile and tributaries irrigate the Rahad, Suki, and Sennar, North and River Nile and the White Nile states public corporation schemes.

The total area under gravity and pump irrigation system is about 2.01 million hectares, o which over 0.25 million hectares are under pumps with high irrigation costs. The flush irrigation constitutes the seasonal flows of Gash and Baraka rivers irrigating more than 0.132 million hectares of alluvial soils. All irrigation systems suffer from sub-optimal utilization of irrigation water due to high diesel-fuel and canals maintenance costs. Irrigation costs were estimated at 35-50percent of the total costs of crop production. Rainfall provides water to the rain-fed mechanized and traditional farming sector occupying more than 90percent of the total cultivated area in the country and to the small scale water harvesting projects spread all over Wadies and Khors in remote inland areas. About 263 water harvesting projects were established throughout the states provided 45 million cubic meters of harvested water in Sudan during 2010-2013.

The equipped area under AWM is estimated at 2.01 million hectares divided into 1.85 million hectares under government schemes and 0.258 million under private sector (FAOSTAT). Sudan was able to irrigate about 44 percent of the developed 2.01million hectares under irrigation schemes owing to deterioration of the irrigation and drainage infrastructures (table1). This raises a concern about the efficient use of water resources at present and for the future in face of the expected redistribution of Sudan Nile share within the Nile Basin Initiative; the

implications of the Ethiopian Resurrection Dam and the climate change in the region and in Sudan.

Although the irrigated agriculture accounts to less than 10 percent of the cultivated area it produced over 25 percent of the total cereals production of Sudan. The irrigated sector produced almost 1.1 million tons of irrigated cereals mainly sorghum and wheat during 2009-2012 (table 2). Contrary to the unreliable production of the rain-fed sector, the irrigated sector acts as a safety valve for reliable production of the basic staple food security crops in the country, particularly during the drought years.

Tables 1-a and 2-a below give the area and production of irrigated crops grown in Sudan during 2009-2012. The variations in crop areas and production reflect the effect of water management capacities and the related economic policies influences on deciding the respective crop areas under cultivation. The resultant values are attributed to variability of AWM during the seasons.

Table (1-a): area of irrigated crops during 2009-2012 in 000 hectares

Crop	2009	2010	2011	2012	average	Standard deviation	Coefficient of variation
Wheat	234	231	174	171	202	34	17%
Sorghum	495	522	408	474	475	49	10%
Groundnuts	98	138	151	156	136	26	19%
Cotton	34	36	148	59	69	54	78%
Total	861	926	880	860	882	31	4%

Source: Ministry of Agriculture and Forestry

Table (2-a): Production of irrigated crops during 2009-2012 in 000 tons

Crop	2009	2010	2011	2012	average	Standard deviation	Coefficient of variation
Wheat	399	415	308	263	346	73	21%
Sorghum	690	1037	739	725	798	161	20%
groundnuts	126	289	298	394	277	111	40%
Cotton	43	62	274	111	123	105	86%
total wheat and sorghum	1089	1452	1047	988	1144	209	18%

Source: Ministry of Agriculture and Forestry

The future demand for water resources is projected by Sudan quarter centennial strategy (2002-2027) to total to 59.2 billion cubic meters by 2027. This will include the irrigation water needs of 42.5 billion cubic meters; the human, animal and industrial needs of 10.1 billion cubic

meters; and the evaporation loss of 6.6 billion cubic meters from the proposed hydropower projects (Sudan Policy and Strategy on Integrated Water resources Management, 2007). Table (3-a) gives the pipeline irrigation expansion plan including the completion of the construction of Merwi, Upper Atbara and Setit and dams and the heightening of the Rosaries Dam, while projecting finance for the establishment of the irrigate schemes.

Table (3-a): Irrigation pipeline expansion plan (area in 000 hectares)

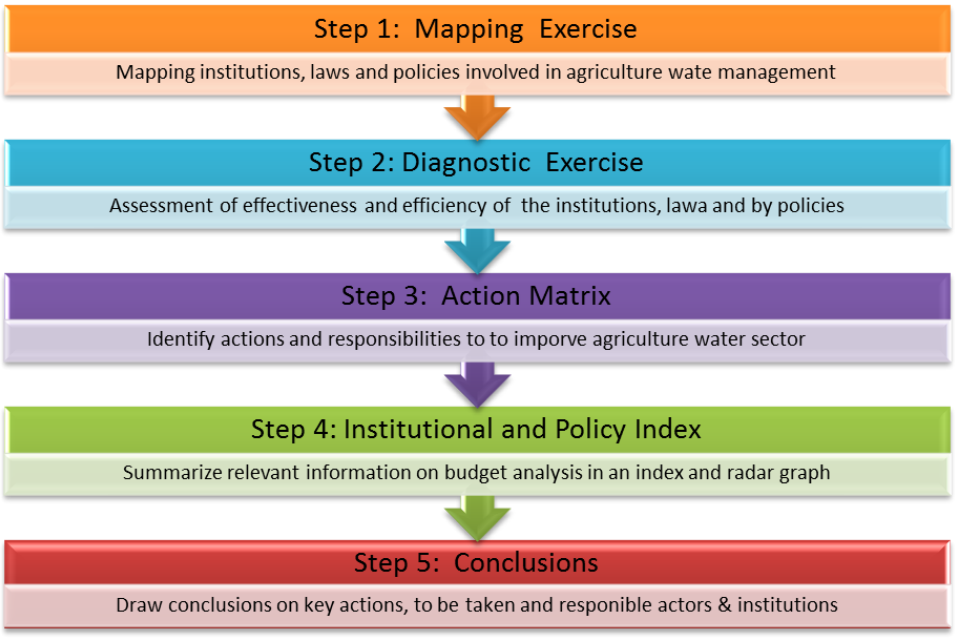
Project	Billion cubic meters	gross area (000 ha)	net area (000 ha)
Merwi Dam and irrigated schemes (completed)	2.1	90	80
Heightening of Rosaries Dam (completed), Kenana and Rahad (pipeline)	4.6	370	300
Upper Atbara and Setit dams (completed) and irrigated scheme (pipeline)	4.5	400	300
Total	11.2	860	680

Source: Ministry of Agriculture and Forestry, 2014

AWM is needed to support AWM activities in Sudan. Sudan suffered from limited institutional and financial capacity that constrains undertaking timely maintenance of the irrigation and canals systems. These resulted in siltation, structural damage, reduced water flow, aquatic weeds infestation, health hazards (mainly malaria and bilharzias) and consequent drops in crop intensity and crop productivity.

Methodology

The partnership for Agricultural Water for Africa (AgWA) has developed a tool to identify practical ways that reflect institutional and policy realities and provide a more solid base for policy and investment design and implementation. The tool comprises a set of instruments to address the different aspects of the development of water for agriculture and to identify reforms/instruments/activities/investments to overcome obstacles and difficulties that hinder development of agricultural water projects. The tool constitutes of five steps as shown in Figure 1.



Step 1 - Mapping Exercise of Institutions, Legal Frameworks and Policies:

Mapping of institutions, laws and policies in AWM serves the identification of the framework within which the dynamics of the agricultural water sector is taking place in Sudan.

1.1 Institutions and actors

Institutions in this context refer to an organization (public or private) that is responsible for one or more aspects of AWM going from national to state to locality level through basin and sub/basin scale.

Table 1 maps the main actors, goals and functions of the (AWM) activities in Sudan.

The mapping exercise reflects the multidisciplinary and complexity of the institutional structure of AWM in Sudan. The relevant key ministries and research corporations are:

The Federal Ministry of Water Resources, Irrigation and Electricity (MWRIE): resulted from the merge in 2012 of the Ministry of Irrigation and Water Resources and the Ministry of Electricity and Dams. The National Water Resources Council is its advisory body at national level.

- The Federal Ministry of Agriculture and Forests (MA&F).
- The Public Irrigation Schemes Managing Boards.
- The State Ministries of Agriculture, Animal Resources and Irrigation (SMAARI) (Except Gadarif state has separate State Ministry of Animal Resources (SMAR).
- Hydraulic research station.

- Agricultural Research Corporation (ARC) and other affiliated research units (livestock, forestry, fisheries)
- University of Gezira.
- International organizations and non-government organizations.

The federal ministries mandates are responsible for:

- Planning and policy formulation, follow up and monitoring of programs, projects and activities
- Carrying out of baseline surveys, collection of statistics and information and evaluation studies on AWM,
- Coordinating with research,
- Undertaking institutional capacity building of staff

The managing boards of the diverse irrigated schemes are responsible for:

- The direct distribution of irrigation water along major and minor canals from the source to the farming ditches and plots.
- Results of mapping institutions, their mandates, and functions are presented in Table 1step 1.1.

The state ministries and associated locality governments offices are responsible for

- Planning and implementation of AWM between states, and in state and its localities,
- Follow up of small producers' related irrigation producers activities at locality levels

The state level institutions are weak in dealing with AWM limited by state boundaries and do not posses capacity to manage basin river, aquifer scale and trans-boundary water resources.

Research on AWM is carried out at federal level by a number of research institutions:

- Land and water research centre
- Water harvesting research institute
- Hydraulic research station
- National corporation for rural water
- Soil and water studies centre
- Agricultural research corporation centres
- Desertification and water research centre

These are responsible for:

- Technical and socio-economic research and technology transfer in water use and management
- Capacity building in water use and management

Other institutions include UNEP and JICA which support integrated water resources management related activities. UNESCO Chair in water resources (UWCR-SD) founded in 1994 in Sudan serves the Nile basin and Shared Aquifer countries in the region and contributes to international debates on water resources.

Table 1: Step 1.1. Mapping of institutions involved in Agricultural Water Management (AWM) in Sudan

Institutions / actors	**Geographical level (GL)/Nature (N)**	**Mandate (AWM related)**	**Functions (AWM related)**
Ministry of Water Resources, Irrigation and Electricity	GL: National N: Public, non-profit – Formal	Planning and policy formulation Administration and management of efficient water resources development and use at federal level Develop federal state level coordination and networks for data collection, project formulation, planning and follow up activities Capacity building of staff at federal and state levels	1. Administrative and technical leadership 2. Capacity building of staff quality through internship training programs, exchange visits, participation in workshops and seminars 3. Representing the country in attending international meetings and conferences 4. Developing communication and contacts for securing funds for financing irrigation dams and hydropower equipments 5. Collection of data and information, analysis and assessment of water resources 6. Formulation of policies and programs on irrigation and hydropower generation structures 7. Issue tenders for implementing companies 8. Supervision and monitoring and building of dams, installation of hydropower equipments
Ministry of Water Resources, Irrigation and electricity-	GL: National N: Public – non-profit – Formal	Supply irrigation water to the four large national public irrigation production schemes (Gezira, Rahad, New Halfa and Suki)	1. Prepare annual operation and maintenance budget for the large national irrigation schemes based in consultation with the Irrigation schemes

Institutions / actors	Geographical level (GL)/Nature (N)	Mandate (AWM related)	Functions (AWM related)
Secretary for Irrigation		Develop and maintain the irrigation and the drainage system of the four large irrigated schemes	Managing Directors 2. Formulate long and midterm plans for operation and maintenance, rehabilitation and establishment of irrigation canals systems in schemes 3. Determine irrigation water services fees in the large irrigated schemes 4. Follow up and monitoring of progress of the performance of irrigation activities in the large irrigated schemes 5. Prepare civil and mechanical guidelines for O&M of irrigation systems in the large irrigation schemes 6. O&M of mechanical and electrical irrigation equipments and devices in the large irrigation schemes 7. Budget irrigation directorates needs of capital equipments, procurement, storage and distribution of the large irrigated schemes 8. Develop vertical and horizontal links between the federal Ministry of Agriculture and Irrigation and affiliated State ministries of agriculture, physical planning supported with technical backup
Ministry f Water Resources, Irrigation and Electricity - Dams Implementation	GL: National N: Public – non-profit - Formal	Carry out technical, administrative and financial management responsibilities of construction of dams Resettle newly constructed	1. Execute technical, administrative and financial activities Dams construction and rehabilitation and their associated resettlement projects of affected people. 2. Obtain the Higher Political

Institutions / actors	Geographical level (GL)/Nature (N)	Mandate (AWM related)	Functions (AWM related)
Unit (DIU)		dams displaced people and residents.	Committee approval on prepared working schedules that guide supervision and execution of dam's construction, resettlement projects and affiliated corporate-community responsibilities. 3. Follow-up progress of contracts committed with specialized government agencies and private companies on surveys, studies, and technical designs related to dams construction and hydropower installations. 4. Prepare and execute technically and economically feasible dams and hydropower generation investment projects : 5. Promote bankable investment projects and obtain funds for their execution. 6. Select appropriate competent companies for implementation. 7. Obtain the Higher Political Committee endorsement for implementation of the projects. 8. Prepare and submit to the Higher Political Committee follow up periodical progress reports on the development and performance of executed projects.
The Hydraulics Research station (HRS)	GL: National N: Public – non-profit – Formal	Conduct research on ▪ developing new water resources ▪ efficient management of water resources ▪ managing of	1. Conduct applied research on water resources use and management 2. Train and capacity building of the staff of the Ministry of Water Resources and Electricity

Institutions / actors	Geographical level (GL)/Nature (N)	Mandate (AWM related)	Functions (AWM related)
		agricultural irrigation systems ▪ hydropower supplies to agriculture and manufacturing industry ▪ river transport ▪ river training ▪ river banks protection, ▪ flood protection and control ▪ water supplies	and other stakeholders, especially on internalizing of modern technology 3. Carry out consultancy services in the area of specialty of the Centre
Ministry of Agriculture and Forestry	GL: National N: Public – non-profit - Formal	Planning and policy formulation for irrigated agricultural development Formulate plans and policies for food security and poverty alleviation of farmers in the agricultural irrigated sector	1. Formulate agricultural water management policies in irrigated schemes 2. Prepare strategies, plans, long term and midterm policies to achieve food security 3. Follow up and monitor the progress of performance of agricultural investment projects and activities 4. Develop innovative modern agricultural technologies for sustainable agricultural development activities, 5. Test and endorse modern agricultural technologies to develop and improve irrigated and rain-fed agricultural production to attain food security and increase cash crops 6. Encourage strategic partnership with foreign governments and private sector in domestic and export agricultural products investments in Sudan

Institutions / actors	Geographical level (GL)/Nature (N)	Mandate (AWM related)	Functions (AWM related)
			7. Develop and commercialize traditional agriculture to enhance rural development and poverty alleviation 8. Improve agricultural extension services and programs 9. Improve mapping and management of land use to enhance rational use of agricultural land and stop deterioration of the environment in collaboration with concerned international organizations and development partners 10. Control of national pests in collaboration with concerned international organizations 11. Intensify international and regional cooperation in the area of agriculture development and conservation
Water Management & Irrigation Institute, Gezira University	GL: National N: Public – non-profit – Formal	Conduct studies and research on water use and management for food security, poverty alleviation and maintaining of friendly environment	1. Training and capacity building in water management through short courses, M. Sc. and Ph.D. by courses and research 2. Conduct problem-solving research and studies on major water management issues 3. Co-operation with national and international institutions working in the field of water resources management
Agricultural Research Corporation	GL: National N: Public – non-profit – Formal	Conduct basic and applied agricultural research to develop appropriate technologies of water related crops and practices	1. Conduct crop water requirement research, 2. Conduct appropriate technologies related to crop water use efficiency (Land and

Institutions / actors	Geographical level (GL)/Nature (N)	Mandate (AWM related)	Functions (AWM related)
		Technology transfer of research results to stakeholders for adoption	Water Centre) 3. Conduct dry agriculture research 4. Conduct appropriate agriculture-water harvesting systems (Water Harvesting Research Institute) 5. Improve capacity building and training in water management and conservative-agriculture system
Water Users Association (WUA)	GL: Scheme N: Communal – non-profit – non-formal	Distribute, supervise and control irrigation water from minor canals down to field inlet water pipes	1. Distribute organized irrigation water quotas to farmers 2. maintenance of minor canals 3. inspection, rehabilitation and maintenance of field inlet pipes and other field irrigation channels
Sudan Metrological Authority	GL: National N: Public – non-profit – Formal	Provide quality meteorological information and statistics Extend early warning information services at locality, state and federal levels to support crop production decision making by stakeholders Furnish early warning awareness about droughts and floods risks for preparatory actions against natural disasters Support information for protecting of forests and pastures against deterioration	1. Collect meteorological data and climate information and predict weather conditions for civil aviation and domestic interests. 2. Predict seasonal expected rainfall and temperature for government agriculture-related agencies, farmers, livestock owners and the public 3. Provide meteorological data and information and analysis reports on estimates of rainfall quantity and expected effect on crop production using satellite and plant cover methods and intelligence information 4. Conduct research and studies on meteorology and climatology

Institutions / actors	Geographical level (GL)/Nature (N)	Mandate (AWM related)	Functions (AWM related)
			5. Keep software data bank on meteorological and climatic data and information and retrieve them when needed.
National Land Commission (NLC)	GL: National N: Public – non-profit – Formal	Sustainable management of land resources (including water)	1. Carry out judicial arbitration, solve land claims disputes and decide on compensations 2. Formulation of land policy including land reform and land-use and recognition of customary rights, 3. Advise on coordination of sector policies 4. Study and record land-use practices

Conclusions

The MWRIE is the key civil service leader institution in AWM in Sudan with the National Water Resources Council as its advisory body at national level. The MA&F, HCNER, and the Research institutions are of less importance to AWM, while the Managing Boards of the Irrigated Public Corporations have devolved a major part of their AWM responsibilities to the farmers unions and WUAs.

The State's governments and the research institutions play a secondary role in AWM. The role of the State governments is confined in supplying water services at locality level, while the research corporations and the international organizations and non-government actors are confined to management of irrigation water supplies in crop production in irrigated schemes and in small scale irrigated agriculture in dry-land.

Policies and legislation

The Regulatory framework

The regulatory framework provides favourable conditions for planning and implementation of development, investment and management of water resources. They are supported by policies, agreements and protocols, and legislations. Sudan has signed agreements with neighbouring countries during the colonial and independence period, and passed laws directly and indirectly related to water resources and agricultural water resources management.

The British colonial government concluded agreements with other governments in the Nile Basin to ensure smooth flow of the River White Nile and the River Blue Nile downstream in Sudan. The agreements covered the Rome Agreement of 1891 between Britain and Italy to organize River Atbara waters, the borders agreement between Britain and Ethiopia to stop construction dams on the River Blue Nile, Lake Tana and Sobat River, the 1906 agreement between Britain and Congo to stop developments on Simliki and Asanjo Rivers in Congo, the River Kajira agreement in 1934 between Britain and Belgium to stop constructions on upper Kajira without the consent of both Egypt and Sudan.

The River Nile agreement of 1959 between Sudan and Egypt sharing the water Nile flows between the two countries marked the beginning ant government of Sudan entering into agreements with stakeholder governments sharing same water resources.

The cooperation agreement of the Equatorial Lakes Project during 1967-1992 between Sudan, Egypt, Uganda, Tanzania, Kenya, and Democratic Congo was next to study the water budget of the Nile Basin at the Lakes to determine the demands of the water resources sharing countries, and seek the possibility of storing water in the Lakes.

Establishment of the Techno-Nile Project in 1992 creating the Ministerial Council and the supporting Technical Advisory Committee to prepare a working plan to develop and sustain the environment of the Nile Basin,

The Nile Basin Initiative in February 1991 to develop one vision for fair/equitable distribution and use of the Nile waters and formulate projects of mutual benefits for the countries, and exchange of data and information to achieve socio-economic development objectives for the basin states.

The signing of the 1992 Cooperation Protocol between Sudan and Ethiopia to exchange data and information on incidents and volume of floods and drought cycles, protection of the water feeding basins tributaries in Ethiopia with the aim of arresting soil degradation and removal of vegetation cover.

The Nubian sandstone aquifer agreement between Sudan, Egypt, Libya and Chad was a step forward in exploiting underground water resources for agriculture and drinking water in remote areas in Sudan.

The Laws

Against the above mentioned regulatory framework Sudan formulated its water resources and irrigation water laws and legislations. Legislations are laws passed by legislative bodies such as a Parliament or City Council. The passed laws are supported by regulations, administrative-tools - are issued by government agencies that provide detailed rules on how to implement the laws.

The regulations provide a flexible tool to the responsible authority to adjust the rules according to emerging events. Hence, while laws are rigid and difficult to change regulations are flexible and can change according to viable justifications.

The main direct governing laws directing the utilization and management of water resources in Sudan are:

The Irrigation and Drainage Act (1990) allows for the management of irrigation and drainage of old and new irrigation lands. It aims to regulate the use of irrigation water and drainage facilities, permit construction of feeder roads inside irrigation schemes.

The Water Resources Act of 1995 established the National Council of Water Resources (NCWR) with broad functions and authorities to regulate and monitor utilization of water resources from different sources (Nile, non-Nile and water courses and ground water) for various reasons (irrigation, drinking water, industry, hydro power and sanitation). In addition, there are several other legislations which illustrate a variety of different policies and govern the use of water resources for irrigation in Gezira scheme and the Gash Delta Agricultural Corporation.

The 1995 National Water Corporation Law specified the responsibility of the National Water Corporation through the Drinking Water and Sanitation Drainage Unit of the Federal Ministry of Water Resources and Electricity to plan, invest on ground water sector supplies, protection against pollution and formulation of supporting legislation for the development of the ground water resources.

Public/environment sanitation law of 1975 is concerned with water pollution issues.

Local government law for 1998 is concerned with establishment of locality councils that issue water legislations related to non-trans-boundary waters under its geographical authority.

State Water Corporations laws are concerned with planning implementation and legislations of state waters.

The main indirect water resources related laws are:

The Freshwater Fisheries Act 1954 to sustain safe management of fisheries resources in freshwater; The Civil Transaction Act 1984 to regulate transactions and deals in agricultural lands; The Internal Navigation Act 1993 to organize river navigation at national and locality level The Environment Protection Act 2001 to create an enabling institutional capacity environment and formulate protecting policies for natural resources conservation including water resources.

The Forests and Natural Renewable Resources Act 2002 to create an organizing and regulating system for forests and renewable natural resources; the Gash Delta Corporation Water Users

Act 2004 to activate improved management, operation and maintenance of the Gash irrigation Scheme, and to enhance better and sustainable use and management of irrigation water and to train and build capacity in irrigation water management; The Gezira Scheme 2005 Law which aims at increasing the involvement of tenants in the management of irrigation water at field level, increasing crop productivity and improving their socio-economic welfare.

Table 2-step 1.2 depicts a number of the relevant primary legislations, their specific targets and measures to achieve those targets.

Table 2- Step 1.2. Mapping of legislation and regulation

Legislation	**Goal/Mission/Principle**	**Specific targets**	**Measures to attain targets**
Irrigation and Drainage Act (1990)	Management of irrigation and drainage system of old and newly irrigated lands	Regulate use of irrigation water and drainage facilities Permit construction of roads inside the irrigation schemes Regulate irrigation of new agricultural land	1. Issue licenses for land use and for water use 2. Establish regulations 3. Invest on infrastructure 4. Allow construction of feeder roads 5. Regulate use of roads by heavy machineries, tractors and trucks
Water Resources Act (1995)	Management and coordination of better water use among different stakeholder/actors	Improve efficiency and effectiveness of water management Regulate water use Improved coordination between actors in the water sector	1. Create the National Council for Water Resources (NCWR) 2. Issue licenses for water use
Gezira Scheme Law of 2005	Increase involvement of tenant farmers in the management of irrigation water at field level to increase crop productivity and improve their socio-economic welfare	Promote decentralization, privatization and more farmers' participation in the management of the Scheme Enhance field water management and utilization	1. Increase direct responsibility of water management at field level 2. Create 1575 water users associations in the Gezira Scheme 3. Lift irrigation water management costs off the scheme budget expenditures item 4. Improve timely and

Legislation	Goal/Mission/Principle	Specific targets	Measures to attain targets
		Land reform	equitable distribution of adequate irrigation water 5. Avail irrigation water supplies throughout cropping-seasons 6. Register type of tenancy land holdings on land ownership or on long term lease basis
The Gash Delta Agricultural Corporation Water Users' Act (2004)	Increase involvement of tenants in irrigation water management for their improved socio-economic welfare	Activate improved management, operation and maintenance of the Gash irrigation Scheme Enhance better and sustainable use and management of irrigation water Train and build capacity in irrigation water management Land reform	1. Establish 92 water uses associations in five out of six blocks 2. Better use and management of water resources 3. Increase the number of farmers trained in irrigation water management 4. Allocate economic and sustainable holding size to farmers
The Environment (Protection) Act, 2001	Development, management and protection of natural resources	Create an enabling institutional capacity environment Formulate protecting policies for natural resources conservation including water resources	1. Establish a council, with supporting constitution, organization structure, functions and powers 2. Formulate policies and general directives for environment protection 3. Delineate contraventions and penalties for violating protection laws of natural resources environment
The Civil Transaction Act, 1984	Regulation of broad-spectrum civil transactions	Regulate transactions and deals of agricultural lands	1. Define the *Muzara'a contract* (the relationship between land owners and farmers/other party

Legislation	Goal/Mission/Principle	Specific targets	Measures to attain targets
			(ies)) and establish conditions validating the contract between the two parties 2. Delineate the different types of agricultural land leases and regulate related issues
Forests and Renewable Natural Resources Act, 2002	Management, organization, regulation of forests and renewable natural resources	Create an organizing and regulating system for forests and renewable natural resources	1. Establish the Forests National Corporation 2. Administer and manage all forests on sustainable basis for conservation of water, soil and biodiversity

Conclusions

The legal and regulatory framework of water resources and AWM in Sudan aims to provide a favourable condition for the development and administration of the water resources management. Few laws governed directly and indirectly the planning of development and management of water resources. The direct laws addressed the development of the water resources in rivers, seasonal streams and underground sources, while the indirect laws and acts addressed the use of irrigation water in agricultural fields.

The safety of river water resources has been captured indirectly within the context of safe use in the fresh water fishing and navigation purposes. These fresh waters may be used for irrigation purposes which have to be clean and safe.

The legal basis for water management, as well as irrigation and drainage, in Sudan at federal level includes the following acts:

- Civil Transaction Act 1984 ties the rights to develop and access water resources with land rights, as long as permission is granted by the respective water authority;
- Irrigation and Drainage Act 1990 states authority over Nile and surface waters, in particular to issue licenses especially for irrigation and discharge into surface waters. The Act included a mechanism allowing for delivery of complaints and feedback to the undersecretary and the Minister and even to a specialized court.
- Water Resources Act 1995 is a major institutional reform concerned with the Nile and Non-Nilotic surface waters as well as with groundwater, hence superseding the 1939

Nile pumps control act that was limited to the Nile waters only. It also establishes the NWRC and the need of a license for any water use;

- National Water Commission Act 1995, which is responsible water planning, coordinate water use, protect the environment, and carry out research on water sources and their sustainable exploitation;
- Groundwater Regulation Act 1998 mandates the Groundwater and Wadies Directorate as the sole government technical organ to develop and monitor Wadies and groundwater, and to issue permits for constructing water points;
- Public Water Corporation Act 2008 gives authority to central government for national planning, research, development and investment in the water supply sector, as well as the corresponding policies and legislations.
- The 2005 Gezira act, in particular, introduced a complete change in management effectively transferring the responsibilities for irrigation to land-owner and to water user associations and thus devolving planting decision-making to the farmers within the water delivery regimes. The Act decentralized water distribution and collection of water fees operated by water users' associations (WUAs).

1.3. Policies and Processes:

This report handled the direct and indirectly related policies and processes of water resources and AWM by reviewing the main water resources strategies and plans containing the general and specific policies of the former MWRE, and the former MAI in Sudan.

The general policies of the present MWRIE are to achieve the economic development, food security, poverty alleviation, protection of the environment and attain welfare of the society. The policies are translated into the specific policies that aim to:

- Formulate long term strategies and plans for fair and sustainable utilization of the scarce water resources of Sudan
- Establish a financial mechanism and encourage the private sector to finance water resources activities
- Develop and strengthen the institutional capacity of human resources and increase their skills to develop the water resources
- Improve community participation in management and delivery of water services
- Conserve rights of common water resources between neighbouring countries and achieve economic integrate ion between the Nile Basin countries

Direct water resources strategies and plans policies:

Sudan Policy and Strategy on Integrated Water Resources Management (2007-2022) is a comprehensive long term plan for the projection of water resources supply and use in Sudan. The strategy guided by the Transitional Constitution of Sudan provided policies to include the market key factors of price incentives that support economic allocation of water shares among

different geographical locations and uses, and to motivate commercial involvement of the private sector in supplying water delivery services at cost. The Strategy also provided policies to estimate water services provided by women in remote rural areas and their effect on small scale crop production and animal husbandry practices.

The National Plan for Development and Utilization of Water Resources (2014) provided policies to increase the water share of Sudan from the River Nile, establish water harvesting projects in rain-fed areas. The Plan also provided polices to increase finance to improve crop production technology research and transfer, and to revise and establish intensive crop mix and rotations to benefit from expected increases in water resources from the Nile and in the rainfall areas.

The former MWI Plan – for the Irrigation Sector (2015 – 2019) provided policies to attract Arab funds finance to invest in irrigation water supply infrastructure and modernized private and public schemes. The plan also provided policies to increase the government expenditures and allocate domestic fund to support the implementation and maintenance of irrigation schemes, intensify continuous training and capacity building of staff in administering and management of irrigation water resources and on applied research in irrigation and rehabilitation of existing irrigation canals sedimentation problems, and to establish accurate data base system to plan irrigation operations.

Indirect water resources strategies and plans:

The Executive Program of the Agricultural Revival (2008) plan provided policies to support institutional reform of the Gezira scheme and the large irrigation schemes, and of the semi-mechanized rain-fed schemes. The plan also provided policies to increase the generation of hydroelectric power from dams to help in the substitution of the high cost diesel by low cost electric power driver water pumps in the agricultural pump schemes. The Plan also provided policies to scale up of approved water harvesting system to support small scale food and cash crop production, rehabilitate and improve village yard pastures and community forests.

The Comprehensive National Food Security Policy (2011) provided policies to supply the required water demand and to raise awareness on crop-water requirements and rational use. The Plan provided polices to mitigate the effect of water-use waste on the environment and to transfer successful and improved water-users-associations practices from the Gezira Scheme to the other irrigation schemes to reduce water loss. The Plan also provided policies to generate incentives to convince the private sector to invest in manufacturing of water pumps, drilling equipment, water pipes and tanks, and supplies of spare parts.

National Adaptation Program of Action (NAPA) of 2007 provided policies to introduce improved irrigation technology and appropriate methods of water harvesting practices that suit different

ecologies and agriculture related activities policies, the Plan also provided policies to produce drought resistant and heat tolerant crops and fodder.

Interim Poverty Reduction Strategy Paper (2012) provided policies to upgrade water-users-associations skills to increase use and improve management of irrigation water supplies, rehabilitate major and minor irrigation canals, expand pilot demonstration farms of innovative soil-moisture retention tillage operations, and expand improved water harvesting projects in dry areas of Sudan.

Sudan National Biodiversity Strategy and Action Plan (2013 – 2020) provided policies to provide financial support to administrative and technical action for safe use of natural resources, and to increase participatory involvement of all stakeholders in planning, knowledge sharing and capacity building of sustainable biodiversity systems. The plan also provided policies to enforce the implementation of preservation laws protecting the ecosystems, species and genetic diversity of biodiversity systems in Sudan.

Table 3- Step 1.3. Mapping of policies

Policy/ Time frame (TF)	**Specific Objectives**	**Measures to attain objectives**
Sudan Policy and Strategy on Integrated Water Resources Management TF: 2007-2022	Recognition of water as a scarce vulnerable resource Distribute equitable shares of water resources among States and users in the country	▪ Establish regulations and strengthen capacity for enforcing laws
	Promote the role of women and market-based factors on water resources use and management	▪ Include women consumption of water resources in domestic and irrigation ▪ Include respective water supply and demand factors of economic production and service industries ▪ participation of women in relevant aspects of water resources management

Policy/ Time frame (TF)	Specific Objectives	Measures to attain objectives
	Promote involvement of the private sector and other stakeholders in water resources service delivery	▪ Introduce incentives for sustainable use of water resources
National Plan for Development and Utilization of Water Resources TF: 2014	Increase water share of Sudan from the River Nile	▪ Launch new projects to benefit from increased share of Nile water
	Enhance creation of additional rain and surface water reservoirs for use	▪ Establish new rain water harvesting infrastructures and projects
	Increase better use and management of current and expected development of additional water resources storage	▪ Plan cropping pattern based on current and future expected availability of water resources in the country
Interim Poverty Reduction Strategy Paper TF: 2012	Revitalize and increase role of the agricultural sector of Sudan in contribution to growth and poverty reduction	▪ Upgrade water users associations skills to increase use and improve management of irrigation water supplies ▪ Rehabilitate major and minor irrigation canals
	Develop sustainable natural resource base ecology and environment	▪ Expand pilot demonstration farms of innovative soil-moisture retention tillage operations ▪ Expand improved water harvesting projects in dry areas of Sudan

Policy/ Time frame (TF)	Specific Objectives	Measures to attain objectives
National Adaptation Program of Action (NAPA) TF: 2007	Focus top priority on developing agriculture, water and health as basic components of food security pillars and sustainable poverty reduced livelihoods	▪ Introduce improved irrigation technology; ▪ enhance capacity of rainfall related water harvesting; ▪ generate climate tolerant crops and fodder and grazing pastures; ▪ diversification of livelihoods
Comprehensive National Food Security Policy TF: 2011	▪ Specify optimal water supply and use ▪ ▪ Raise awareness on crop-water requirements ▪ ▪ mitigate water-use waste on the environment	▪ Research and capacity building in irrigation water use
	▪ Evaluate and enhance transfer of improved water-users associations system to other irrigation schemes	▪ evaluation indicators ▪ capacity building outcomes
	▪ generate incentives to promote private sector investment on manufacturing water pumps, drilling equipment, water pipes and tanks, and supplies of spare parts	▪ Fund raising and tax waiver
Sudan National Biodiversity Strategy and Action Plan/ 2013-2020	Mainstreaming of biodiversity strategy action plan benefits and mitigating losses across formal government agencies and the civil society level at large	▪ Conduct research to identify causes of biodiversity loss ▪ Raise awareness about biodiversity endowments at the

Policy/ Time frame (TF)	Specific Objectives	Measures to attain objectives
		government and society levels
	Reduction of pressures on biodiversity and promotion of sustainable use and management	Promote sustainable use and management of natural resources
	Improving biodiversity safety measures for preservation of ecosystems, species and genetic diversity	Formulate policies and enact preservation laws protecting the ecosystems, species and genetic diversity of biodiversity systems in Sudan
	Enhancing the universal benefits of biodiversity and ecosystem services	Provide financial support to administrative and technical action for safe use of natural resources
	Enhance participatory biodiversity development and conservation	Expedite participatory planning, knowledge sharing and capacity building of sustainable biodiversity system
Ministry of Agriculture and Irrigation Plan – Irrigation Sector 2015 – 2019	Optimum management irrigation water demand	Raise awareness of optimum irrigation water use
	Maintenance of basic irrigation infrastructure	Provide finance for development and upgrading of private and public irrigation schemes Collect irrigation services fees to finance running cost of operation, maintenance and replacement activities

Policy/ Time frame (TF)	Specific Objectives	Measures to attain objectives
	Introduction of appropriate technology and control methods for meeting increased demand for irrigation water and reduction of water losses	Intensify continuous training and capacity building involved in administering and management of irrigation water resources Increase government expenditures on applied research in irrigation
	Sustainable use of water resources to achieve food security and economic development	Rehabilitate existing irrigation canals sedimentation problems Invite banks to finance development and modernization of private and public sectors schemes
	Updating of data and information systems, and legislations on irrigation water supplies and use, Formulation of strategies, programs and policies for implementing irrigation investment projects guarantee of required investment finance for irrigation projects Follow up and monitoring the progress of irrigated agricultural investments	Establish accurate data base system to plan irrigation operations Attract Arab investments in irrigation water supply infrastructure and services guaranteed by Arab Funds and Arab and Islamic Banks

Conclusions:

Sudan developed a number of strategies and plans embedded with policies addressing the water resources and agricultural water management. The strategies policies are divided into two parts, those formulated by the MWRIE and those formulated by line ministries (the MA&F and the MFNE) and environment oriented institutions (HCENR).

The legislations and policies defined practical AWM at federal level included:

- Draft National Water Policy 1999, amended in 2006, to ensure "sustainable and integrated management of available water resources and recognition of water as an instrument for conflict resolution".
- An Integrated Water Resources Management (IWRM) Strategy from 2008, currently reworked
- The National Adaptation Programme of Action to address climate variability and climate change focusing agriculture, water resources and public health
- The National Water Supply and Sanitation Policy 2010, still awaiting endorsement at the national level, to ensure equitable and sustainable utilisation and provision of safe water and sanitation, with a view to achieving the Millennium Development Goals (MDGs).
- Water, Sanitation and Hygiene (WASH) strategic plans for the 15 States, covering a period of five years from 2011- 2016, were completed in May 2011
- The National Agricultural Revival Programme 2007-2012, to improve water control through rehabilitation of the large irrigation schemes, encouraging development of the agro-industry by establishing a number of sugar factories, and improving infrastructure. Construction of the Merowe Dam was part of this programme.
- The general trends of the AWM policies aim to:
- Increase the water share of Sudan from the River Nile and water supplies from rainfall using approved water harvesting projects. This will urge the government to attract Arab funds finance to invest in irrigation water supply infrastructure and to modernize private and public schemes.
- Increase of government expenditures to carry out rehabilitation and maintenance of irrigation canals, conduct continuous training and capacity building of staff in irrigation water management, support related applied research especially in reducing sedimentation problems in canals.
- Introduce the market parameters of price incentives to motivate commercial involvement of the private sector in supplying water delivery services at cost; and to involve women participation in water services in remote rural areas providing irrigation and drinking water to small scale crop production and animal husbandry practices.
- Urge the line ministries and environmental institutions to undertake institutional reform and rehabilitation of irrigated schemes and rain-fed mechanized schemes revising land tenure, rent and size policies especially in large mechanized schemes, credit supplies to

producers, especially small producers lacking collateral, provision of agricultural services and extension, marketing arrangements of inputs supplies and crop output.

- Establish mechanisms for continuous assessment of resources using data collection and analysis which require the strengthening of the institutional capacity of the responsible agencies to establish data banks for evaluation and planning purposes.
- Provide logistics and tools that will upgrade data collection and analysis technology such as the use of Geographical information systems (GIS), Remote Sensing (RS), Groundwater Survey Equipment (GSE), and Global Positioning Systems (GPS). The policies also requested carrying out an inventory of the existing data and to backup them for national, state and local governments use.
- Supply irrigation and drainage services under cost recovery systems for all irrigation schemes. The water service pricing mechanism must promote equitable and efficient water use. In this context, the policies provided for the establishment of norms and procedures for sustaining financially viable irrigation schemes. Therefore the policy called for better organization and strengthening of the management capacity of the water users associations in collection of water-services charges.
- Undertake the training of staff, farmers and water users associations in area of water extension, water-rational use and optimum irrigation practices in the Gezira scheme and the other irrigated schemes.
- Strike a balanced use of safe water resources to protect the environment and sustain biodiversity in the environment.

STEP 2 - DIAGNOSTIC EXERCISE: ASSESSING PERFORMANCE OF INSTITUTIONS, LEGAL FRAMEWORKS & POLICIES

In this section, a framework to analyze effectiveness, capacity and governance dimensions of institutions, legal and regulatory framework, policies and processes is provided and organized in order to facilitate the identification of actions and reforms needed to improve the performance of the agricultural water sector.

The analysis is conducted by answering a set of questions through both quantitative/qualitative indicators and organized in Tables 4 & 5. This will lead to the assessment of major capacity and effectiveness bottleneck/opportunities for strengthening institutions, legal environment and policies, as well as of readiness/resistance to change by the different institutions/actors, and will include broad indications on the balance/relation between formal and informal aspects within the water sector and on the internal/external power relations energizing such system. Step 2, thus, allows to identify inputs and outputs getting in/out of the sector frame/box and to assess whether they are adequate.

2.1 Institutions

Assessing institutions' performance means evaluation of the identified institutions capacity in fulfilling the specific functions assigned to them and to solve problems in the AWM sector. This involves, the assessment of the effectiveness of the institutions in complying with their mandate/functions/areas of responsibility, assessment of the human//financial/technical capacity of institutions and actors, and finally analysis of the governance and stakeholders relationships as displayed in Table 2.1.

The MWRIE succeeded in formulating strategies, plans and policies for development of water resources physical structures and management. This Ministry was able to complete the heightening of the Rosaries Dam, the construction of Merowe Dam, the construction of Sett and Upper River Atbara Dams, and is in the process of securing funds from Saudi Arabia to build three additional dams and develop 0.42 million hectares of irrigation scheme on the Setit and Upper River Atbara Dams.

The Ministry also indulged in rehabilitation program of the Northern and the River Nile State Public Pump Schemes, regrouping of private sector pump schemes under the Wheat Resettlement Program and established compensation irrigation schemes for Merowe Dam affected people in the two states (and those in the Blue Nile State affected by the Rosaries Dam). The Ministry introduced new electric pumps substituting the old diesel pumps, and constructed irrigation canals, and provided initial finance to the affected people to produce their crop production activities.

However, the rehabilitation program was not accompanied by agricultural services, credit facilities and price incentives resulting in utilizing 50percent of the total developed area in the Northern State and 70percent in the River Nile State. The implementations of the Wheat Program attained 30percent and the compensation schemes achieved 12percent in the Northern State, while they reached 19percent and 31percent respectively in the River Nile State.

The MA&F managed to formulate the Green Mobilization/Executive Agricultural Revival Plan (GM/ARP) 2008-2012, and executed part of it during the first two years of launching the plan. However, due to shortage in financial resources the implementation of the ARP started to face delays.

The MWRIE succeeded in obtaining finance to build dams and compensate affected people. The Ministry was able to install hydroelectric generation power that facilitated the substitution of high cost diesel irrigation pump by low cost electric pumps.

Agriculture in Wadies and Khors

The current utilization of Wadies and Khors water streams is modest since most of the focus is

on drinking water for humans and livestock in remote areas away from the available rivers especially in Darfur, Kordofan, Red Sea, Kassala and Gadarif states.

1) These are limited in coverage area and depend on traditional technologies and methods under direct auspices of state governments, about 45 million cubic meters of water supplies were developed throughout the states of Sudan.
2) The Gash and Baraka rivers irrigate silt soils in Kassala and Red Sea states. The annual estimated flows of the Gash River ranged between 600 and 800 million cubic meters enough to flood 0.17 million hectares for crop production. The present use of the land goes down to 25percent of total potential area. One assumed cause for such low performance is attributed to administrative lack of coordination and conflict of interests among federal, state, and locality governments.

However, MWRIE experience generation gap in planning and administration capacities and lack of coordination with line ministries and within the institution. The advisory NWRC is non operative since its establishment in 1995.

The MA&F produced a number of agricultural and food security plans but suffers from poor financial support from MFNE, weak coordination with related departments of the SMAARI in the respective states.

The Gezira Scheme is decapitated with lack of supporting finance to rehabilitate and carry out annual maintenance of its destroyed canals. The policy of decentralization and privatization policy resulted in discharge of numbers of qualified and experienced agricultural inspectors, personnel, and skilled labour.

The introduction of the Gezira Act of 2005 was not supportive to enable full participation of the tenant farmers and their WUAs in AWM. Apart from the large area under sorghum crop, the Gezira Scheme has drops in cultivating thousands of hectares of cotton, wheat and groundnuts.

The agricultural research corporation has confined its research into breeding of crop varieties with little focus on crop-water economies research. The poor financial allocations and the high turnover of research staff together with the poor research facilities led to the limited role played by agriculture research in the irrigated sector.

The role of the Ministry of Livestock Resources, Fisheries and Pasture (MLRFP) and the associated Animal Research Corporation is weak with respect to AWM.

Table 2.1a -Step 2.1 Table 4: Assessing the performance of institution								
Institution/ Function	**Effectiveness**		**Capacity**			**Governance dimension**		
	Quantitative	**Qualitative**	**Human**	**Financial**	**Technical**	**Institutions & stakeholders governance relationship**	**Dynamics of relations between different levels within institutions**	**External actors' influence**
Ministry of Water Resources, Irrigation and Electricity/ Administrative and technical civil service leadership	Attracted Arab-Islamic Banks investment in heightening of Rosaries Dam, building of Merwi hydroelectric dam and construction of Setit and River Atbara dams Established water harvesting projects in Kordofan states	The investment added hydroelectric generated power to the national grid, Assisted in starting the substitution of diesel by electrically run pumps in the large pump schemes in the Northern, River Nile and Sinnar states	Depended on staff of the Ministry and on secondment of staff from the Ministry of Agriculture, Hired private sector consultancies for carrying out technically and socio-	Availability of financial resources were key to successful building of dams and water harvesting projects	shortage of qualified staff existence of generation gap among staff	Water resources development, rehabilitation, management and maintenance are scattered among two ministries and managing boards of irrigated	Slow networking and communication mechanism Overlapping of AWM responsibilities Delays in implementation caused by availability of funds	Involvement and coordination with international and regional actors can promote change, WORLD Bank had influence on irrigation schemes assessmen

Table 2.1a -Step 2.1 Table 4: Assessing the performance of institution								
Institution/ Function	**Effectiveness**		**Capacity**			**Governance dimension**		
	Quantitative	**Qualitative**	**Human**	**Financial**	**Technical**	**Institutions & stakeholders governance relationship**	**Dynamics of relations between different levels within institutions**	**External actors' influence**
	Formulated a 5-years irrigation plan	The constructed dams were associated with resettlement and compensation programs which were achieved smoothly in the Blue Nile and in the Merwi area of the Northern State. However, the construction of Kajbar Dam was delayed for dissatisfaction of affected	economically feasible water harvesting projects studies			schemes	Many investments going on parallel creating administrative overlap and congestion same	ts and reform during the 1980s Political will is manifested

Table 2.1a -Step 2.1 Table 4: Assessing the performance of institution								
Institution/ Function	**Effectiveness**		**Capacity**			**Governance dimension**		
	Quantitative	**Qualitative**	**Human**	**Financial**	**Technical**	**Institutions & stakeholders governance relationship**	**Dynamics of relations between different levels within institutions**	**External actors' influence**
		people with the resettlement and compensation component						
National Council for Water Resources (NCWR)/ Policy making	Non operational	Non operational	Large number of representatives and stakeholders nominated	No finance is available	High calibre selected	Not operational	Not operational	Not operational
Ministry of Agriculture and Forestry/	Provided ARP and Food Security Program, had technical	The Ministry appreciates the importance of policy formulation	Insufficient skilled human resources	Weak financial resources to allow	The Ministry involvement on AWM is focused on	Weak involvement of the private	Weak institutional linkages and networking	FAO and IFAD had positive support to

Table 2.1a -Step 2.1 Table 4: Assessing the performance of institution								
Institution/ Function	**Effectiveness**		**Capacity**			**Governance dimension**		
	Quantitative	**Qualitative**	**Human**	**Financial**	**Technical**	**Institutions & stakeholders governance relationship**	**Dynamics of relations between different levels within institutions**	**External actors' influence**
Policy making	support in policy formulation at state level, Participate in policy and planning committees at federal level, Embarked on CAADP-NAIP preparation			close follow up and monitoring of AWM	the Undersecretary for irrigation Other agricultural administrations in the AWM is minimal, Existence of a technical unit involved in follow up of irrigated crop production	sector in providing investment and operational and marketing finance to public irrigation schemes in the pump irrigation schemes Low response of private	regarding policy formulation, planning, implementation and follow up of activities related to irrigation schemes No coordination between ministry of agriculture departments	irrigation schemes (Gash and Khor Abu Habil water harvesting scheme in North Kordofan) Political support was manifested once by an ex state minister of

Table 2.1a -Step 2.1 Table 4: Assessing the performance of institution								
Institution/ Function	**Effectiveness**		**Capacity**			**Governance dimension**		
	Quantitative	**Qualitative**	**Human**	**Financial**	**Technical**	**Institutions & stakeholders governance relationship**	**Dynamics of relations between different levels within institutions**	**External actors' influence**
					seasonal plans and implementation. Limited knowledge generation and application in AWM sector.	sector in privatization of public irrigation schemes.	of planning and the public corporations and the between the undersecretary of agriculture and the under secretary of irrigation under the same ministry.	Agriculture in North Kordofan state
Water Manage	Limited	Research	Availability	Inadequat	The institute	Maintains	Weak link	Weak

Table 2.1a -Step 2.1 Table 4: Assessing the performance of institution								
Institution/ Function	**Effectiveness**		**Capacity**			**Governance dimension**		
	Quantitative	**Qualitative**	**Human**	**Financial**	**Technical**	**Institutions & stakeholders governance relationship**	**Dynamics of relations between different levels within institutions**	**External actors' influence**
ment & Irrigation Institute, Gezira University	research executed on agricultural water management	programs are demand driven	of qualified staff	e financial resources to carry out pipeline research proposals	has the technical capabilities to conduct research in AWM	good relationships with irrigation schemes management	with the private sector especially in financing AWM research	political support, weak relationship with international organizations
Agricultural Research Corporation (ARC)	Past research on crop water requirement covered all irrigated crops in the Gezira scheme, But requires updating	Weak link with technology transfer institutions on crop water use/management to farmers.	Insufficient researchers working in irrigation water.	Inadequate research budget for AWM research.	Capacity building for researchers in AWM is required.	Weak relation between research units and staff in different research units locations	Slow implementation of research and links among different research units in different parts of the	Wakened consultancy services of ARC on problems related to AWM in farmer fields

Table 2.1a -Step 2.1 Table 4: Assessing the performance of institution								
Institution/ Function	**Effectiveness**		**Capacity**			**Governance dimension**		
	Quantitative	**Qualitative**	**Human**	**Financial**	**Technical**	**Institutions & stakeholders governance relationship**	**Dynamics of relations between different levels within institutions**	**External actors' influence**
	Limited capacity building on AWM research					across the country	country	
Water Users Association (WUA)	Established water users associations in the Gezira scheme The WUAs are supported by Gezira 2005 law and regulations.	Quality of WUAs is weak since employing non-experienced staff. Disputes among tenants about delays and inadequate delivery of irrigation water to their fields on time as requested	Many WRUAs do not have adequate staff/personnel to carry out activities	No budget lines therefore no funds to fulfil their duties	WRUAs do not have the technical capacity and skills for irrigation water management	Inexperienced WUAs are undermined by Scheme Administration		Elite manipulate the WUAs

Table 2.1a -Step 2.1 Table 4: Assessing the performance of institution								
Institution/ Function	**Effectiveness**		**Capacity**			**Governance dimension**		
	Quantitative	**Qualitative**	**Human**	**Financial**	**Technical**	**Institutions & stakeholders governance relationship**	**Dynamics of relations between different levels within institutions**	**External actors' influence**
		Conflicts exist in agriculture water management						
Sudan Metrological Authority	Provides information on rainfall situation that have reflection on river-dams water storage and flows related policies	Quality of data and information sometimes not reliable	Inadequate staff and modern tools for data collection	Inadequate finance	Poor technical capacity of staff and loss of experience staff by pension	Weak federal and state coordination	Low dynamics between the departments of the Authority	No external support

Conclusion of assessing the performance of institutions:

The general performance of the affiliated institutions in the area of AWM was successful. The MWRIE produced long term strategies and plans in water resources and agricultural production systems, accessed investment support for building 3 new dual purpose irrigation and hydroelectric generation dams, and for developing 0.42 million hectares of pipeline agricultural irrigated scheme on Upper Atbara River.

Similarly, the MA&F produced a number of development plans which were not fully implemented particularly in area of AWM rehabilitation programs. The poor budget allocations to the ministries and public schemes in particular did not allow undertaking operational and maintenance functions of irrigation canals and identification of appropriate polices and projects for improving the AWM in those schemes. These institutions lack coordination among themselves and with each other with respect to AWM. The involvement of the private sector in investing in water resources and agricultural water research, services delivery and infrastructure building is weak.

Table 2.1b- Step 2.1: Summary of conclusion of assessing the performance of institutions

Institution	Function underperforming	Causes of the institutional under performance (Capacity, Governance)
Ministry of Water Resources, Irrigation and Electricity (MWRIE)	Poor coordination between institutions involved in AWM	**Capacity:** Limited technical and financial resources; **Governance:** Inter-ministerial competition; Conflicts between institutions **Governance:** Slow and long processes of policy reforms
	Poor water resources management and development in the States and at national level	**Capacity:** Lack of development of human skills **Governance:** Lack of coordination between Central (national) and States **Governance:** Inadequate provision of finance to support

Institution	Function underperforming	Causes of the institutional under performance (Capacity, Governance)
		investment in water resources and management
National Council for Water Resources (NCWR)	Setting policies	**Capacity:** Limited technical resources **Governance:** Inter-ministerial competition; Conflicts between institutions **Governance:** Slow and difficult to meet in one place and one time
Ministry of Agriculture and Forestry (MA&F)	Inadequate rural advisory services and technology transfer	**Capacity**: Limited technical and financial capacity **Capacity:** limited human resources **Governance:** Overlapping of National and State administration
	Poor planning of agricultural resources in Sudan	**Capacity:** Limited involvement of private sector in AWM development **Governance:** Rules and regulations in AWM investments are not enforced
Water Users' Associations (WUAs)	Poor management of irrigation water at field level	**Capacity:** Lack of technical and financial capacity **Capacity:** Lack of skilled human capacity **Governance**: Absence of coordination with relevant Ministries and institution

Table 2.2- Step 2.2a Assessing the performance of legal and regulatory frameworks in Sudan

Primary Legislation	Specific Targets	Effectiveness		Governance dimensions		
		Strengths	Weaknesses	Formal/Informal aspects	Readiness to change	Resistance to change
Irrigation and Drainage Act (1990)	Regulate use of irrigation water and drainage facilities Permit of roads inside irrigation schemes Regulate irrigation of new agricultural land	The Act has made the Minister of WRI the concerned authority The act broaden the scope of the existing legal regime to include drainage activities	The 1990 Act does not define the waters which it applies	The Act does not target the vulnerable and poor people	No	Yes/the Act is relatively old
Water Resources Act (1995)	Improve efficiency and effectiveness of water management Regulate water use Improved coordination between actors in the water	The Act defined water resources The Act applied to all water resources The Act covered the use of water resources for all purposes	The NCWR has very large and wide representation	The Act is general in nature and does not address specific issues of the rural poor	Yes	No

Primary Legislation	Specific Targets	Effectiveness		Governance dimensions		
		Strengths	Weaknesses	Formal/Informal aspects	Readiness to change	Resistance to change
	sector					
Gezira Scheme Law of 2005	Promote decentralization, privatization and greater farmers' participation in management of the Scheme	Involvement of beneficiaries	Lack of technical capacity for WUAs in management of irrigation systems	WUAs lack enforced regulations that can support management of irrigation water	No	Local communities lack regulations that organize the relation between WUAs and beneficiaries
	Enhancement of water management and utilization	Strong Farmers union	Lack of technical capacity	WUAs lack enforced regulations that can support management of irrigation water	No	Local communities lack regulations that organize the relation between WUAs and beneficiaries
	Land reform	Political support	Ineffective mechanism for implementation	WUAs lack enforced regulations that can support management of irrigation water	No	Local communities lack regulations that organize the relation between WUAs and beneficiaries

Primary Legislation	Specific Targets	Effectiveness		Governance dimensions		
		Strengths	Weaknesses	Formal/Informal aspects	Readiness to change	Resistance to change
The Gash Delta Agricultural Corporation Water Users' Act (2004)	To take active part on the operation, maintenance and improvement of the Gash irrigation Scheme Enhance efficiency and sustainability in using irrigation water Training and capacity building in irrigation water management Land reform	Involvement of beneficiaries and allocation of agricultural land	Quickly prepared resulting in poor quality – Reference to one specific project	The Act is limited to specific area and does not cover the whole State	No	Yes, the Act is poorly formulated and does not cover aspects related to water management
The Environment (Protection) Act, 2001	Creation of enabling environment of institutions and policies for	Explicit statement of water resources	Low priority	Establishes "The Environment and Natural Resources Higher Council"	Yes	No

Primary Legislation	Specific Targets	Effectiveness		Governance dimensions		
		Strengths	Weaknesses	Formal/Informal aspects	Readiness to change	Resistance to change
	protection of environment and natural resources including water resources					
The Civil Transaction Act, 1984	Regulates transactions and deals of agricultural lands	Regulates the relationship between landlords and tenants/users	There is no regulation for selling water	There is conflict between rural communities and government institutions responsible for land	Yes, it covered diversity in agricultural production relations	Yes, there is need to consider water resources
Forests and Renewable Natural Resources Act, 2002	Creates a system that organize and regulates forests and renewable natural resources	Protects forests and natural resources The Act encourages private sector and community based forests	There is no mechanism to enforce the Act	Enforcement of the Act requires coordination with other concerned Ministries	Yes, it conserves natural resources	No

Conclusion of assessing the performance of legal & regulatory frameworks in Sudan:

Sudan issued a number of water resources laws at federal and state levels that have own specific objectives and mandates:

In 1994 all institutions functioning in water resources area were grouped together under the umbrella of the former Ministry of Irrigation and Water Resources.

In 1995 the Law of Water Resources was launched. The main objectives were to:

1) Develop public ownership of water resources in Sudan
2) Establish the NCWR with membership of related ministries, agencies and corporations, representatives of states governments, expertise of water related affaires.

Important mandates and authorities of the Council:

   a. Formulate the general policies of water resources, their potentials, development, uses and management, protection against pollution and degradation,
   b. Assigned a specialized committee to prepare underground water regulations draft, and a second one to introduce adjustments in the regulation of water pumps withdrawals from all surface water resources in the country,

3) Environmental Sanitation Law of 1975: concerned with water pollution issues
4) Local Government law of 1998 to establish locality councils issuing water legislations concerned with non-trans-boundary water resources within their geographical areas.

All these multiple laws by federal and state levels led to the following aspects:

- Duplication and overlapping of responsibilities and operations
- Distribution of carrying out research and studies, implementation and maintenance operations among many uncoordinated agencies and institutions, resulted in conflicts and contradicting interests and waste of financial and human resources
- Absence of unified standards and quality control measures, basic rules governing design studies, and water investments
- Spreading thin of professional advice and supervision, administration and management expertise among many divers agencies and institutions which created structural shortages in each one
- Absence of coordination among units of the same departments within the Ministry and among the different agencies and institutions mandated with above mentioned responsibilities and roles
- The Gezira Scheme Law of 2005 promoting participation of tenants in water users associations who lacked technical and managerial capacity limited their contribution to supply and distribute adequate irrigation water from canals into field levels, and resulted in poor crop stands and yields

The finding of this exercise shows that the primary legislations have not met one or more specific targets of achieving sustainable and efficient water resources and agricultural water management. For example, the Water Resources Act (1995) has not enforced the implementation of the National Council for Water to engage on its mandated advisory and

supervision role. Table 2.2.b provides the summary of conclusions of assessing the performance of legal and regulatory frameworks.

Table 2.2.b- Step 2.2 Summary of conclusions of assessing the performance of legal and regulatory frameworks		
Primary legislation	**Specific targets not achieved**	**Formal/Informal aspects (F/I), Readiness (Rd) and Resistance (Rs) to change**
Irrigation and Drainage Act (1990)	Regulate use of irrigation water and drainage facilities	**F/I:**Water use sources are not defined **F/I** : The Act does not target the vulnerable and poor people **Rd:** No **Rs:** Yes/the Act is relatively old
Water Resources Act (1995)	Improve efficiency and effectiveness of water management Improved coordination between actors in the water sector	**F/I:** non-operating national council for water Lack of coordination and overlapping of responsibilities between different actors **Rd:** Yes **Rs:** No
Gezira Scheme Law of 2005	Promote decentralization, privatization and more farmers' participation in the management of the Scheme Enhance field water management and utilization	**F/I:** Poor capacity of farmers to engage in senior level management of large scheme administration Lack of technical capacity of water users associations **Rd:** No **Rs:** Yes, due to weak enforcement of the Act to formulate regulations that organize the relation between water users associations and beneficiaries
The Gash Delta Agricultural Corporation Water Users' Act (2004)	Enhance better and sustainable use and management of irrigation water Train and build capacity in irrigation water management	**F/I:** The Act does not define the respective roles of the federal, state and locality governments and farmers union Lack of technical capacity of water users associations **Rd:** No **Rs:** Yes, due to weak enforcement of the Act to formulate regulations that organize the relation between water users associations and beneficiaries
The Environment (Protection) Act, 2001	Create an enabling institutional capacity environment	**F/I:** The established Higher Council for Environment and Natural Resources

Table 2.2.b- Step 2.2 Summary of conclusions of assessing the performance of legal and regulatory frameworks		
Primary legislation	**Specific targets not achieved**	**Formal/Informal aspects (F/I), Readiness (Rd) and Resistance (Rs) to change**
		lacks the administrative power to enforce functions and mandates No enforcement of protection laws and penalties **Rd:** Yes **Rs:** No
The Civil Transaction Act, 1984	Regulate transactions and deals of agricultural lands	**F/I:** Agricultural lands are not formally registered **Rd:** Yes, because agricultural production relations are divers and socially bound **Rs:** Yes, there is need to consider water resources in land transactions
Forests and Renewable Natural Resources Act, 2002	Create an organizing and regulating system for forests and renewable natural resources	**F/I:** Enforcement of the Act requires coordination with other concerned Ministries **Rd:** Yes, it conserves natural resources **Rs:** No

2.3 Policies and Processes

Assessing the policies and processes means weighing up the ability of the identified policies to attain the specific targets described in Table 3 and to solve problems in the agricultural water sector.

Table 2.3a analyzes the effectiveness of the current policy environment and of the governance dimensions of policies.

Table 2.3a. - Step 2.3. Assessing the performance of policies					
Policy	**Specific policy objective**	**Effectiveness**		**Governance dimensions**	
		Strengths	**Weaknesses**	**Formal/Informal aspects**	**Readiness for reform/dialogue/compromises**
Sudan Policy and Strategy on Integrated Water Resources Management TF: 2007	Recognition of water as a scarce vulnerable resource and distribute equitable water supplies to different States and users in country	Creation of awareness about expected future water scarcity and treating water as an economic good	No given guidelines for AWM and enforcement of regulations	Undefined vertical and horizontal responsibilities and links between the various institutions working in the water sector	Training and capacity building in various areas to enhance appreciation of the benefits of cooperation i enabling the capacity of the stakeholders and to enhance the development and efficient implementation of water resources
National Plan for Development and Utilization of Water Resources TF: 2014	Enhancement of rain and surface water	Increasing the availability of water supplies in rural areas	The plan lacks ways of implementation	Lack of coordination with MA&F – The role of civil society is not clearly identified in the plan	Focus on the issue of climate change to bring together different parties, institutions and communities to participate in the subject matter dialogue
Interim Poverty Reduction Strategy Paper TF: 2012	Revitalization of the agricultural sector, increasing its contribution to growth, exports	Emphasis on the role of agriculture in poverty reduction	Identified activities and stakeholders but not linked to	MFNE is the founder, leader and responsible for implementation of the strategy	Involving relevant stakeholders offers a space for dialogue and commitment for policy implementation. The policy identified poorer

Table 2.3a. - Step 2.3. Assessing the performance of policies					
Policy	**Specific policy objective**	**Effectiveness**		**Governance dimensions**	
		Strengths	**Weaknesses**	**Formal/Informal aspects**	**Readiness for reform/dialogue/compromises**
	and poverty reduction		implementing timed work programme		groups and designed implementable poverty reduction programs.
National Adaptation Program of Action (NAPA) TF: 2007	Focus on agriculture, water and health as top priority to achieve food security and sustainable livelihoods	Created awareness about future expected climate change effect on natural resources and mitigation, especially water resources	Lack of political commitment to implement the Plan	Wide consultation of related stakeholders in formulation of NAPA	Sporadic implementation of water and public health related projects
Comprehensive National Food Security Policy TF: 2011	Identifying AWM for food security crops based on crop water requirements to reduce irrigation water losses and waste and to	Involvement of wide range of stakeholders in policy creation	Lack of adequate financial support	MA&F is the lead institute guides the relevant parties to attain this objective	Continued dialogue among stakeholders for reform of the Plan during the implementation stage

Table 2.3a. - Step 2.3. Assessing the performance of policies					
Policy	**Specific policy objective**	**Effectiveness**		**Governance dimensions**	
		Strengths	**Weaknesses**	**Formal/Informal aspects**	**Readiness for reform/dialogue/compromises**
	mitigate effects of water misuse on the environment				
	Re-evaluation, reform and enhancement of the introduction of WUAs in irrigation schemes	Awareness of policy makers about involvement of bottom root organization	Financial resources and training needs of water users associations are not specified	Involvement of farmers in the process of re-evaluation, reform and reform	WUAs implementation piloted in the Gezira scheme by policy makers to enable farmers to participate in AWM at field level
	Provision of incentives for private sector investment in water resources equipment manufacturing (water pumps, drilling equipment, pipes, tanks and spare parts)	Involvement of private sector to promote investment in national industry for manufacturing water resources and irrigation	Incentives are not specified	inadequate financial institutions support to private sector to manufacture water services machinery and equipment	Weak involvement of financing and fiscal policy institutions in the dialogue

Table 2.3a. - Step 2.3. Assessing the performance of policies					
Policy	**Specific policy objective**	**Effectiveness**		**Governance dimensions**	
		Strengths	**Weaknesses**	**Formal/Informal aspects**	**Readiness for reform/dialogue/compromises**
		equipments			
Ministry of Agriculture and Irrigation Plan – Irrigation Sector 2015 – 2019	Maintenance of basic irrigation infrastructure	Improve performance of irrigation sector	The irrigation infrastructures are fragmented and require large financial resources and appropriate timing	MFNR governs allocations and disbursement of maintenance funds delaying implementation programs, Under Gezira law, 2005, MA&F have no direct influence on farmers to grow strategic crops under current limited supplies of irrigation water in Gezira scheme	Difficulty of convincing farmers union leadership to reconcile between national and individual interests when deciding on crop areas and crop mix

Conclusion of assessing the performance of policies:

The main findings and conclusions are that Sudan has several policies either directly or indirectly related to the water sector. Despite the sound objectives of these policies they are not reaching their targets. The reasons range from overlapping responsibilities, to lack of economic incentive and to insufficient irrigation infrastructure in rural areas.

Table 2.3.b- Step 2.3 Summary of conclusions of assessing the performance of key policies

Policy	**Specific Objectives not achieved**	**Reasons behind specific objective not achieved:** **Formal/Informal aspects (F/I), Readiness (Rd) and resistance (Rs) to change**
Sudan Policy and Strategy on Integrated Water Resources Management TF: 2007-2022	Establishment of a financing mechanism for funding of water resources management functions Promote participation and engagement of the private sector and other stakeholders in service delivery	**F/I:** Multi-users of water resources and overlapping responsibilities **Rd:** Yes, finance is essential for development of water resources. **Rs:** No **F/I:** Lack of economic incentive **Rd:** Yes, the private sector pumps more financial resources in the water sector and increase efficiency and competitiveness of the sector. **Rs:** No
	Enhance creation of additional rain and surface water reservoirs for use	**F/I: established Dam Unit in the Ministry responsible for water harvesting and haffirs** Lack of coordination between the institutes working in this area/topic. **Rd:** **Rs:** Yes, it does not address modern technologies in

Policy	Specific Objectives not achieved	Reasons behind specific objective not achieved: Formal/Informal aspects (F/I), Readiness (Rd) and resistance (Rs) to change
		irrigation
	Increase better use and management of current and expected development of additional water resources storage	F/I: existence of irrigated schemes with poor management and financial capacity Rd: no, because of conflict of interests of stakeholders Rs: yes as coordination deprives vested interests of certain parties in management board
Interim Poverty Reduction Strategy Paper TF: 2012	Revitalize and increase role of the agricultural sector of Sudan in contribution to growth and poverty reduction	**F/I:** Lack of political good will **Rd:** Yes **Rs: no**
National Adaptation Program of Action (NAPA) TF: 2007	Focus top priority on developing agriculture, water and health as basic components of food security pillars and sustainable poverty reduced livelihoods	**F/I:** Lack of government commitment and overlapping of responsibilities among related institutes **Rd:** Yes **Rs: no**
Comprehensive National Food Security Policy TF: 2011	Specify optimal water supply and use Raise awareness on crop-water requirements mitigate water-use waste on the environment	**F/I:** Lack of government commitment **Rd:** Yes **Rs: no**
	Evaluate and enhance transfer of improved water-users associations system to other irrigation schemes	**F/I:** Deterioration of irrigation infrastructures at scheme level, which is beyond of financial capacity of the farmers

Policy	Specific Objectives not achieved	Reasons behind specific objective not achieved: Formal/Informal aspects (F/I), Readiness (Rd) and resistance (Rs) to change
		Rd: Yes, it enhances the performance of institutions **Rs: no**
	generate incentives to promote private sector investment on manufacturing water pumps, drilling equipment, water pipes and tanks, and supplies of spare parts	**F/I:** Lack of government commitment **Rd:** Yes, it promotes industry of irrigation water equipment which encourage use of technologies that enhance the efficiency of irrigation water **Rs:** relative resistance to risk of competition of imported equipment and machinery
Sudan National Biodiversity Strategy and Action Plan/ 2013-2020	Mainstreaming of biodiversity strategy action plan benefits and mitigating losses across formal government agencies and the civil society level at large Improving biodiversity safety measures for preservation of ecosystems, species and genetic diversity	F/I: involvement of multiple scattered administrative and consultative institutions in environment and biodiversity Rd: no, due to slow handling of environment and bio-diversity issues Rs: yes, takes time to develop awareness and political support
Ministry of Agriculture and Irrigation Plan – Irrigation Sector 2015 – 2019	Maintenance of basic irrigation infrastructure	**F/I:** Lack of government commitment to provide financial resources **Rd:** Yes

Policy	Specific Objectives not achieved	Reasons behind specific objective not achieved: Formal/Informal aspects (F/I), Readiness (Rd) and resistance (Rs) to change
	Introduction of appropriate technology and control methods for meeting increased demand for irrigation water and reduction of water losses	**Rs: no**

STEP 3 - ACTION MATRIX

The action matrix uses the results of previous analysis/assessment through step 1 to 3 in order to define actions, policy reforms, and investment plans aimed at improving the agricultural water sector. It suggest what changes should occur to improve the agricultural water sector in a given country and identifies what different actors can do to improve inputs and outputs of the sector.

3.1 Institutions

Table 3.1 gives the institution and the related function underperforming identified and the causes, the proposed action and the responsible actor. An abstraction of the identified underperforming function causes for which actions are proposed is given below:

- Bias towards large irrigated infrastructure investments giving less weight to small producers related water harvesting activities
- Inadequate availability of local component delays completion of dams and related affected people compensation programs
- Dependence on consultants and limited involvement of e staff of the ministry and related corporations
- Building parallel institutions doing same work and being fond of establishing specialized councils and committees with limited use of employees and staff exposure Disorganized civil service function of the ministries focusing responsibilities on few senior staff and ignore institutional system

- Poor enforcement of laws limiting their testing verification and reform
- Limited training and exposure to exchange programs
- Marginalizing the role of the planning and policy formulation function in tncing he respective ministries
- Marginalizing the role of research, livestock, forestry and range water related services
- Lack of networking and team ms work programs which result into few people administering the key points and the rest kept engaged in futile bureaucratic assignments or reduced to doing clerical jobs
- Poor data system and management
- Ignoring the role of maintenance and rehabilitation activities and given low priority in fund and budget allocations

Table 3.1. - Step 3.1 Action matrices of institutions				
Institution	**Function underperforming**	**Causes of the institutional under performance (Capacity, Governance)**	**Proposed Action**	**Responsible**
Ministry of Water Resources, Irrigation and Electricity (MWRIE)	Biased focus on large dams and water irrigation pumping schemes Delays in construction of pipeline Dams and large schemes rehabilitation programs Poor and delayed water resources management and development in dry land agriculture	**Capacity:** Limited administrative and technical capacity in planning and policy formulation and follow up and monitoring process of concerned department of the Ministry Limited and delayed allocation of local financial component to continue construction of water infrastructures Inadequate compensation financial resources and technical capacity to implement resettlement of affected people **Governance:** Inter-ministerial competition; conflicts between institutions **Governance:** Slow and	Remove bias towards large investment programs by raising institutional capacity of small water resources activities Involve State government institutions related to water use and safety Allocate adequate development budget to local financial counterpart Allocate adequate budgets for water harvesting and ground water development programs Enhance systematic training and mobilization of financial resources from government Enhance available network Establish forums of stakeholders and policy decision makers to undertake timely decisions based on	Ministry of Water Resources and Electricity (MWRE) Ministry of Finance and National Economy Ministry of Agriculture and Forests State Ministries of Agriculture and Irrigation Community leadership International organizations and NGOs Ministry of Justice Ministry of Interior

Table 3.1. - Step 3.1 Action matrices of institutions				
Institution	**Function underperforming**	**Causes of the institutional under performance (Capacity, Governance)**	**Proposed Action**	**Responsible**
		long bureaucracy processes Poor enforcement of water resources laws and regulations	follow up and evaluation feedback on progress of the performance of water resources activities and implementation of reform	
	Overlap and conflicting mandates among line ministries and between federal and state level governments on issues related to water resources development Poor coordination between institutions involved in AWM	**Capacity:** Lack of development of human resources capacities and skills Absence of institutional defined roles and lack of interaction among the departments within the Ministry and between with related units at federal, state and locality governments levels **Governance:** Lack of coordination between Central (national) and States Inadequate provision of	Systematic training, exchange programs, continued field visits and surveys Strengthening of the follow up and monitoring departments Reinstate the assigned mandates and roles and defining clear boundaries between departments and units in the Ministry of Water Resources, Develop strong working and information management networks within the same Ministry and with concerned stakeholders institutions, Provide adequate budgets to	Ministry of Water Resources and Electricity (MWRE) Ministry of Agriculture and Irrigation + Ministry of Finance and National Economy State Ministries of Agriculture, Livestock and Irrigation

Table 3.1. - Step 3.1 Action matrices of institutions				
Institution	**Function underperforming**	**Causes of the institutional under performance (Capacity, Governance)**	**Proposed Action**	**Responsible**
		finance to support investment in water resources and management	carry out daily work and assignments Provide adequate finance to support field visits and surveys and follow up and monitoring activities Mobilization of financial resources from government, private sector and donors	
National Council for Water Resources (NCWR)/	The Council is non operating due to overlapping objectives and functions with the Ministry mandate Large number of members does not facilitate adequate financing and regular meetings Advisory nature of the Council makes its responsibilities slow and does not commit the respective ministers to resort	**Capacity:** Limited technical resources; **Governance:** Inter-ministerial competition; Conflicts between institutions Slow and difficult to meet in one place and one time	To revise and redesign the Council terms of reference to be problem solving advisory unit To create close networking with the different specialized departments to be updated on emerging issues at field level	Ministry of Water Resources and Electricity Water Resources Research institutions Agricultural Corporation Higher Council for Environment Meteorological

Table 3.1. - Step 3.1 Action matrices of institutions				
Institution	**Function underperforming**	**Causes of the institutional under performance (Capacity, Governance)**	**Proposed Action**	**Responsible**
	to the Council given the rapid actions to be timely taken Poor links and co-ordination between the Council and the different departments of the MWRIE taken			department Department of Hydrology in the University of Khartoum, University of Sudan and University of Gezira
Ministry of Agriculture and Forests	No link between agricultural departments and water resources planning and management activities Concern with seasonal irrigated crops information, with weak effect on farmers decision making Inadequate rural advisory services and technology transfer	**Capacity**: Limited technical and financial capacity Limited human resources **Governance:** Overlap between federal and State and irrigation schemes and projects administration Weak participation of farmers unions and private sector providing inputs and services at early preparatory stages	Units Systematic training Strengthening of coordination units between actors in technology Generation and transfer, and recipients Support early involvement of experts, farmers unions and private sector in advisory services, follow up Forums and monitoring activities	Federal Ministry of Agriculture and Forestry, State Ministry of agriculture, Livestock and Irrigation, Ministry of Water Resources and Irrigation and Electricity Ministry of

Table 3.1. - Step 3.1 Action matrices of institutions				
Institution	**Function underperforming**	**Causes of the institutional under performance (Capacity, Governance)**	**Proposed Action**	**Responsible**
				Finance, Farmers Unions, Private sector representatives National experts
	Poor planning of agricultural investment in Sudan Poor link between the departments of the Ministry and the managing directors of the irrigated schemes Poor link between the federal Ministry of Agriculture and the related state ministries on irrigated agriculture policies and plans and seasonal implementation supplies of inputs and credit	**Capacity:** weak capacity of Investment Department in the Ministries of Agriculture and Forests, and in the Ministry of Water Resources, Irrigation and Electricity, Limited involvement of private sector in AWM development **Governance:** Rules and regulations in AWM investments are not enforced	Create mechanism for involvement of private sector in AWM Increase awareness about rules and regulations and set a mechanism for enforcement	Ministry of Agriculture and Forests + Ministry of Water Resources, Irrigation and Electricity (MWRE) Ministry of Investment, State Ministries of Agriculture, Livestock, and Irrigation

Table 3.1. - Step 3.1 Action matrices of institutions				
Institution	**Function underperforming**	**Causes of the institutional under performance (Capacity, Governance)**	**Proposed Action**	**Responsible**
				Ministry of Finance an National Economy, Managing boards of irrigation schemes and projects Private Sector
Water Users' Associations (WUAs)	Poor management of irrigation water at field level	**Capacity:** Lack of technical and financial capacity Lack of skilled human capacity **Governance**: Absence of coordination with relevant Ministries and farmers unions and training institutions Poor extension services	Systematic training of water users staff, mobilize financial resources at farmers' level Enhance coordination between relevant ministries and training institutions Expand role of technology transfer and extension services of the Ministry of Agriculture to provide demonstrations for water users	Ministry of Agriculture and Forestry State ministries of Agriculture hosting large and small irrigated schemes Farmers unions Training and vocational training institutes

1.2 Legal and regulatory framework:

For each of the problems (for each law/regulation) listed in step 2.2, actions to solve them are proposed together with the institutions/actors responsible to implement those actions. This is shown in Table 3.2.

The main causes are:

1. The laws have not defined the sources and types of water resources
2. The laws are vague when considering target beneficiaries
3. The acts establish consultative councils demanding them to administer ad manage water resources, which overlap with mandates given to specialized departments in the concerned ministries and research, production corporations
4. Lack of coordination and overlapping of responsibilities between different actors
5. Poor capacity of farmers to engage in senior level management of large scheme administration
6. Lack of technical capacity of water users associations
7. Weak enforcement of the laws and acts, and formulation of regulations that organize the relation between water users associations and beneficiaries
8. The Act does not define the respective roles of the federal, state and locality governments and farmers union
9. Lack of technical capacity of water users associations
10. Weak executing body to follow up and enforce act and regulations

Table 3.2- Step 3.2 Action matrix for legal and regulatory frameworks

Primary legislation	**Specific targets not achieved**	**Formal/Informal aspects (F/I), Readiness (Rd) and Resistance (Rs) to change**	**Proposed actions**	**Responsible agent**
Irrigation and Drainage Act (1990)	Regulate use of irrigation water and drainage facilities	**F/I:**Water use sources are not defined The Act does not target the vulnerable and poor people **Rd:** No **Rs:** Yes/the Act is relatively old	Define water sources and put guidelines to regulate use of irrigation water and drainage facilities Design mechanisms to implement the act	Ministry of Water Resources and Irrigation and Electricity (MWRIE) Ministry of Agriculture and Forest (MA&F)
Water Resources Act (1995)	Improve efficiency and effectiveness of water management Improved coordination between actors in the water sector	**F/I:** non-operating national council for water Lack of coordination and overlapping of responsibilities between different actors **Rd:** Yes **Rs:** No	Create a mechanism for revival of the national council for water and limit number of members Create coordinating networks and define roles and responsibility of different actors	Ministry of Water Resources and Electricity (MWRIE) Ministry of Agriculture and Forests

Primary legislation	Specific targets not achieved	Formal/Informal aspects (F/I), Readiness (Rd) and Resistance (Rs) to change	Proposed actions	Responsible agent
Gezira Scheme Law of 2005	Promote decentralization, privatization and more farmers' participation in the management of the Scheme Enhance field water management and utilization	**F/I:** Poor capacity of farmers to engage in senior level management of large scheme administration Lack of technical capacity of water users associations **Rd:** No **Rs:** Yes, due to weak enforcement of the Act to formulate regulations that organize the relation between water users associations and beneficiaries	Conduct an evaluation study to indentify basic causes of failure, Revise recommendations of previous conducted studies to identify reasons for not being implemented Create political lobby to show that the scheme is a national scheme that looks for the welfare of the society and takes into consideration the interests of the tenants of the scheme Provide systematic training of local communities and mobilization of local and government fund	Ministry of Agriculture The Board of Directors of the Gezira Scheme

Primary legislation	Specific targets not achieved	Formal/Informal aspects (F/I), Readiness (Rd) and Resistance (Rs) to change	Proposed actions	Responsible agent
The Gash Delta Agricultural Corporation Water Users' Act (2004)	Enhance better and sustainable use and management of irrigation water Train and build capacity in irrigation water management	**F/I:** The Act does not define the respective roles of the federal, state and locality governments and farmers union Lack of technical capacity of water users associations **Rd:** No **Rs:** Yes, due to weak enforcement of the Act to formulate regulations that organize the relation between water users associations and beneficiaries	Provide systematic training of local communities and mobilization of local and government fund Revise the different roles and responsibilities of the concerned stakeholders and resolve administration conflicts over the scheme	Ministry of Water Resources, Department of Irrigation Ministry of Agriculture The State Ministry of Agriculture, The management of the Gash Scheme Farmers Union
The Environment (Protection) Act, 2001	Create an enabling institutional capacity environment	**F/I:** The established Higher Council for Environment and Natural Resources lacks the administrative power to enforce functions and mandates No enforcement of protection laws and penalties **Rd:** Yes **Rs:** No	Mobilization of technical and financial resources	Ministry of Environment and Forestry

Primary legislation	Specific targets not achieved	Formal/Informal aspects (F/I), Readiness (Rd) and Resistance (Rs) to change	Proposed actions	Responsible agent
The Civil Transaction Act, 1984	Regulate transactions and deals of agricultural lands	**F/I:** Agricultural lands are not formally registered **Rd:** Yes, because agricultural production relations are divers and socially bound **Rs:** Yes, there is need to consider water resources in land transactions	Define main actors for land and water use for agricultural production and regulate relation between them	Ministry of Justice Ministry of Water Resources and Electricity Ministry of Agriculture and Forests
Forests and Renewable Natural Resources Act, 2002	Create an organizing and regulating system for forests and renewable natural resources	**F/I:** Enforcement of the Act requires coordination with other concerned Ministries **Rd:** Yes, it conserves natural resources **Rs:** No	Sharing benefits and responsibility between national and State governments	Ministry of Environment Ministry of Agriculture and Foresters

3.3 Policies and Processes

For each of the problems (for each policy) listed in step 2.3, actions to solve them are proposed together with the institutions/actors responsible to implement those actions. This is shown in Table 3.3.

Main identified policies not achieved are:

- Propose mechanism to overcome financial limitations
- Participation of private sector and farmers in water resources and agricultural water services and supplies management
- Increase investment in water harvesting to increase use of rainfall

- Institutional reform of the Gezira scheme
- Electrification of pump schemes
- Involve private sector in marketing and processing of water equipments and tools
- Introduce new technology in data collection and analysis of rainfall, river flows, supplies of agriculture water

Table 3.3- Step 3.3. Action matrix for policies and strategies

Policy	**Specific objective not achieved**	**Reasons behind specific objective not achieved:** **Formal/Informal aspects (F/I), Readiness (Rd) and resistance (Rs) to change**	**Proposed actions**	**Responsible**
Sudan Policy and Strategy on Integrated Water Resources Management TF: 2007	Establishment of a financing mechanism for funding of water resources management functions Promote participation and engagement of the private sector and other stakeholders in service delivery	**F/I:** Multi-users of water resources and overlapping responsibilities **Rd**: Yes, if finance is available for development of water resources. **Rs:** No, pending on availability of finance **F/I:** Lack of economic incentive **Rd:** Yes, if the private sector sees benefit in putting more finance in the water sector **Rs:** No	Encouragement of formal, national, regional and international fund organization to invest in AWM facilities Provision incentives to private sector and set guidelines for service delivery in AWM	Ministry of Water Resources and Electricity (MWRE) Ministry of Agriculture and irrigation Ministry Livestock, Fisheries and Pastures Ministry of Water Resources, irrigation and Electricity (MWRIE) Ministry of Agriculture and irrigation

Policy	Specific objective not achieved	Reasons behind specific objective not achieved: Formal/Informal aspects (F/I), Readiness (Rd) and resistance (Rs) to change	Proposed actions	Responsible
	Enhance creation of additional rain and surface water reservoirs for use Increase better use and management of current and expected development of additional water resources storage	**F/I:** established Dam Unit in the Ministry responsible for water harvesting and haffirs Lack of coordination between the institutes working in this area/topic. **Rd: yes** ..... **Rs:** No, but need to address introduction of modern technologies in irrigation F/I: existence of irrigated schemes with poor management and financial capacity Rd: no, because of conflict	Expand investment in water harvesting in rural areas to enhance food self sufficiency and poverty reduction	Ministry of Water Resources, Irrigation and Electricity Ministry of Agriculture and Forests State Ministries of Agriculture, Livestock and Irrigation Ministry of Social Affairs International organizations and NGOs

Policy	Specific objective not achieved	Reasons behind specific objective not achieved: Formal/Informal aspects (F/I), Readiness (Rd) and resistance (Rs) to change	Proposed actions	Responsible
		of interests of stakeholders Rs: yes as coordination deprives vested interests of certain parties in management board		

National Plan for Development and Utilization of Water Resources TF: 2014	Enhancement of rain and surface water use	**F/I:** Lack of coordination between the institutes working in this area/topic. **Rd:** yes, provided strengthening cooperation among stakeholders on common interests **Rs:** no, provided research and technology transfer is introduced on wide scale	Mobilization of financial resources Strengthening water harvesting technologies and extension services Link production with markets supported by microfinance	Ministry of Agriculture and Forests Ministry of Water Resources, Irrigation and Electricity (MWRIE) State Ministries of Agricultural , Livestock and Irrigation Microfinance Agencies
Interim Poverty Reduction Strategy Paper TF: 2012	Revitalize the agricultural sector, increase its contribution to growth, exports and poverty reduction	**F/I:** Lack of political good will **Rd:** Yes **Rs:**	Coordination between relevant Ministries and institutions and provision of financial resources	Ministry of Finance and National Economy Ministry of Agriculture and Forests
National Adaptation Program of Action (NAPA)	To focus on agriculture, water and health as highest priority areas to enhance food	**F/I:** Lack of government commitment and overlapping	Provision of financial resources and rehabilitation of	Ministry of Environment

TF: 2007	security and sustainable livelihoods	of responsibilities among related institutes **Rd:** Yes **Rs:**	infrastructure	Ministry of Agriculture and Forests Ministry of Health
Sudan National Biodiversity Strategy and Action Plan/ 2013-2020	Main streaming of biodiversity strategy action plan benefits and mitigating losses across formal government agencies and the civil society level at large Improving biodiversity safety measures for preservation of ecosystems, species and genetic diversity	F/I: multiple scattered administrative and consultative institutions in environment and biodiversity Rd: no due to slow handling of environment and bio-diversity issues Rs: yes, takes time to develop awareness and political support		Ministry of Environment High Council for Environment and Natural Resources
Comprehensive National Food Security Policy TF: 2011	Specify optimal water supply and use Raise awareness on crop-water requirements mitigate water-use waste on the environment	**F/I:** Lack of government commitment **Rd:** Yes. **Rs:**	Mobilization of financial resources and coordination between relevant ministries	Ministry of Agriculture and Forests Ministry of Livestock Resources, Fisheries and Pastures Ministry of Finance and

				National Economy
	Evaluate and enhance transfer of improved water-users associations system to other irrigation schemes	**F/I:**Deterioration of irrigation infrastructures at scheme level, which is beyond financial capacity of the farmers **Rd:** .Yes, it enhances the performance of institutions **Rs:** No	Provide technical training and capacity building for WUAs	Ministry of Agriculture and Forests
	generate incentives to promote private sector investment in manufacturing water pumps, drilling equipment, water pipes and tanks, and supplies of spare parts	**F/I** Lack of government commitment **Rd:** Yes, it promotes industry of irrigation water equipment which encourage use of technologies that enhance the efficiency of irrigation water **Rs:** Yes.....	Provide support and credit to private sector to engage in water sector related industry	Ministry of Finance and National Economy Ministry of Industry
Ministry of Agriculture and Irrigation Plan – Irrigation Sector 2015 - 2019	Maintenance of basic irrigation infrastructure Introduction of appropriate technology and control methods for meeting increased demand for irrigation water and reduction	**F/I:** Lack of government commitment to provide financial resources **Rd:** Yes, **Rs:**	Mobilize financial resources and raise funds to rehabilitate irrigation infrastructure	Ministry of Finance and National Economy Ministry of Agriculture and Forests

	of water losses	.....		

STEP 4 - INSTITUTIONAL AND POLICY INDICATORS

An integral part of the tool is the public/donor budget analysis that helps assess policies and programmes introduced in a country in terms of implementation of political commitments towards objectives and targets. Note that the budget was computed as three-year average (2012-2014) and the grants were only made for irrigation infrastructure during the period 2012-2013.

The analysis focuses on two key dimensions of budget analysis, for which different indicators were developed (see table below). These dimensions are:

1. Strategic priorities and political commitment of government and donors

This dimension illustrates the strategic priorities and political commitments assigned by governments and donors to water resources, agriculture water, and hydropower investment in national water policy, national agricultural water policy; and international water resources agreements.

The indicators are used are: a) irrigation projects budget in agricultural public budget; b) irrigation projects budget in total public budget; and c) irrigation projects budget in total irrigation donor budget (IDB);

Results showed that irrigated agriculture accounts for slightly less than two thirds (62percent) of total agricultural public budget, but only 0.4percent of total public budget indicating the very low public expenditures allocated to agriculture. Nonetheless, irrigation infrastructure, which is usually itemized separately in the budget accounted for slightly more than three quarters (76percent) of the agricultural budget and 1percent of total public budget.

In recent years, most irrigated projects experienced deterioration of irrigation infrastructures, which represent a main constraint to agricultural production and the government tried to allocate more expenditures for the maintenance of irrigation infrastructures to boost agricultural production in the country.

Irrigation dams enjoyed high budget because of the government policy to develop hydropower generation in suitable locations in the Nile, but utilization of storage water for agricultural production was not well exploited.

Contribution of donors was very low and confined only to irrigation infrastructure during 2012 and 2013.

2. Efficiency of the public spending in the irrigation and hydropower sectors

This dimension shows the level of decentralization and participation in both sectors (2.1.); as well as the timely utilization of budgetary appropriations (2.2.) as a measure of efficiency of governance and the credibility of public budget.

Actual budget spending for irrigated agriculture is low and represented slightly more than half (54percent) of the planned budget reflecting poor performance of the sector. In contrast, share of actual spending on irrigation dams outweighed the planned spending and recorded about 171percent.

Table 4.1 shows all these indicators for the case of Sudan.

Table 4.1–Institutional and policy indicators		
Dimensions	**Sub-dimensions and indicators**	**Values**
1. Strategic priorities and political commitment of government and donors	✓ Irrigated agriculture budget in agricultural public budget (percent)	62
	✓ Irrigated agriculture budget in total public budget (percent)	0.4
	✓ Irrigation projects budget in total donor budget (percent)	0
	✓ Irrigation dams budget in agricultural public budget (percent)	74
	✓ Irrigation dams budget in total public budget (percent)	5
	✓ Irrigation Infrastructure budget in agricultural public budget (percent)	76
	✓ Irrigation Infrastructure budget in total public budget (percent)	1
	✓ Irrigation Infrastructure budget in total grants budget (percent)	4
2. Efficiency of the public spending in the irrigation and hydropower sector	**2.1. Decentralization and participation**	
	✓ Share of public spending in irrigation by Central government units (percent)	77
	✓ Share of public spending in irrigation by Regional government units (percent)	23
	✓ Share of public spending in irrigation by Local government units (percent)	0
	✓ Share of public spending in hydropower by Central government units (percent)	60
	✓ Share of public spending in hydropower by Regional government units (percent)	40

	✓ Share of public spending in hydropower by Local government units (percent)	0
	2.2. Timely utilization of budgetary appropriations	
	✓ Share of actual spending on planned public spending for irrigated agriculture (percent)	54
	✓ Share of actual spending on planned public spending for irrigation dams (percent)	171

STEP 5 – CONCLUSIONS

The MWRE has the mandate of formulating policies and plans to develop modern and rational management of water resources use. The Ministry is also responsible for drafting the regulations and the provision of service delivery at federal level. The Ministry has two main agencies that deal directly with AWM in Sudan, the Secretariat for Irrigation and the Dams Unit. The former is responsible for AWM in public and private sector irrigated and for water harvesting activities in remote areas away from the rivers.

The MA&F has the mandate of formulating policies and plans that create an enabling institutional environment for sustainable use of land and irrigation water resources in agriculture for producing sustainable food security crops and support poverty alleviation. The Ministry has two specialized units. While one unit deals with AWM and crop production policies and plain in the irrigated sector the other deals with the rain-fed sector production activities.

The public irrigated corporation management boards are responsible for the direct AWM for growing field crops. They have decentralized administration for supply of irrigation water and maintenance of major and minor canals. The WUAs support the irrigation management in distributing water from the minor canals into the farmer field, and in collection of water services charges.

The research institutions Agricultural Research Corporation (ARC), the Animal Resources Research Corporation (ARRC), and the National Centre for Research (NCR), the Hydraulic Research Centre (HRC) station are responsible, among others, for AWM technology development and transfer.

The non-government actors (civil society, private sector, external partners) support AWM activities by participating in WUAs. However, the involvement of these actors in the delivery of water services for irrigation purpose is rather weak.

The regulations of the AWM laws are not updated to mainstream the activities of the different affiliated actors towards fulfilling their objectives. The Irrigation and Drainage Act and the Water Resources Act provide water permits through licensing but had not developed water property rights, water services pricing and penalties on water pollution.

The Gezira Scheme Law (2005) and the Gash Delta Agricultural Corporation Water Users' Act (2004) have proposed the introduction of the decentralized management system into the public corporations, especially the decentralization of irrigation water distribution. The main emphases of those laws were directed towards the establishment of WUAs for the collection of water service charges and the distribution of irrigation water shares from the main and miner canals into the field inlet channels.

The various strategies and plans prescribed AWM related policies aimed to:

- Establish a mechanism for continuous assessment of water resources throughout data collection, storage, analysis, dissemination and monitoring stages.
- Introduce modern technology for collection of the required data such as the GIS, simulation models software, river flows and rainfall gauging advanced system.
- Develop appropriate cost recovery systems and mechanisms to be used in irrigation schemes. The objective of the water services pricing is to promote equitable supply and limiting the waste of used irrigation water.
- Establish norms and procedures for financial sustainability and viability of irrigation schemes through organized collection of the water service charges by enthusiastic and trained water users associations.
- Generate adequate supplies of hydroelectric power to facilitate the substitution of high cost diesel driven irrigation pumps by the low cost electrically driven pumps.
- Increase water harvesting projects to increase the benefits of the use of rainfall water in dry land agricultural production systems.
- Coordinate and establish networks among line ministries and agencies, and between the different departments within ministries and agencies to avoid fragmentation of stakeholder mandates and responsibilities and waste of efforts and funds.

The formulated strategies, plans and policies related to the water resources and agriculture water management could not achieve their targets mainly due to undefined roles and overlapping responsibilities of the ministries. This developed into weak research, ineffective management of production corporations, and poor economic incentive to farmers and civil

service staff. The involvement of the private sector in providing delivery services was weak while the allocations of the development and general budgets were directed towards the construction of irrigation and hydropower generation infrastructures and with insufficient water harvesting irrigation infrastructure in rural areas.

The strategies and plans centred on improving the institutional capacity of water resources development and AWM. These institutions have trained experts in irrigation and crop husbandry but were confronted by high turnover of employees due to low remunerations and incentives of the decentralization policy spreading the limited number of staff all over the states without logistic support or working budgets.

The institutions concerned with water harvesting programs, especially for small producers in agriculture, are fragmented with poor coordination which resulted in ineffective policy implementation and dependency on international organizations and NGOs. The FAO, IFAD, WFP, UNEP and UNDP provided technical and financial support to capacity building, carrying out of situation analysis in area of water related policy-making and management.

Final Action matrix

The final action matrix proposes to organize information gathered through steps 3.1 to 3.3 in a single table listing proposed actions to solve problems with the agricultural water sector according to the institution/actor responsible for its implementation.

Table5.1. – Step 5.1. Final action matrix for AWM in Sudan

Proposed actions	Responsible agents
Political will is needed to support equal access to water resources among regions Stabilize the status of irrigation sector in appropriate situation	Government Cabinet
Study the effect of building new dams in Sudan in light of the current construction of the Ethiopian Resurrection Dam Establish an effective coordination unit with other related ministries and local institutions Develop vertical and horizontal networks and introduce integrated work programs among different departments within the same ministry and with the state ministries and locality offices	MWRIE, MA&F, MFNE, SMAARI, Research Corporations, Farmers Union,

Invest in human capital to strengthen the capacity of the planning and the policy formulation of staff, rural and farming communities; farmers can be trained in business and vocational disciplines	MWRIE, MA&F, SMAARI, Farmers unions, MFNE, Ministry of Labour
▪ Capacity building of AWM related Technical and legal institutions: ▪ Strengthen institutional capacity by providing logistics and supporting labs and tools for carrying out mandated activities ▪ Provide incentives to staff and skilled labor to reduce the high turn over into other jobs ▪ Provide training in planning and policy formulation ▪ Provide training in data collection and analysis o Establish data banks and software memory of seminars, workshops, studies, others ▪ Provide vocational training and design of infrastructure for farmers and skilled labor o Train farmers, water users associations and skilled labor on management, operations and maintenance of water canals, pumps, sprinkler irrigation and water harvesting technologies ▪ Training to build technical capacity of WUAs on management of irrigation at field levels and on group action to provide necessary financial resources ▪ Improve staff capacity on communication skills and networks ▪ Undertake joint research and studies on common water resources development and legal rights allocations, o Strengthen applied research in areas of water harvesting o Participate in workshops and conferences presenting domestic experiences o Carry out consultative visits and exchange of expertise inside country and abroad	MWRIE, MA&F, MFNE, Ministry of Education, Ministry of Labour, Universities, Research corporations, Department of Extension and technology transfer of MA&F , WUAs, private sector
Legal support for AWM: ▪ Revise present laws and regulations to remove overlap and duplications ▪ Introduce new laws that comply with internal and international changes ▪ Continue revising and updating regulations that sustains the effects of the issued laws	MWRIE, MA&F, Ministry of Justice, MFNE, SMAARI
Financial support for AWM: ▪ Mobilize new financial resources ▪ Provide timely adequate budget allocations to facilitate carrying out regular AWM operations and maintenance that keep the institution and public corporations active in achieving their mandates and services ▪ Keep up to date management information system (MIS) on	MFNE, MWRIE, MA&F, SMAARI, Irrigated Agricultural Corporations Managing Boards, Research

budgeting and water accounting for technical and financial planning and M&E purposes ▪ Increase budget allocations to establish more water harvesting projects to cope with growing demands for supplementary AWM in rain-fed areas ▪ Provide funds to carry out surveys on underground water resources	Corporations
▪ Increase water harvesting investments to increase utilization of rainfall and seasonal streams outside the Nile Basin ▪ Establish agricultural water supply services and provide training opportunities for private companies and farmers cooperatives ▪ Establish water harvesting communities to expand up-scaling of the system in large areas under rain-fed conditions	MWRIE, MA&F, SMAARI, Farmers Unions, Community based organizations, NGOs, International Organizations, private sector
Strengthen advisory services with respect to water conservation and improved management and practices	National Council for Water Resources, HCNER
To pilot a selected block in the Gezira Scheme for a complete AWM technical package support	FAO/AgWA
To pilot a selected block in Abu Habil Water Harvesting Project in North Kordofan for a complete AWM technical package support	FAO/AgWA

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Annexes

Government irrigation schemes

Scheme	**Equipped area (ha)**
Gezira and Managil	870750
White Nile pump schemes	192375
New Halfa	152280
Rahad	121500
Blue Nile pump schemes	112590
Gash Delta (spate irrigation)	101250
Northern pump schemes	41715
Suki	35235
Tokar Delta (spate irrigation)	30750
Guneid sugar	15795
Assalay sugar	14175
Sennar sugar	12960
Khashm Elgirba sugar	18225
other areas	132300
Total	**1851900**

Source: FAO AQUASTAT

Private sector irrigated schemes

Private sector	**Type**	**Crops**
Field crops		Ha
White Nile	pumps	12500
Blue Nile	pumps	27000
Main Nile	pumps	152000
Atbara River	pumps	2000
Seleit	pumps	8500

Rajhi	Central pivot	7500
Alwaha Dal	Central pivot	5600
Total		**215100**
Sugar		
Kenana	pumps	34318
White Nile	pumps	8992
Total		**43310**
Grand total		**258410**

Source: FAO AQUASTAT, and the Ministry of Agriculture and Forestry