ADAPTATION FUND BOARD SECRETARIAT TECHNICAL REVIEW OF PROJECT/PROGRAMME PROPOSAL

PROJECT/PROGRAMME CATEGORY: Regular-sized Project Concept

Country/Region: Sudan/Africa
Project Title: ***Increasing flood and drought resilience in Khartoum metropolitan area through integrated urban-rural watershed management, spatial strategies, EWSs and water harvesting***
Thematic Focal Area: **Urban; Integrated Water Resources Management**
Implementing Entity: **UN-HABITAT**
AF Project ID: **SDN/MIE/Water/2018/1**
IE Project ID:
Requested Financing from Adaptation Fund (US Dollars): **$9,982,000**
Reviewer and contact person: **Alyssa Gomes**
Co-reviewer(s): **Katya Kuang-Idba**
IE Contact Person: **Tarek Abdel Monem**

Review Criteria	Questions	Comments	UN-Habitat response
Country Eligibility	1. Is the country party to the Kyoto Protocol?	Yes	
	2. Is the country a developing country particularly vulnerable to the adverse effects of climate change?	Yes. Several vulnerability indices rank Sudan among the most vulnerable to climate change and variability, due to a high dependency on traditional agricultural practices, coupled with non-climate factors, such as protracted social conflict, high levels of poverty and limited access to capital, markets, and technology. Additionally, Khartoum specifically has experienced increased incidences of extreme flooding and drought conditions.	
Project Eligibility	1. Has the designated government authority for the Adaptation Fund	Yes. Dr. Noureldin Ahmed Abdalla, the Secretary General of the Higher Council for Environment and Natural Resources and the DA for the Adaptation Fund has endorsed this concept in a letter dated 29 July, 2018.	

	endorsed the project/programme?		
	2. Does the project / programme support concrete adaptation actions to assist the country in addressing adaptive capacity to the adverse effects of climate change and build in climate resilience?	Yes. However, some clarifications are requested. The project intends to employ an integrated urban-rural watershed approach, considering all catchment areas around Khartoum metropolitan area, urban development patterns and climate change risks and impacts to manage urban flood / water cycles in Khartoum. It aims to manage both flood and drought risks in a comprehensive way, by linking rural (agriculture and cattle) and urban (domestic) water management needs. Concrete adaptation actions are financed, mainly under the third component. These include an up-stream water harvesting system that will also reduce flood impacts in East Nile community (i.e. the most flood vulnerable community in Khartoum) and the establishment of flood early warning systems in communities located downstream of Wadi's that lead to Khartoum. The two dams /water reservoirs are constructed with financing under the third component, while the early warning systems are financed under the first two components. It is mentioned on page 19, the 'whole' water catchment system is required to manage droughts and floods in and around Khartoum city, taking into account upstream water harvesting options, agriculture irrigation and groundwater recharge. Please clarify in the concept proposal, the measures in place for ground water recharge to ensure sustainability of the groundwater resources in this area. **CR 1**	**CR 1:** Groundwater monitoring and water information system in Sudan have been very minimal and suffered huge deterioration over the years because of inadequate finance and capacity. Reduced groundwater recharge in Sudan – either through decreased precipitation or increased temperature and evaporation – has grave repercussions for Sudan. National studies have shown that soil moisture would decline under future climate change. When coupled with increased water consumption, population growth, high variation in rainfall and the high rate of evaporation, a looming water crisis appears likely. Upstream water harvest initiatives are adopted and promoted at national and local levels, especially in areas that suffer from devastating floods, to reduce flood impacts (and associated protection of human beings and their properties), but also to increase water availability during dry season and to increase ground water recharge (through water reservoirs), also during the dry season. A Paragraph is been inserted in part II.A section focused on component 3.

		On page 18 innovation is mentioned in the sense that early warning systems will be established at the settlement/ community level, presumably for the first time and coordinated at the unity/locality level. However, the innovative elements are not clearly demonstrated. Please provide further information on the innovative aspects of the planned interventions and measures that would have the potential to be replicated and scaled up. **CR 2** Please clarify the financial mechanism for micro credit funds (For example: soft loans? grants?). **CR 3**	**CR 2:** During a meeting between UN-Habitat and the AF secretariat it was mentioned that the adaptation fund is looking for innovative approaches / techniques in an urban context, including the establishment of EWSs in informal / unorganized communities. This project tends to set-up EWSs in such context: in communities host for a large part (ex)DPs / newcomers in an area that has still an informal status or has recently been formalized, thus lacking established planning and decision-making structures. The innovation is in setting up planning and decision-making structures in which all groups are able to participate equally and which can be used for more than just setting-up EWSs. As there are many communities in Sudan that host large numbers of (ex)DPs and are informal or to be formalized, there is an opportunity to set up these new and 'open' planning and decision-making structures, thus improving local governance. A Paragraph has been inserted in Part II.A section component 2 **CR 3:** The term 'micro credit funds' has been replaced by 'saving groups.' During consultations with women groups it was suggested that 'women saving groups' could be used for multiple purposed, including for

			intervention maintenance and replication purposes, but the options need to be further explored during the full proposal development phase.
		Elaborate further on how and for what specific purposes the micro-credit funds would be granted? (E.g. Income generation projects, livelihood sustainability, EWS, training for operation and maintenance of physical infrastructure, irrigation and water supply structures) **CR 4** Please clarify the selection process for beneficiaries to receive micro credit funds? (e.g. competitive?). Additionally, would women's groups specifically be the target beneficiaries of these funds? **CR 5**	**CR 4:** see above: this depends on the 'willingness' of women groups but in this project it could be a tool to ensure maintenance and replication of interventions, especially for community level early warning systems but also for upstream water harvesting / irrigation measures **CR 5:** The initiatives would come form women saving groups that are already established. These groups will form the core, together with other representatives from the communities, to select for what purpose the money will be saved. Beneficiaries for micro credit funds will are not relevant bacuse these will not be used
	3. Does the project / programme provide economic, social and environmental benefits, particularly to vulnerable communities, including gender considerations, while avoiding or mitigating negative impacts, in compliance with the Environmental and	Not clear. Economic, social and environmental benefits are outlined in Table 9. The project discusses generating multiple socio-economic benefits by supporting livelihood diversification and increasing income generation among vulnerable groups, particularly women and youth; while supporting increased community resilience and preventing economic losses from damage to physical assets and negative impacts relating to loss of access to basic services during flood conditions. Increasing community awareness of flood impacts, particularly the connection between flooding conditions and health impacts, is also a key expected outcome.	**CAR 1:** Potential environmental and social risks related to proposed activities that have been identified at this stage (concept note) and will be avoided / mitigated, include equal access and benefits of particlulary women, youth and DP groups. These groups are generally not well organized (for more detail see annex 2) and therefore the project will avoid / reduce these potential risks by ensuring equal representation of vulnerable groups, especially women, youth and DPs, but also nomads,

	Social Policy and Gender Policy of the Fund?	**CAR 1:** Please elaborate more fully on the possible negative impacts of the project, and what the potential mitigating actions may be.	during consultations, planning processes and for possible job opportunities. As for the set-up of EWSs, decision-making structures in which all groups are able to participate equally and which can be used for more than just setting-up EWSs, will be established. Based on an initial analysis of the target area and the outcome of the Environmental and Socio-economic Impact study of Wadi Abu Soueid Water Harvesting and Spreading Project in Khartoum State, Sudan,[1] which is close to the target area, other potentially negative impacts include increase in the densities of the noxious Adar (Sorghum sp.) weed and semi-parasitic Buda (Striga hermonthica) plant, security problems (including trespassing on farmland and rangeland by nomadic groups from neighboring areas and animal thefts), and uncontrolled flooding of potentially productive farmland due to neglect of dam maintenance. Mitigation will be put in place to avoid these potentially negative impacts, including a government committed maintenance plan and budget. However, in the case of the proposed project, there are streams that allows to discharge water in case the dam

[1] http://khartoumspace.uofk.edu/handle/123456789/9244

			exceeds its capacity (although unlikely because its will be designed for a 50 year flood event). A paragraph has been inserted in Part II.B
	4. Is the project / programme cost effective?	More information is requested. According to the proposal concept, cost effectiveness is demonstrated in component 1 through the utilization of land use planning strategies, coupled with early warning systems; which together, are a cost-effective way to address climate risks and vulnerability over the long term by avoiding future costs. Under the second component, the emphasis on community ownership is framed as cost effective in the realm of operation and maintenance expenditures, while also promoting sustainability. Under the third component, the construction of dams and water reservoirs is a more cost-effective alternative to relocating existing communities in the East Nile sub-region. Please clarify whether there was a costed alternatives analysis undertaken, and, if so, what other feasible alternatives were considered under components 1 and 2. Please also clarify if there was any additional cost-based rationale on why the activities proposed under components 1 and 2 were ultimately chosen. **CR 6**	**CR 6:** As mentioned in Part II.C alternative intervention to land use planning strategies, coupled with early warning systems to reduce flood impact have been considered, including relocation and infrastructure interventions such as the construction of upstream water harvesting systems, strengthening of drainage channels and construction of resilient houses. Although the construction of upstream water harvesting systems is the most effective way of reducing downstream floods compared to the more costly option of constructing large drainage systems, this has only been prioritized (by the government) for the highly flood vulnerable East Nile sub-region. Due to limited funds, the government then requested to at least warn other flood vulnerable areas from flood events and to reduce urban development in flood prone areas through spatial planning strategies. Relocation has not been considered as a feasible option because this is not in line with the AF ESP compliance.
	5. Is the project / programme consistent with national or sub-	More information requested. While relevant national and sub-national strategies and plans are outlined in Section D and the	**CR 7:** The Sudan Council of Ministers approved the National Communication and NAPA and directed Sudan Higher Council for Environment and Natural

	national sustainable development strategies, national or sub-national development plans, poverty reduction strategies, national communications and adaptation programs of action and other relevant instruments?	concept proposed is in line with numerous UNFCCC-related, and national plans and policies, additional information on how this project will coordinate with the ongoing NAP process would be appreciated. **CR 7**	Resources (HCENR) to coordinate NAPA implementation. Since the HCENR is the Key implementing agency of the project, it will incorporate and coordinate the project with other NAP ongoing project using the already established coordination mechanism. Moreover, the project interventions will be coordinated within the UNDAF - Environment, Climate Resilience and Disaster Risk Management Working Group where UN-Habitat is active member. The Working Group is mandated with coordination among stakeholders on environment and climate change projects/interventions in Sudan. The keg agencies engaged are: UNEP, UNDP, UN-Habitat, IFAD, UNSECO, WFP, UNCEF and FAO in addition to the Government (Ministry of International Cooperation) and line ministries. A Paragraph has been inserted in Part II.D
	6. Does the project / programme meet the relevant national technical standards, where applicable, in compliance with the Environmental and Social Policy of the Fund?	The concept submission indicates that it is in line with AF, ESP, GP, and national technical standards but that additional details regarding relevant rules, regulations, and standards; as well as relevant compliance procedures, will be provided in the full proposal.	
	7. Is there duplication of project /	More information is requested.	**CR 8:** Table 13 has been updated to show the unique nature of this project

	programme with other funding sources?	The information provided in table 13 is well noted, however in table 13, please elaborate on the additionality of the project - please demonstrate any new national policy and legislation, additional economic, social and environmental benefits on the top of all other existing or past projects. This will show that this project is unique and not duplication of any other projects. **CR 8** Please clarify if there exists some coordination, for instance on possible knowledge sharing, and establishing synergies between complimentary activities on projects financed by other funders, such as the GCF and GEF. **CR 9**	**CR 9:** The UNDAF Environment, Climate Resilience and Disaster Risk Management Working Group focusses on, among other: - Contributing to the implementation and coordination of climate change adaptation and mitigation strategies and applying 4Ws tools (who does What Where and when to identify synergy and avoid duplication) with regular and ad-hoc meetings and reporting to RCO and Government on progress and achievements as well as leveraging of environment funding for Sudan (GCF, Adaption Fund, UNREDD, GEF, etc.). - Strengthening disaster risk management (preparedness, response, recovery) and early warning systems at all levels (policy level, community preparedness etc). - Cross-cutting areas: Awareness raising (education), capacity development, information/data and knowledge exchange and management, coordination, gender and youth Above exists coordination mechanism will be used. A Paragraph has been inserted in part II.F

	8. Does the project / programme have a learning and knowledge management component to capture and feedback lessons?	Yes. KM activities are incorporated into each component. Table 14 provides a detailed overview.	
	9. Has a consultative process taken place, and has it involved all key stakeholders, and vulnerable groups, including gender considerations in compliance with the Environmental and Social Policy and Gender Policy of the Fund?	Yes. The concept was developed based on a thorough consultative process, as mentioned on pages 13,14,15 and table 15, 16, and 17 offer a detailed record of participating parties to this process. Additional consultative processes with vulnerable groups, including indigenous peoples, displace people and youth; will be undertaken at full proposal stage. In annex 2, a gender approach and baseline is included. This is termed as a 'work-in-progress' annex, and all details will be provided during the full proposal development phase. At the full proposal stage, please specify details for specific approaches for the involvement of youth and displaced persons (DPs) in project benefits.	
	10. Is the requested financing justified on the basis of full cost of adaptation reasoning?	The proposed concept offers a comprehensive approach for addressing the impacts of the increased climate variability in the target regions, which is outlined in detail in Table 18. The proposed under the first component will allow Khartoum state and municipal government to	

		collect information on drought/flood risks, which will enable more effective planning. Early warning systems do not currently exist for wadis around Khartoum, meaning that communities in it, don't have the capacity to plan for and address climate change. Additionally, local governments don't have the resources and capacity for the needed flood protection infrastructure being financed under this concept proposal.	
	11. Is the project / program aligned with AF's results framework?	Yes. The project is aligned with AF outcomes 2,3,4, and 6. At the full proposal stage, please use quantitative numbers (where possible) to measure and targets and verifications of the project. These numbers will become a benchmark for future project evaluation.	
	12. Has the sustainability of the project/programme outcomes been taken into account when designing the project?	Yes. Project design aims to ensure longer term ex-post sustainability through anchoring activities into existing government programs, strategies, and plans; the rationale behind the sustainability of this project's design is adequately developed for this stage of project development, and can be found on pages 47-49 of the concept proposal.	
	13. Does the project / programme provide an overview of environmental and social impacts / risks identified, in compliance with the	The project is classified as a medium risk Category B project, mainly relating to the proposed infrastructure construction under the third component. Specific concrete interventions have been identified on pg. 19: "*Accurate locations of each dam axis were confirmed and detailed topographic surveys were carried out at each site".*	**CAR 2:** Although the possible dam options can be regarded as large infrastructure interventions, identified potential environmental and social risks and impacts are expected to be reversible to to be avoided / mitigated (see CAR 3, for details annex 2 and

	Environmental and Social Policy and Gender Policy of the Fund?	The dimensions of the dams have been estimated and their locations have been identified. **CAR 2:** Please provide details on how the categorization of the project was conducted that led to assigning Category B to this concept. Even though this is a concept-stage proposal, there is a need to further consider the possible impacts and risks of the choice of the infrastructure solutions being proposed. In particular, the impacts of the two dams proposed for the target geographic area could be considerable. The concept does not definitively rule out some of the social impacts, including resettlement, and environmental impacts appear highly likely. **CAR 3:** Please elaborate on the potential environmental and social impacts/risks of the project, especially with regards to the two dams. Please ensure the risks are fully taken into account.	the following environmental ans social impacts study in an area close to the target area: http://khartoumspace.uofk.edu/handle/123456789/9244 Moreover, the size of the currently discussed dams could be reduced which would result in the proposal of a larger number of small dams. Therefore, because the potential risks and impacts of possible dams reversable or possible to mitigate, the project has been categorized as a category B project. A Paragraph has been inserted in part II.K **CAR 3:** During the full proposal development phase, all environmental and social risks and impacts will be identified, quantified and mitigated. The ministry of Ministry of Environment, Natural Resources & Physical Development is planning to hire a consultant to conduct an environmental and social risks and impact assessment of the proposed dams / reservoirs (or more smaller dams) in line with national technical standards and in compliance with the AF ESP and GP. As per annex 2, any potential risk of resettlement is ruled out. The dams will be constructed on public land where nobody lives. Any (informal) land use, such as for agriculture, will

			be identified and assessed in detail during the the full proposal development phase. Some potential social risks identified during the concept note stage are related to equal access to (irrigation) water and avoidance of social tension to access this water. Mitigation measures will be put in place to reduce these risks. As for potential environmental impacts, these will be assessed in detail (i.e. quantified) during the full proposal development phase. For similar interventions in the Khartoum area no significant negative impacts were identified, except for potential maintenance commitment issues and equal access of water: 'identified negative impacts of the Wadi Abu Soueid Water Harvesting and Spreading Project (see link above) included a significant increase in the densities of the noxious Adar (Sorghum sp.) weed and semi-parasitic Buda (Striga hermonthica) plant, security problems (including trespassing on farmland and rangeland by nomadic groups from neighboring areas and animal thefts), and uncontrolled flooding of potentially productive farmland due to neglect of dam maintenance.' Follow-up activities mitigated these risks. For the proposed project prove of a government committed maintenance

			budget will be provided during the full proposal development phase. Although the proposed dams are government priorities to reduce flood impacts in East Nile and to reduce water scarcity and potential risks and impacts are expected to not be significant (see above and annex 2), the size / dimensions of the proposed dams could be reduced (although not preferred by the government) to reduce any potential environmental and social risks. In this case a larger number of smaller dams / water reservoirs could be proposed. Inputs have been added to Part II.K and annex 2.
Resource Availability	1. Is the requested project / programme funding within the cap of the country?	Yes. The requested amount falls within the 10 million-country cap.	
	2. Is the Implementing Entity Management Fee at or below 8.5 per cent of the total project/programme budget before the fee?	Yes, It is at 8.5%	
	3. Are the Project/Programme Execution Costs at or below 9.5 per cent of the total project/programme	Yes, it is at 9.5%	

	budget (including the fee)?		
Eligibility of IE	4. Is the project/programme submitted through an eligible Implementing Entity that has been accredited by the Board?	Yes. UN-Habitat is an accredited implementing entity accredited by the AF Board.	
Implementation Arrangements	1. Is there adequate arrangement for project / programme management, in compliance with the Gender Policy of the Fund?	n/a at concept stage	
	2. Are there measures for financial and project/programme risk management?	n/a at concept stage	
	3. Are there measures in place for the management of for environmental and social risks, in line with the Environmental and Social Policy and Gender Policy of the Fund?	n/a at concept stage	
	4. Is a budget on the Implementing Entity Management Fee use included?	n/a at concept stage	

	5. Is an explanation and a breakdown of the execution costs included?	n/a at concept stage	
	6. Is a detailed budget including budget notes included?	n/a at concept stage	
	7. Are arrangements for monitoring and evaluation clearly defined, including budgeted M&E plans and sex-disaggregated data, targets and indicators, in compliance with the Gender Policy of the Fund?	n/a at concept stage	
	8. Does the M&E Framework include a break-down of how implementing entity IE fees will be utilized in the supervision of the M&E function?	n/a at concept stage	
	9. Does the project/programme's results framework align with the AF's results framework? Does it include at least one core outcome indicator	n/a at concept stage	

	from the Fund's results framework?		
	10. Is a disbursement schedule with time-bound milestones included?	n/a at concept stage	

Technical Summary	The project concept proposal titled, 'Increasing flood and drought resilience in Khartoum metropolitan area through integrated urban-rural watershed management, spatial strategies, EWSs and water harvesting' aims to achieve its objective as mentioned in the title by taking a comprehensive approach to address flood and drought impacts in Khartoum city and surrounding areas. The project will achieve this through a combination of 1) Khartoum state- and city-level institutional capacity strengthening to plan, develop and manage the above in combined with spatial strategies and the development of early warning systems, 2) Concrete interventions, including an up-stream water harvesting system that will also reduce flood impacts in East Nile community (i.e. the most flood vulnerable community in Khartoum) and the establishment of flood early warning systems in communities located downstream of Wadi's that lead to Khartoum and; 3) Increased community ownership over activities. The project has the following components: **Component 1: Institutional capacity strengthening of Khartoum state and city**, that will focus on increasing the flood and drought resilience of Khartoum city and surrounding areas by integrating flood and drought risks and vulnerability information into strategic plans and early warning systems that consider the 'whole water system' in Khartoum state and municipality. **Component 2: Community-level action planning**, that will focus on strengthening the awareness and ownership of adaptation and climate risk reduction processes and activities in the most flood and drought vulnerable communities through community level action planning. **Component 3: Physical interventions to increase flood and drought resilience of communities**, that will focus on increasing the flood and drought resilience of the most at risk / vulnerable communities and their assets in and around Khartoum. The initial technical review finds that the project concept has been overall well articulated, a clearly defined target areas and group, attempts to involved vulnerable groups to benefit from the project and proposes well-defined integrated measures to meet its objectives. A few clarification requests have been made:

	Corrective Action (CAR): **CAR 1:** Please elaborate more fully on the possible negative impacts of the project, and what the potential mitigating actions may be. **CAR 2:** Please provide details on how the categorization of the project was conducted that led to assigning Category B to this concept. **CAR 3:** Please elaborate on the potential environmental and social impacts/risks of the project, especially with regards to the two dams. Please ensure the risks are fully taken into account. **Clarification Requests (CRs):** - **CR 1:** Please clarify in the concept proposal, the measures in place for ground water recharge to ensure sustainability of the groundwater resources in this area. - **CR 2:** Please provide further information on the innovative aspects of the planned interventions and measures that would have the potential to be replicated and scaled up in other parts of the country. - **CR 3:** Please clarify the financial mechanism for micro credit funds (loans? grants?). - **CR 4:** Elaborate further on how and for what specific purposes the g micro-credit funds would be granted? (Income generation projects? Livelihood sustainability EWS? Training for operation and maintenance of physical infrastructure, irrigation and water supply structures?). - **CR 5:** What would be the selection process for beneficiaries to receive micro credit funds? Would women's groups especially be the targeted beneficiaries of these funds? - **CR 6:** More information is requested regarding whether there was a costed alternatives analysis undertaken and what other feasible alternatives were considered under components 1 and 2; as well as any cost-based rationale on why the activities proposed under components 1 and 2 were ultimately chosen. - **CR 7:** While relevant national and sub-national strategies and plans are outlined in Section D and the concept proposed is in line with numerous UNFCCC-related, as well as national plans and policies, additional information on how this project will coordinate with the on-going NAP process would be appreciated. - **CR 8:** Please elaborate on the additionality of the project - please demonstrate any new national policy and legislation, additional economic, social and environmental benefits on the top of all other existing or past projects. - **CR 9:** Please clarify if there exists some coordination for possible knowledge sharing and establishing synergies between complimentary activities financed by other funders.

Date:	08/17/2018

ADAPTATION FUND

REGIONAL PROJECT/PROGRAMME PROPOSAL

PART I: PROJECT/PROGRAMME INFORMATION

Title of Project/Programme:	Increasing flood and drought resilience in Khartoum metropolitan area through integrated urban-rural watershed management, spatial strategies, EWSs and water harvesting
Country:	Sudan
Type of Implementing Entity:	Multilateral
Implementing Entity:	United Nations Human Settlements Programme
Executing Entities:	National level: - Higher Council of Environment - Ministry of Environment, Natural Resources & Physical Development State level: - Higher Council of Environment Khartoum State - Ministry of Infrastructure Khartoum State - Ministry of Physical Planning Khartoum State Locality Level: - East Nile Locality - Omdruman Locality - Karari Locality Community level: - Sudanese Environment Conservation Society - Popular Committees Institutions: - Sudan Meteorological Authority - University of Khartoum (Water Research Centre)
Amount of Financing Requested:	USD 10 million

Project Background and Context:

Introduction to the problem

According to government priorities,[1] urgent action is required to address the the following:

Adverse climate change related impacts of:

- ☐ Increasing flash floods from mountains / Wadi's (i.e. streams) around Khartoum
- ☐ Increased droughts around Khartoum

Socio-demographic issues:

- ☐ Rapid urbanization (in flood risk areas)
- ☐ Vulnerabe groups, especially informal / poor / refugees being impacted by above

Development-economic issues:

- ☐ Livelihood and assets security issues due to floods and droughts
- ☐ Very limited support from international community

Institutional gaps:

- ☐ No integrated / comprehensive approach to climate change-related flood and drought issues (around Khartoum)
- ☐ Limited capacity to plan Khartoum pro-actcively, taking into consideration flood and drought risks and impacts

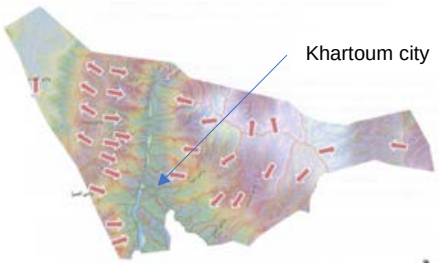


Figure 1. Khartoum state watershed map
Source: Ministry of environment

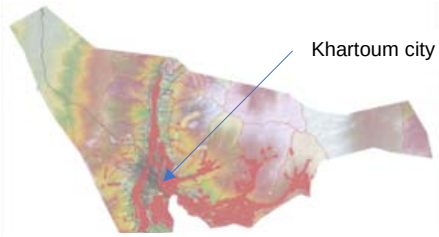
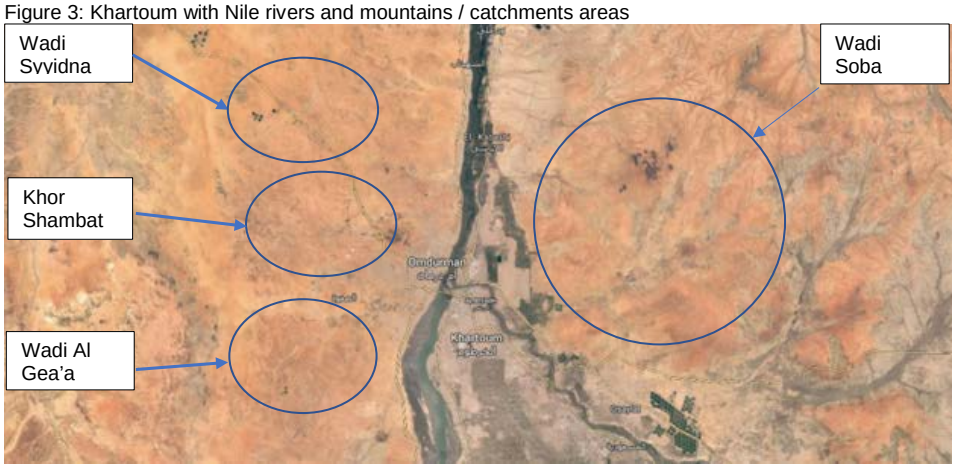


Figure 2: Khartoum state flood area map
Source: Ministry of environment

Approach of the proposal

Figure 3: Khartoum with Nile rivers and mountains / catchments areas



[1] See section D (analysis of national priorities / strategies and section H (outcomes consultations with government stakeholders).

Khartoum metropolitan area is located in a flat area where the Blue and White Nile join and stream from the South to the North. The city is surrounded by mountain areas in the west and east. There are several rainwater catchment areas west and east from Khartoum metropolitan area that form Wadis and Khors (i.e. streams) that stream into the Niles in the city (see figure 1 above). There is limited understanding of the climate change-related flood risks and impacts in these areas, especially taking into consideration rapid urban expansion patterns. For instance, settlements in East Nile locality in Khartoum, were planned and built in a flood plain area, resulting in destructive flood impacts this decade. There is also limited understanding of climate change related drought risks and impacts in these areas, which is relevant for downstream groundwater recharge but also for upstream villages, which depend on agriculture and cattle as main source of income (i.e. livelihood).

An integrated urban-rural watershed approach, considering all catchment areas around Khartoum metropolitan area, urban development patterns and climate change risks and impacts is required to manage urban flood / water cycles in Khartoum in an intergrated manner. This allows managing both flood and drought risks in a comprehensive way, also linking rural (agriculture and cattle) and urban (domestic) water management needs and to further plan the city taking into condideration future climate change-related risks and impacts. For this approach, comprehensive and detailed risks mapping is needed, combined with pro-active spatial / urban planning strategies that take into consideration these risks and urban growth patterns and setting-up early warning systems for floods coming from Wadi's around Khartoum. As flood impacts in East Nile locality is most extreme, concrete flood reduction measures are proposed. This will be done through the the establishment of an up-stream water harvesting system, which will reduce floods, but also provide water in the dry season.

With the renaissance dam under construction in Ethiopia, it is likely that flood patterns and impacts will change for the Blue Nile and Nile after that in Khartoum. It is expected that floods from the river will be reduced but there is a high degree of uncertainty. For this reason, this project will not focus on floods from the river Niles, but on the catchment areas around Khartoum resulting in flash floods during the monsoon season.

Geographic – demographic context

Sudan is the 3rd largest country in Africa. The territory borders South Sudan, six other African nations, and the Red Sea. The majority of the land is composed of vast arid plains interrupted by a few widely separated ranges of hills and mountains. Water resources outside the Nile basin are limited, soil fertility is low, and drought is common. The Nile Basin traverses Sudan, from south to north. The Blue and White Nile converge at the capital, Khartoum. Sudan's current water resources, as well as its ability to harness them, are limited and prone to severe shortage.[2]

Figure 4: Sudan territory
Source: Sudan NAP

The population of Sudan is around 40 million (2016) with an annual population growth of 2.4 percent (2016). The pupulatio is expected to double by 2050.[3] Poverty headcount ratio at national poverty lines was 46,5 in 2010 while 15 percent for

[2] Sudan NAP (2014, p 20)
[3] http://worldpopulationreview.com/countries/sudan-population/

Poverty headcount ratio at $1.90 a day.[4] Sudanese Arabs account for 70 percent of the population of Sudan, with the rest of the population being Arabized ethnic groups of Beja, Copts, Nubians and other peoples. There are more than 597 tribes in Sudan speaking more than 400 dialects and languages. Sudan also has a young population with 41 percent of its total population under the age of 15. 20 percent of Sudanese people are 15 to 24 years old, 31% are between 25 and 54 and just under 4 percent are 55 to 64 years old. The population over 65 years of age is only 3.3 percent. Sudan has a very low median age of 18.9 years.[5]

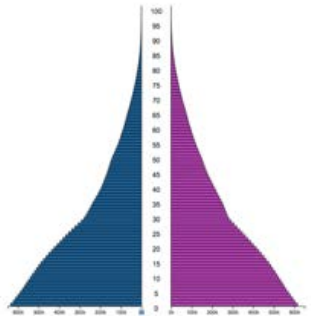


Figure 5: Sudan population peramid

Economic, social and environmental context

'Sudan is burdened with low and economic development and serious environmental problems. In recent years, Sudan has made significant development strides, yet profound poverty and other challenges persist. Factors such as life expectancy, school enrollment, and GDP per capita combine to place Sudan in the low human development category (165 out of 188) of the UNDP Human Development Reporting system.[6] Sudan's major environmental problems are deforestation, overgrazing, soil erosion, and desertification. In arid zones, historic vulnerability to drought has combined with anthropogenic pressures to create a situation of declining soil fertility and water resources, low agricultural productivity, and persistent food insecurity.'[7]

'Traditional subsistence agriculture dominates the Sudanese economy, with over 70 percent of the population dependent upon crop production and / or livestock husbandry to support their livelihoods. Agriculture accounts for about 39 percent of GDP (2016)[8], and is responsible for the vast majority of employment. However, the sector is dominated by small-scale farmers who employ largely rain-fed and traditional practices – which renders Sudan highly vulnerable to climate variability (as seen during past persistent drought), and to anticipated climate change.'[9] The industry sector added value has gone down to 3 percent after indepence of South Sudan, while services have gone up to 58 percent.

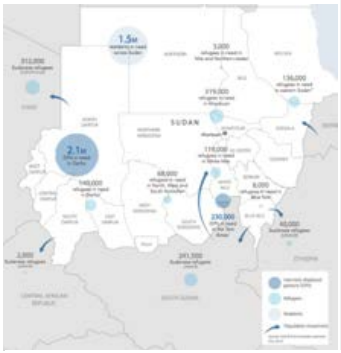


Figure 6: refugees and displaced persons in Sudan

Displaced persons and refugees are especially vulnerable as they are already often in need of food and water and are also at risk of floods, as many reside in areas at risk of floods.

Climate change: observations, projections, impacts and vulnerabilities

'Sudan is highly vulnerable to climate change and climate variability, predominantly a result of climatic and non-climatic factors. These factors, in addition to the interaction of other multiple stresses such as ecosystem degradation, complex disasters and conflicts, and limited access to

[4] https://data.worldbank.org/country/sudan
[5] http://worldpopulationreview.com/countries/sudan-population/
[6] http://hdr.undp.org/en/countries/profiles/SDN
[7] Idem
[8] https://data.worldbank.org/country/sudan
[9] Sudan NAP (2014, p 21)

capital, markets, infrastructure and technology, have all weakened people's ability to adapt to changes in climate.

Climatic factors constitute, above all, temperature increases and infrequent precipitation. Sudan's Second National Communication (2013) illustrated that air temperatures have been steadily increasing over the period 1960 – 2009, with temperature increases between 0.2°C and 0.4°C per decade for the periods March – June and June – September. When averaged across all seasons, temperatures in the 2000-2009 periods are roughly between 0.8°C and 1.6°C warmer than they were in the 1960 – 1969 period. Rainfall is also very variable and is becoming increasingly unpredictable. During the period 1981 – 2012 the rainfall in the whole country was significantly decreased compared to 1971 – 2000.

Figure 7: future increasing temperature

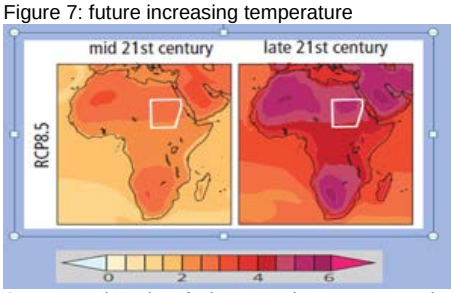
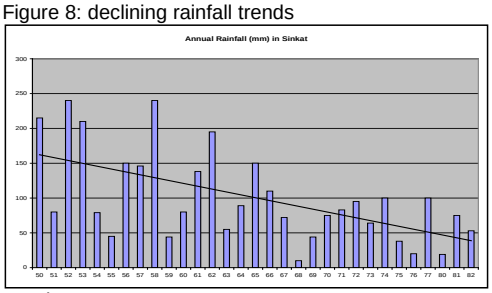
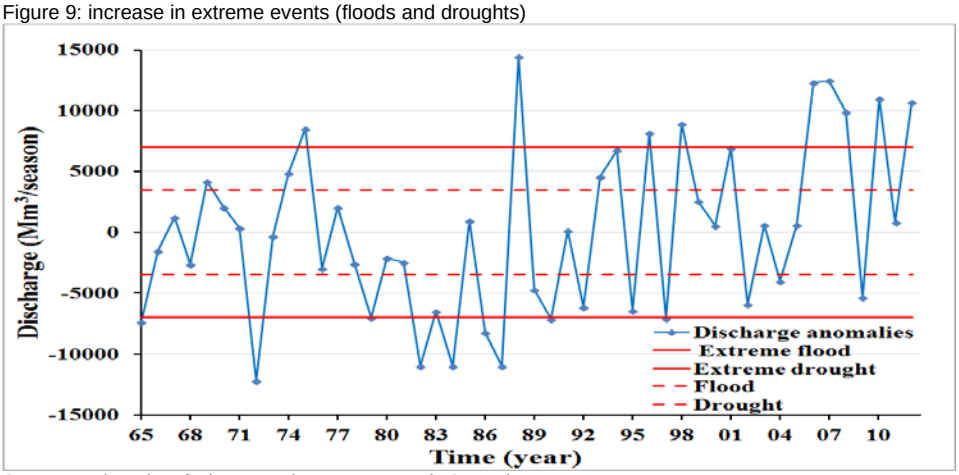


Figure 8: declining rainfall trends



Source: University of Khartoum (Water Research Centre)

Figure 9: increase in extreme events (floods and droughts)



Source: University of Khartoum (Water Research Centre)

Both the Second National Communication (2013) and the National Adaptation Plan (2014) illustrated that the frequency of extreme climatic shocks is increasing, particularly drought and floods. Frequent drought threatens about 19 million hectares of rain-fed mechanized and traditional farms, as well as the livelihoods of many pastoral and nomadic groups; more than 70 percent of Sudan's population's livelihood depends on these sectors. Floods in Sudan can either

be localized caused by exceptionally heavy rainfall or more widespread, caused by the overflow of the River Nile and its tributaries.

Non-climatic factors that contribute to the vulnerability of communities in different parts of Sudan include unsustainable management of natural resources, and socio-economic factors such as poverty, lack of income diversity, unequal distribution of income, urbanization, population growth, and lack of adequate infrastructure, and lack of international support and investments.' [10]

Table 1: extreme weather and climate events in Sudan: types, frequency, sectors affected and impact categories

Event	*Occurrence*	*Vulnerable areas*	*sectors*	*Impacts*
Drought	Frequent	North & Western Sudan (North Kordofan and Darfur), Kassala State and some parts of the rain-fed areas in central Sudan.	Agriculture, livestock, water resources and health.	Loss of crops and livestock (food shortage), decline in the hydroelectric power, displacement wildfire.
Floods	Frequent	Areas within the River Nile basin and low areas from extreme South to far North. Mountain areas along Red Sea.	Agriculture, livestock, water resources and health.	Loss of life, crops, livestock; insects & plant diseases, epidemic/vector diseases, decline in hydro power; damage to infrastructure & settlement areas
Dust storms	Frequent	Central and northern parts of Sudan	Transport (aviation and land traffic)	Air and land traffic accidents and health.
Thunder - storms	Infrequent	Rain-fed areas throughout all Sudan	Aviation	Loss of lives and properties.
Heat waves	Rare	Northern, central parts of Sudan besides the Red Sea State.	Health, agriculture & livestock.	Loss of live, livestock and crops.
Wind-storms	Rare	Central and north central Sudan	Settlements and service infrastructure	Loss in lives, property; damage to infrastructure (electricity and telephone lines)

Source: Government of Sudan (2013) Sudan's 2nd national communication

The greatest climate change-related risks and impacts threatening Khartoum State are those caused by changes and fluctuations in temperature and precipitation, resulting in droughts and desertification, heavy intermittent seasonal rain and flash floods coincides with the periodic flooding of the Nile. According to the manager of Emergency Room, the average annual rainfall is 121 mm based on previous records but by mid-August 2014, 600 mm rainfall was recorded. This high intensity of rainfall caused flashfloods and wide water flow which was over the drainage capacity. The eastern Sahel, in which Khartoum is located, is very likely to experience decreases in annual precipitation, which can threaten the water and food security of the capital. Furthermore, temperature increases can exacerbate drought conditions.

Floods Impacts and events in Khartoum

In recent years, Khartoum experienced recurrent episodes of severe flooding, including from the expansion from the river Nile and rainwater / stormwater running down from the mountain areas (see figure 10). People living in low-laying areas or upstream floodplains in (ex)informal settlements are most vulnerable, especially the poor, often (ex-)DPs. Recent flood events that caused significant damage to houses and infrastructure, but also displacement and death, include the floods of August 2009, 2013, and 2014. Floods in 2009 affected 22,291 homes in primarily urban informal settlements in Khartoum and caused damage to critical water and sanitation systems. Khartoum was the most heavily affected state by the 2013 floods that affected nearly half a million people nationally (with over 184,000 in Khartoum). In 2014, heavy rains from

[10] Government of Sudan (2015, p 3) INDC

July to September resulted in floods that affected over 32,000 people in Khartoum, killing seventeen.

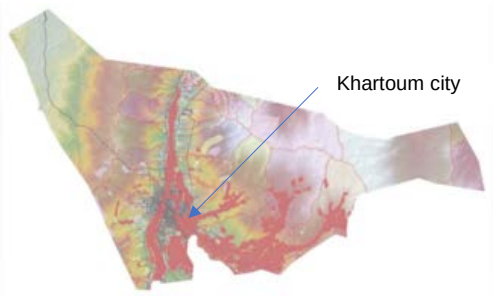


Figure 10: Khartoum state flood area map
Source: Ministry of environment

East Nile (Sharg Elneil), Omdurman and Karari localities, out of Khartoum seven localities, are the most vulnerable areas for floods.[11] During the 2013 floods, tens of villages were completely washed away and thousands of villagers became homeless; over 25000 houses were affected, including over 15,000 completely destroyed, which is unprecedented in the history of Sudan (see table 2 below). In particular, Eastern Nile locality and Karari locality were hit hard. These areas host vulnerable populations, most of whom are living below the poverty level. While flooding occurs in these areas annually, the government does not have the capacity to address the problems.

Table 2: 2013 flood impacts in Khartoum State

No. of affected households	People		Houses Destroyed		Schools	Affected Service Utilities			
	Deaths	Injuries	Totally Destroyed	Partially Destroyed		Home latrines	Public Latrines	Health Centres	Water Stations
25,676	31	44	15,089	12,965	222	17,048	80	20	18

Source: Humanitarian Aid Commission (HAC)

According to the analysis of the planning team of Road, Bridge and Drainage Corporation (RBDC) at the Ministry of Infrastructure and Transportations of Khartoum state,[12] the main causes of floods in Khartoum is drainage issues. In particular, natural water streams from the mountains are blocked by newly developed urban area and roads without proper drainage system based on poor planning and lack of knowledge about geographical characters, including flood risks. Similarly, building houses in floodplains without consideration of room for river or runoff in the city, cause inundation and damage of houses and properties. According to Road, Bridge and Drainage Corporation, spatial planning considering flood risks and resilient housing construction is a major technical and institutional challenge for urban development and flood management authorities. Therefore, the recent floods can be linked not only to intensified rainfall related to climate change, but also to the urban planning challenges. Many factors influence vulnerability such as lack of early warning and line of communication, population density and poverty.

Drought impacts and events around Khartoum

Upstream in East Nile Locality, floods and droughts both result in crop failure and death of livestocks. During the dry season between March – June, with relative humidity reaches as low as 8 percent, and tempreture reachs on average over 40º C, the area suffers severly from shortage of water for livelihood (livestock and agriculture) subistituted by using water tankers which is unaffordable for many of them and therefore, they are forced to move with their animals to other places fetching for water and grazing areas. The traditional crop and livestock production systems share common characteristics in the sense that: (i) they both evolved as specific forms of adaptation to prevailing environmental condition; (ii) both systems were founded on common property customary land tenure arrangements (administer by the local leaders (Sheikhs) and

[11] See section D (analysis of national priorities / strategies and section H (outcomes consultations with government stakeholders).
12 UN-Habitat impliminted flood project in Khartoun 2015

popular committees; (iii) both are essentially rainfall-based activities; (iv) both systems are based on low level of technological input; and (v) low level of productivity and yields which is particularly conspicuous in the farming sector.

Target areas and population

Based on research and outcomes of consultations with the government and other stakeholders,[13] the projects main focus will be on upstream water harvesting in East Nile Locality to reduce floods and drought impacts upstream and to reduce flood impacts downstream. Besides that flood (from Wadi's) early warning systems will be established in Karari Locality and Omburdman Locality. As for Watershed and spatial planning strategies, the project will focus on Khartoum state as a whole and Khartoum metropolitan area within it.[14] (see figure 3).

East Nile Locality

Figure 11: 2013 flood impacts in Al Kariab and Al Marabie - East Nile (Sharq Elneil)

Figure 12: floods impacts north of upstream village Elsheikh Alamin (31 July 2018) and natural grazing area between ElSheikh Alamin and Elbayadat cluster of villages - 31 July 2018

[13] See section D (analysis of national priorities / strategies and section H (outcomes consultations with government stakeholders).
[14] http://worldpopulationreview.com/countries/sudan-population/

Figure 13: Wadi Soba catchment area. For detailed info about flood risks see annex 3.

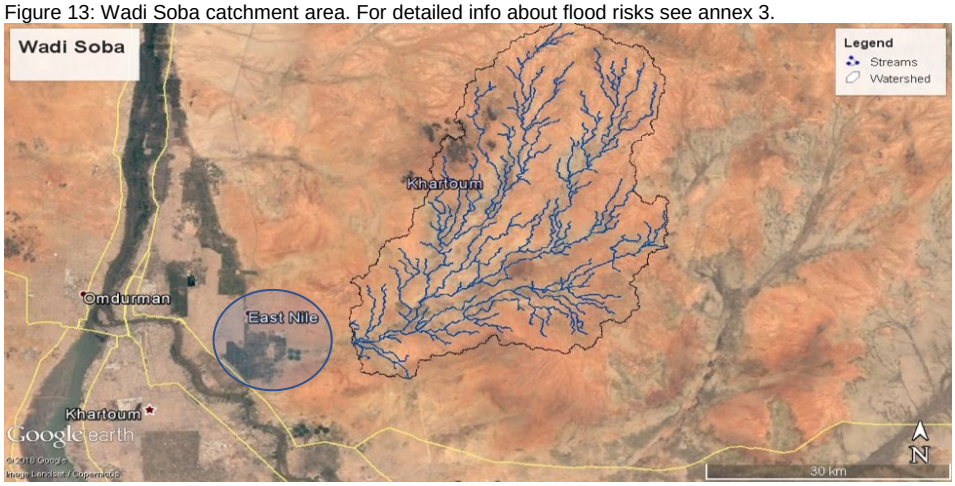


Table 3: East Nile target area and disaggregated data (for concrete intervention under component 3)

Target area	Total	Women	Children (<15)	Youth (15-24)	Elderly (>60)	Dis-abled	In-formal	(Ex-) DPs	In-digenous
East Nile Locality	1,078,498	575,062	459,440	212,464	301,198	32,354	5%	45%	22%
Soba Sharq Administrative unit	113,433	56,081	57,352	22,346	11,003	3,630	3%	7.5%	17%
El Kariab (down)	28.500* (5.7 / HH)	49%	42%	20%	10%	5 %	Formalized	30%	18%
El Marabie (down)	26.370* (6 / HH)	50%	42%	20%	10%	4 %	Formalized	0%	10%
Elshiekh Alamin (upstream)	7200	50%	43%	20%	10%	2%	0	0	3%
AL Bayada (upstream)	3600	50%	45%	18%	8%	3%	0	0	0

Source: community and focus group consultations (see annex 1)

East Nile Locality, located downstream of Wadi Soba, is considered to be the most flood prone area in Khartoum. Due to the extreme flood impacts (see info above), concrete flood reduction measures are required. This will be done through the establishment of an up-stream water harvesting system, which will reduce floods, but also provide water in the dry season for settlements located upstream. To understand flood impacts and community and vulnerable groups needs, consultations were conducted in two settlements (i.e. communities), namely, El Kariab and El Marabies, which are the most flood prone settlements located in Soba Adminstrative Unit of East Nile Locality, which also includes Al Huda settlement as target area under this project. Besides that, consultations were held in one 'upstream' settlements (i.e. villages) which is dependend on water for the inhabitants' income / livelihood (i.e. agriculture and cattle). The village Elsheik Alamin (and dual-village Bayadat) represents communities that suffer

from droughts in Soba East Adminstrative Unit in East Nile locality. The villages of Um Ketra and Um Ushyra are also targeting under this project (and consultations there will be conducted during the full proposal phase. For an overview of total beneficiaries per activity see Part II.C.

The total area of the East Nile locality is about 8,188 km² which is equivalent to one-third of the Khartoum State total area. Land uses in east Nile Locality include agricultural (55.4 percent) residential use (32.4 percent), commercial (6 percent), service (4.2 percent) and finally industry (2 percent). The total area for agriculture is 300,874 feddans[15] of which 221,338 (73.57 percent) are rainfed-based traditional agriculture and 3536 Feddans grazing areas.[16]

Consultations with the Popular Committees and Women Groups in downstream El Kariab and El Marabie, which are within the target area of East Nile locality, revealed (see annex 1) that the recurrent floods in 2007, 2013 and 2016 resulted in destruction of houses, loss of properties, cases of death, shortage and contamination of drinking water, death of animals, bites of scorpios and snakes and the lack of vaccines. There are some constraints and barriers for communities and groups to cope with disasters, including inability of communities to organize and mobilize its members due to lack of effective structures, lack of skills and knowledge related to the process of rescue, lack of community-based early warning and emegency action plan and budget, weak verical and horizontal coordination and communication, shortage of information before, during and after floodslack of proper planning for residentail areas as some areas are prone to floods, The magnitude of the floods were beyond the capacity of local community (reached two meters) which called for an external support in term of rubber boats and small ferry boats to rescure vulnerable groups in addition to high level of poverty and unemployment rates. Youth action groups were active during the flood period to provide support and rescue for the affected people in East Nile Locality and other affected parts of Khartoum state, They are active on Facebook and other social media to communicate with the rest of society to publicize and disseminate information about the disaster. The groups include, but not limited to: Merciful initiative; Luster initiative; Unique Lace initiative; Emergency Road initiative and life makers initiative. Women, children and elderly are expecially vulnerable to flood impacts because of mobility issues, closure of schools, related health issues and costs. Barriers to adapt include lack of knowledge and skills and limited options to participate in planning and decision-making. As for some DPs, of which some indigenous groups, in formalized areas, planning and decision-making structures are lacking.

The consultations urge to implement needs in the forms of infrastructure and capacilty building with respect to flood reduction and water supply measures, strenthen community knowledge, skills and organizational and planning capacities, development of early warning and monitoring system and creation of an emergency room at community level and strenthen vertical and horizontal coordination and communication. Moreover, women and youth could be targeted for trainings and setting up and management of early warning sysems. The women unions have strong solidarity and working together through women group savings (locally called Sanduq) on a rotational manner.

Consultations with the Popular Committees and Women Groups in upstream village Elsheik Alamin and dual-village Al Bayada, revealed (see annex 1) that inhabitants increasingly suffer from floods, droughts and diseases and that especially animals are affected by the droughts. The latest flood impacts were in 2013 and 2016, which also led to increase in diseases. Floods led to death of animals, damage to farms, cut-off of the transportation and difficulties to sustain business

15 = 0.42 hectares = 1.038 acres
16 Ministry of Agriculture annual report 2009

between the villages and capital of the locality and drop-out of students. The villagers seem to be limited in their adaptation efforts because of weak disaster related communication, lack of emergency plans and lack of skills and knowledge. Besides that, health and sanitation services are of low quality. Adaptation measures proposed by the villagers include (among others): the Construction of small dam north-east of the village at one of the tributaries of Wadi Soba, Rehabilitation and improvement of community existing Hafir (water reservoir as the underground water is salty, Introduction of water saving technology for irrigation from expected water reservoir behind the dam taking into account the high evaporation during dry season, Introduction of Women income generation activities and capacity building of popular committee and youth in flood disaster (prepareness and management).

The population census in 2008 showed that 49 percent of migrants in Sudan have migrated to Khartoum. Most of the population are vulnerable in terms of income level as the majority of them came from other States to Khartoum due to natural disasters of drought and desertification and armed conflicts and also for the purpose of education and improving living conditions. The most vulnerable segments in urban community are the new migrants, displaced persons, women and children, and increasing numbers of young people. Most of indigenous groups are from Darfur, Nuba Mountain in Kordofan and Nubian from North Sudan. Almost, most of the indigenous groups are fully integrated in the urban fabric by process of re-planning of informal settlements and provision of secured land title to their home and socially and ecomically integrated by having engaged in the local economic activities as casual labour, self-employment and jobs in private and public sectors.

Karari Locality

Karari Locality is located downstream of Wadi Syyidna, Khor Shambat and Khor Omer. Due to flood impacts (see info above), flood early warning systems are needed. To understand flood impacts and local needs, consultations were conducted in El Fateh settlement, which is part of El Fateh Adminstrative Unit. The project also targets Al-Thowrat (blook 22 and 23), in which consultations will be conducted during the full proposal development phase.

Table 4: Karari target area and disaggregated data (for establishment of early warning system)

Target area	Total	Women	Children (<15)	Youth (15-24)	Elderly (>60)	Disabled	Informal	Ex-DPs	Indigenous
Karari Locality	1,293,195	659,529	55,605	254,759	125,431	49,141	3%	12%	11.7%
El Fateh Adminstrative Unit	86,332	44,893	37,123	17,180	8,374	3,885	0	95%	29%
El Fateh	53,632	27,889	23,062	10,136	5,202	2,413	0	97%	34%

Source: community and focus group consultations*

The area is disposed to rainfall disasters. It is a densely populated area whose inhabitants are of mixed tribal origin, the majority of whom are low-income groups. Most were originally displaced persons (DPs) in Khartoum prior to their transfer to the present location. The causes of their original displacement vary between drought, desertification and conflicts. The dominant type of work in El Fateh area is self-employment and casual labor. Poverty is rampant and exceeds 70 percent. Only 48 percent of housholds is connected to piped water while 52 percent depend on water vendors at exetemly high price for inferior water. There is no electricity depite some electric poles fixed on main streets. The majority of houses (over 80 percent) is built of mud. 70 percent

of group members in El Fateh had no previous experiences with floods. Communication in the pre / during disaster period was through different means of mass media (radio, and TV) and few through modern means of communication such as cell phones. It was found by the Disater Magement and Refugee Studies Institute (DIMARSI) in focus groups discussion in El Fateh that the damages in the area were due to weakness of the buildings, lack of coordination between governmental authorities in containing the disaster, and bad drainage systems. The most vulnerable groups are children, women, elders and handicapped for the same reason as in East Nile.

Omdurman Locality

Figure 14: Houses Destroyed and Neigbourhood inundated with flood – West Omdurman in 2014

Omdurman and Karari localities are located downstream of Wadi Syyidna, Khor Shambat and Khor Omer. Due to flood impacts (see info above), flood early warning systems are needed. To understand flood impacts and local needs, consultations were conducted in El Fateh, which is part of El Fateh East Administrative Unit of Karari Locality. Consultations in all target communities Al Salha and Al Gea'a will be conducted during the full proposal development phase.

Table 5: Omdurman target area and disaggregated data (for establishment of early warning system)

Target area	Total	Women	Children (<15)	Youth (15-24)	Elderly (>60)
Omdurman Locality	698,900	345956	298731	137683	67793
Al Salha	25,000	12,625	11,250	4,950	2,150
Al Gea'a	13,810	6,960	6,213	2,679	1,119

Source: community and focus group consultations*

Project / Programme Objectives:

Overall objective:

Increasing flood and drought resilience in Khartoum metropolitan area through integrated urban-rural watershed management, spatial strategies, EWSs and water harvesting.

Sub-objectives:

1. Increase institutional capacity of Khartoum state and municipal government to increasing the flood and drought resilience by integrating risks and vulnerability information into strategic plans and warning systems that consider the 'whole water system' in Khartoum state and municipality.

   (In line with AF Outcome 2: Strengthened institutional capacity to reduce risks associated with climate-induced socioeconomic and environmental losses).
   (In line with AF Outcome 7: Improved policies and regulations that promote and enforce resilience measures).

2. Strengthened awareness and ownership of adaptation and climate risk reduction processes and activities in the most flood and drought vulnerable communities through community level action planning and establishment of early warning systems

   In line with AF Outcome 3: Strengthened awareness and ownership of adaptation and climate risk reduction processes at local level
   (In line with AF Outcome 6: Diversified and strengthened livelihoods and sources of income for vulnerable people in targeted areas).

3. Increasing the flood and drought resilience of the most at risk / vulnerable communities and their assets in and around Khartoum through physical interventions

   (In line with AF Outcome 4: Increased adaptive capacity within relevant development and natural resource sectors)

Project Components and Financing:

Table 6: project components and financing

Project Components	Expected Outcomes	Expected Outputs	Amount (US$)
1. Institutional capacity strengthening of Khartoum state and municipal government	1.1. Increased government capacity to reduce flood risks and increase resilience to drought of all Khartoum inhabitants and surrounding villagers through integrated urban watershed management 1.2. Increased government capacity to avoid development and housing in flood-risk areas and to plan and manage development in safe places through spatial planning strategies 1.3. Increased capacity to predict floods and warn inhabitants downstream of Khartoum State's Wadi Soba (East Nile Locality), Wadi Syyidna (Omdurman Locality) and Wadi Syyidna, Khor Shambat and Khor Omer (Karari Locality)	1.1. One Khartoum state / metropolitan area integrated urban-rural watershed management strategy focused on drought (i.e. water supply) and flood resilience, including trainings conducted and knowledge products produced that can guide other state and municipal governments 1.2. One Khartoum metropolitan area spatial / urban strategy focused on flood and drought risks and vulnerability and risk maps produced, including trainings conducted and knowledge products producted that can guide other municipal governments 1.3. Three wadi early warning systems established (Locality level) in flood zones of Khartoum Wadi's and integrated into Khartoum city flood warning system, including trainings conducted and knowledge products produced that can guide other institutions	476,000 400,000 450,000 1,326.000
2. Community-level action planning	2.1. Increased awareness, ownership and community-level capacity to develop, operate and maintain interventions in target communities	2.1. Seven downstream community-level early warning systems established, including practical knowledge products produced 2.2. Eleven community plans developed, and community members (especially women and youth) trained to operate and maintain early warning systems and water supply / irrigation systems (in support of livelihoods) 2.3. Community members trained in seven downstream communities to construct flood resilient and environmentally friendly houses, including practical knowledge products produced	400,000 600,000 200,000 1,200,000
3. Physical interventions to increase flood	3.1. East Nile Locality and especially Soba Sharq Administrative unit (and	3.1. Two dams / water reservoirs constructed up-stream of Wadi Soba, leading to upstream villages	5,800,000

and drought resilience of communities	El Kariab, El Marabi and ElHuda within it) protected from floods 3.2. Inhabitants of East Nile Locality and especially East Soba Adminstrative Unit in Rural area such Elsheik Alamin, Al Bayada and Um Ketra villages in the Upstream have increased the resilience of their livelihoods (agriculture, cattle)	water and livelihood security and downstream communities flood reduction, including technical knowledge products produced	
Total			8.326.000
4. Project/Programme Execution cost			874.000
5. Total Project/Programme Cost			9.200.000
6. Project/Programme Cycle Management Fee			782.000
Amount of Financing Requested			9.982.000

Projected Calendar:

Table 7: project calander

Milestones	Expected Dates
Start of Project	August 2019
Mid-term Review (if planned)	
Project/Programme Closing	August 2023
Terminal Evaluation	

PART II: PROJECT / PROGRAMME JUSTIFICATION

A. Project components

In order to achieve the overall project objective, to 'increasing the flood and drought resilience in Khartoum metropolitan area through integrated watershed management, spatial strategies and Early Warning Systems,' the project takes a comprehensive approach to address flood and drought impacts in Khartoum city and surrounding areas. As suggested by the Ministry of infrastructure and transportation and a representative of Khartoum municipal government[17], an approach that looks at the 'whole' water catchment system is required to manage droughts and floods in and around Khartoum city, taking into account upstream water harvesting options, agriculture irrigation and groundwater recharge and downstream drinking water supply, flood reduction options and urban expansion and population growth trends.

The project will achieve this through a combination of 1) Khartoum state- and city-level institutional capacity strengthening to plan, develop and manage above in combined with spatial strategies and the development of early warning systems, 2) concrete interventions, including an up-stream water harvesting system that will also reduce flood impacts in East Nile community (i.e. the most flood vulnerable community in Khartoum) and the establishment of flood early warning systems in communities located downstream of Wadi's that lead to Kahrtoum and 3) increased community ownership over activities.

A specific approach to respond to the needs of women and youth will be taken while also considering the needs of other vulnerable groups such as DPs. This is achieved through a 'gender' baseline and approach (see annex 2) which requires a data baseline and the engagement of representatives of these groups in consultations – and where groups are formed and sustained throughout all stages of the project and through which communities participate in project implementation: in planning and executing activities and monitoring. Below, the rationale for the need of the different components is discussed.

Component 1: Institutional capacity strengthening of Khartoum state and city

In line with AF outcomes 2 and 7 and Sudan government priorities (see Part II.D), this component will focus on increasing the flood and drought resilience of Kahrtoum city and surrounding areas by integrating flood and drought risks and vulnerability information into strategic plans and early warning systems that consider the 'whole water system' in Khartoum state and municipality by developing:

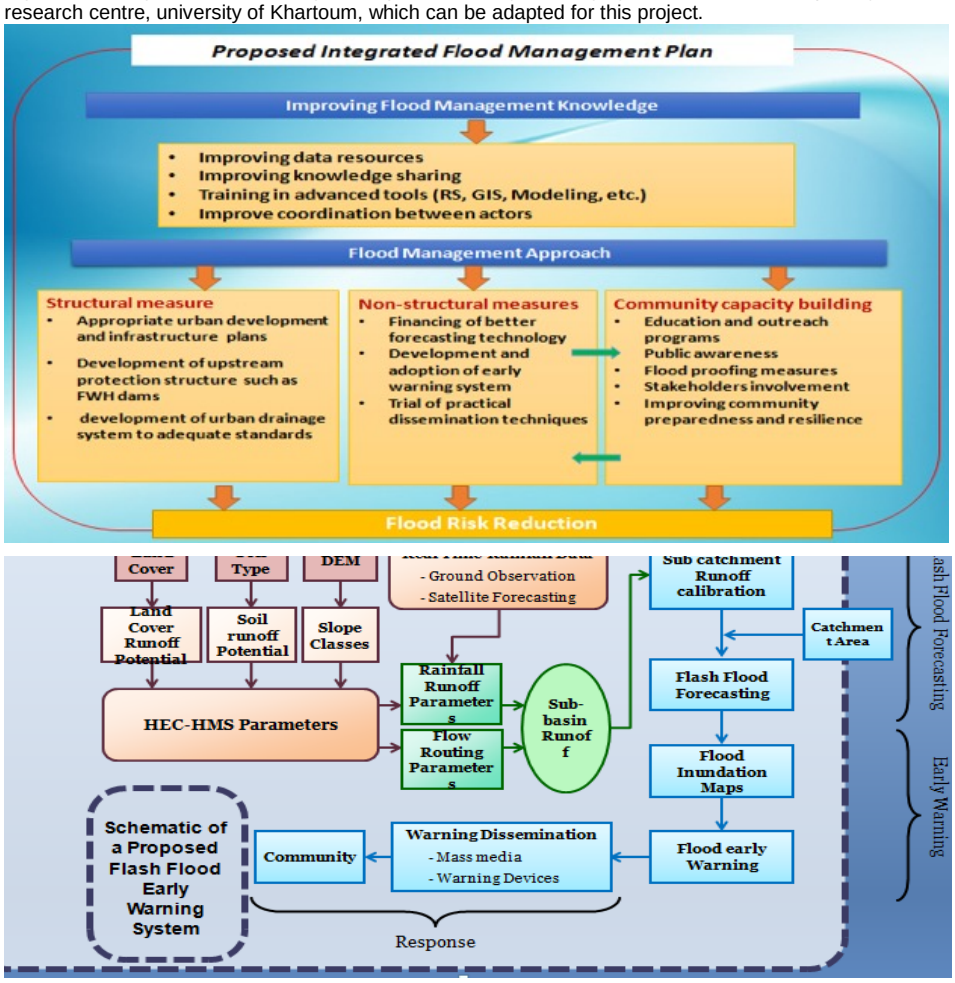
1.1. One Khartoum state / metropolitan area integrated urban-rural watershed management strategy focused on drought (i.e. water supply) and flood resilience, including trainings conducted and knowledge products produced that can guide other state and municipal governments
1.2. One Khartoum metropolitan area spatial / urban strategy focused on flood and drought risks and vulnerability and risk maps produced, including trainings conducted and knowledge products producted that can guide other municipal governments

[17] See part II.H

1.3. Three wadi early warning systems established (Locality level) in flood zones of Khartoum Wadi's and integrated into Kahrtoum city flood warning system, including trainings conducted and knowledge products produced that can guide other institutions

The information generated under above outputs will allow Khartoum state and municipal government to reduce flood risks and increase resilience to drought of all Khartoum inhabitants and surrounding villagers. It will also increased capacities to avoid development and housing in flood-risk areas and to plan and manage development in safe places. For the Localities downstream of Wadi's that are at risk of floods, flood early warning systems will be established. In short, this component is required to produce the lacking flood and drought risks information in and around Khartoum and to use this to develop a comprehensive response.

Figure 15: Integrated flood management plan and early warning system models developed by Water research centre, university of Khartoum, which can be adapted for this project.



Component 2: Community-level action planning

In line with AF outcome 3 and 6 and government priorities (see Part II.D), this component will focus on strengthening the awareness and ownership of adaptation and climate risk reduction processes and activities in the most flood and drought vulnerable communities through community level action planning by:

2.1. Establishing seven downstream community-level early warning systems, including practical knowledge products produced.
2.2. Developing eleven community plans, and community members (especially women and youth) trained to operate and maintain early warning systems and water supply / irrigation systems (in support of livelihoods).
2.3. Training of community members in seven downstream communities to construct flood resilient and environmentally friendly houses, including practical knowledge products produced

The above outputs produced will increase the awareness, ownership and community-level capacity to develop, operate and maintain interventions in target communities. This is required to ensure interventions respond to community and vulnerable groups needs and to sustain interventions and livelihoods. Early warning systems will be established at settlement / community level and coordinated with at the unit and Locality level. This activity is rather innovative; the target communities host for a large part (ex)DPs / newcomers in an area that has still an informal status or has recently been formalized, thus lacking established planning and decision-making structures. The innovation is in setting up planning and decision-making structures in which all groups are able to participate equally and which can be used for more than just setting-up EWSs. As there are many communities in Sudan that host large numbers of (ex)DPs and are informal or to be formalized, there is an opportunity to set up these new and 'open' planning and decision-making structures, thus improving local governance. The community plans will focus on operation and maintainance arrangements for the early warning systems but also for upstream water harvesting / irrigation measures. As suggested by women groups,[18] women saving groups could be used for maintenance and replication purposes, but this need to be further explored during the full proposal development phase. The flood prone target settlements have been identified through consultations.[19]

Deleted: because the settlements consists of large groups of (unorganized) ex-informal DPs

Deleted: revolving micro-credit funds

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Component 3: Physical interventions to increase flood and drought resilience of communities

In line with AF outcome 4 and government priorities (see Part II.D), this component will focus on increasing the flood and drought resilience of the most at risk / vulnerable communities and their assets in and around Khartoum by:

3.1. Construction of Two dams / water reservoirs constructed up-stream of Wadi Soba, leading to upstream villages water and livelihood security and downstream communities flood reduction, including technical knowledge products produced.

The above intervention will reduce flood impacts on the most flood-at-risk East Nile settlements while enhancing water availability to sustain livelihoods of upstream vllages and recharge groundwater downstream.

[18] See section D (analysis of national priorities / strategies and section H (outcomes consultations with government stakeholders).
[19] Idem

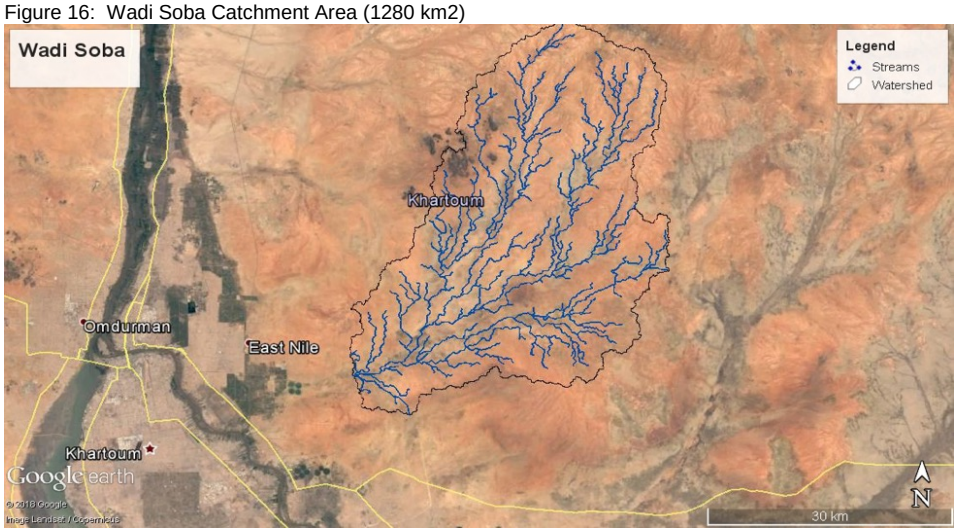
Groundwater monitoring and water information system in Sudan have been very minimal and suffered huge deterioration over the years because of inadequate finance and capacity.

Reduced groundwater recharge in Sudan – either through decreased precipitation or increased temperature and evaporation – has grave repercussions for Sudan. National studies have shown that soil moisture would decline under future climate change. When coupled with increased water consumption, population growth, high variation in rainfall and the high rate of evaporation, a looming water crisis appears likely.

Upstream water harvest initiatives are adopted and promoted at national and local levels, especially in areas that suffer from devastating floods, to reduce flood impacts (and associated protection of human beings and their properties), but also to increase water availability during dry season and to increase ground water recharge (through water reservoirs), also during the dry season.

Wadi Soba is a large ephemeral water shed in East Nile Locality, Khartoum State. The Wadi is infamous because it often poses threat to life and properties during wet rainy seasons. Soba Wadi is characterized by several tributaries that join the main water course as it flows from North to South-West direction. Watershed area of Soba Wadi is large; it is about 1280 km2.

Figure 16: Wadi Soba Catchment Area (1280 km2)



Preliminary hydrological study of the whole catchment and for each sub-catchment separately was undertaken by Khartoum State Roads, Bridges and Drainage Corporation (RBDC) but also by the university (see annex 3). Two dam locations have been identified thus far. One is Um jidad and the other is Kaboyta. Um Jidad Wadi is located on the east-upper watershed of Soba Wadi with a sub-basin area of 194 km2 as shown on Figure 17. Kaboyta Wadi is located on the west-upper watershed of Soba Wadi with a sub-basin area of 124 km2 as shown on Figure 18.

These potential dam locations in the upper part of Wadi Soba watershed could be fit because the area is thinly populated unlike further downstream the Wadi. Moreover, good dam location sites

Deleted: have been chosen

are identified there; thus better control of the Wadi flow will be possible by dams upstream the watershed than downstream.

The location selection and design process of the dams is evolving. Thus far, hydrological studies of the whole catchment and for each sub-catchment separately have been carried out. Detailed topographic surveys were carried out at two potential sites. Preliminary details of these dams is summarized in the following table.

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Table 8: proposed dam dimensions

Dam name	Length, m	Max. height, m	Storage Capacity, Mm3
Um Jidad	4500	6.58	9.23
Kabota	2444	5.80	3.57

Although the storage capacity of each dam is relatively large, which is in line with government preferences / standards, significant reservoir evaporation and seepage losses are expected. These losses will be assessed when results of the geotechnical investigations become available.

Detailed design of the body of optional dams will be made after receiving the geotechnical investigations that are presently going on. It may be another option to reduce the size of the proposed dams and construct a larger number of smaller dams.

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Figure 17: possible dam location on (Um Jidad Wadi) of Wadi Soba

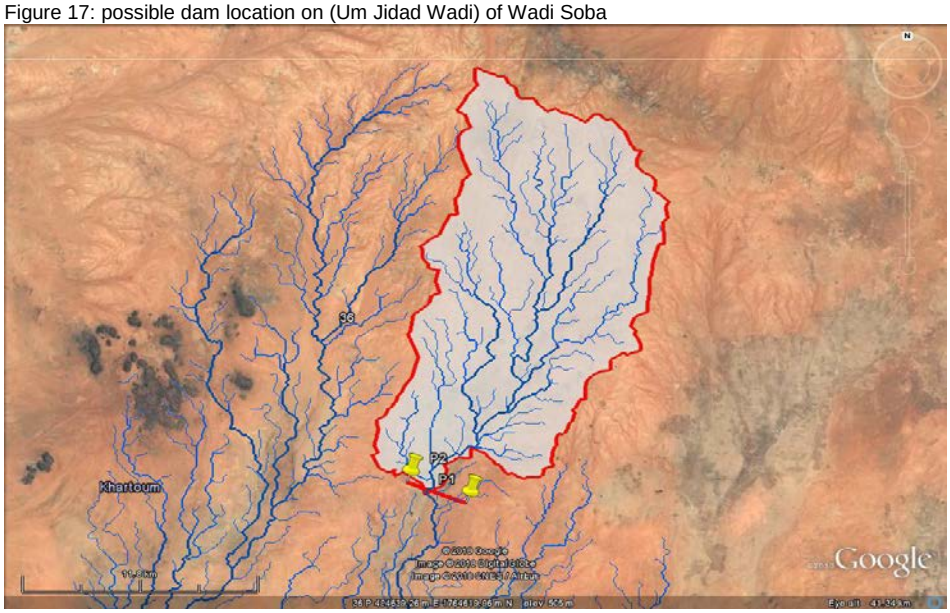
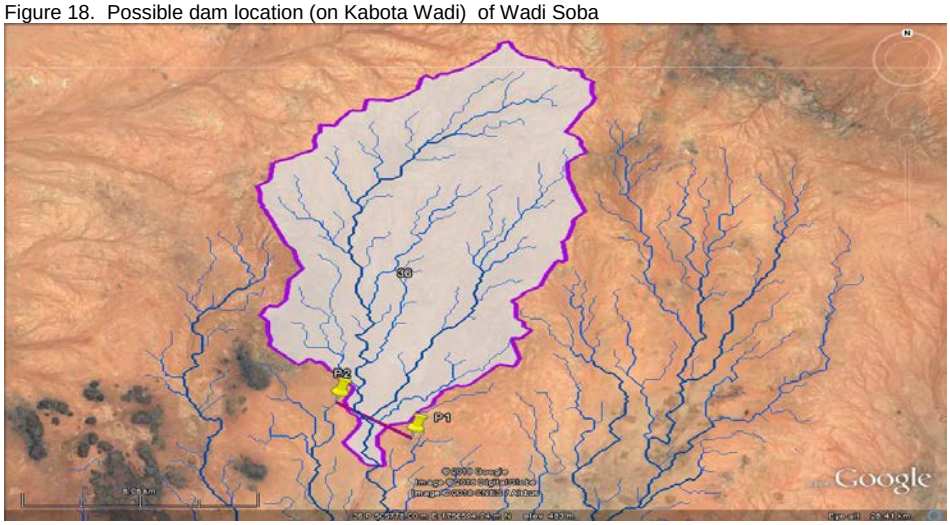


Figure 18. Possible dam location (on Kabota Wadi) of Wadi Soba



Each dam will be designed as earth dam equipped with reinforced concrete spillway to pass the 50-year flood and bottom outlets to control reservoir sedimentation and downstream water releases. The upstream face of the dam will be protected from scour and wave action by rip rap. Energy dissipaters downstream the spillway and bottom outlets will be appropriately provided. Detailed reservoir routing scenarios for each dam will be made after finalizing the detailed design. Probability of each reservoir being filled each year will be assessed as well.

During the full proposal phase, feasibility studies and environmental and social risks and impacts assessment will be conducted in line with AF ESP and GP. Depending on this, locations and dimension may be adjusted (i.e. more smaller dams). Eventually, all details, including exact locations, dimensions, land use, etc. will be provided of all proposed activities so that all potential environmental and social risks and impacts can be identified and quantified.

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B. Economic, social and environmental benefits

Table 9: Expected economic, social and nnvironmental project benefits

Type of benefit	Baseline	With/after project
Economic	Climate change is already leading to economic and livelihood losses, caused by floods and droughts impacts on assets and agriculture and cattle (lack of water)	Component 1: ❑ Strategies will reduce negative flood and drought impacts in Khartoum city and surroundings, which will reduce negative effects on urban and community economies ❑ Government budget and resources for disaster relief activities during and after a potential disaster will be reduced and saved Component 2: ❑ Trainings in support of livelihood sustainability and flood reduction (i.e. EWSs) will sustain and improve income generation for the most vulnerable groups, especially

		women and youth and will empower them in decision-making processes. Component 3: ❑ Interventions will reduce loss of assets for the most flood vulnerable communities and groups (poor, DPs) and in that way reduce negative economic effects ❑ Interventions will reduce livelihood losses for the most drought vulnerable communities and groups (poor, people dependend on agriculture and cattle as main source of income)
Social	Climate change is already leading to negative social impacts, especially caused by floods and droughts, leading to rural – urban immigration and social tension and unequal development benefits	Component 1: ❑ Strategies will be gender sensitive, which means specific needs of vulnerable groups (poor, DPs, women, youth) will be considered and included in the strategies ❑ Disaster induced negative impacts on people's access to basic services will be reduced Component 2: ❑ Through trainings and decision-making platforms, social networks of the residents will be strengthened and improved, especially between DPs and host community members ❑ Community and household self-help will be improved, especially of women-headed households and youth Component 3: ❑ Concrete interventions will contribute to social well-being, especially for vulnerable groups (DPs, poor, women, youth, etc.) ❑ Disaster induced negative impacts on people's access to basic services will be reduced
Environmental	Climate change is already leading to negative environmental impacts, especially differences in temperature and precipitation, leading to floods and droughts, which in turn leads to erosion, deforestation, deserfication, etc.	Component 1: ❑ Natural water sources such as streams, underground water tables and ground wells will be better managed to reduce negative environmental impacts Component 2: ❑ Community awareness of flood impacts, also on the environment and the relation between flood and health issues will be improved Component 3: ❑ Environmental health and waste related issues will be reduced due to the improved flood infrastructure

Potential environmental and social risks and impacts related to proposed activities that have been identified at this stage (concept note) and will be avoided / mitigated, include equal access and benefits of particlulary women, youth and DP groups, but also nomads (see part II.k and annex 2. These groups are generally not well organized (for more detail see annex 2) and therefore the project will avoid / reduce potential risks by ensuring equal representation of vulnerable groups, especially women, youth and DPs but also nomads during consultations, planning processes and for possible job opportunities. As for the set-up of EWSs, decision-making structures in which all groups are able to participate equally and which can be used for more than just setting-up EWSs, will be established.

Based on an initial analysis of the target areas (see also part II.H and annex 2) the outcome of the Environmental and Socio-economic Impact study of Wadi Abu Soueid Water Harvesting and Spreading Project in Khartoum State, Sudan,[20] which is close to the target area, other potentially negative impacts include increase in the densities of the noxious Adar (Sorghum sp.) weed and semi-parasitic Buda (Striga hermonthica) plant, security problems (including trespassing on farmland and rangeland by nomadic groups from neighboring areas and animal thefts), and uncontrolled flooding of potentially productive farmland due to neglect of dam maintenance. Mitigation will be put in place to avoid these potentially negative impacts, including a government committed maintenance plan and budget. However, in the case of the proposed project, there are streams that allow to discharge water in case the dam exceeds its capacity (although unlikely because its will be designed for a 50 year flood event).

Approach to ensure equal distribution of benefits to the most vulnerable groups

In annex 2, a gender approach and baseline is included. This is a 'work-in-progress' annex, which means all details will be provided during the full proposal development phase. At this stage a 'basic' approach and baseline for women is provided, but more details will need to be included, also for specific approaches for youth and DPs.

C. Cost-effectiveness

UN-Habitat analysed both individual proposed interventions and the total package of proposed interventions from a cost-perspective point of view (besides other selection criteria related to sustainability and potential environmental and social risks) to maximize the beneficiaries reached and impacted.

Cost-effective rationale component 1: land use planning strategies are considered to be one of the most cost-effective ways to understand and respond to climate change risks and vulnerability, especially to avoid future development in risk areas (and cost associated with this potential risk, such as destroyed houses and assets. The same accounts for the development of an integrated watershed management strategy, which will allow Khartmoum state and municipal government to make strategic choices, also from a cost-effective point of view. As for the establishment of early warning systems, this is also an effective way of avoiding costs caused by future floods. Early warning systems will be established for the communities at risk of flash floods from Wadi's ending in Khartoum.

Alternatively, infrastructure interventions, such as the construction of dams / water reservoir, the strengthening of drainage channels and construction of resilient houses in areas at risk of floods could be proposed, but this is prioritized for the East Nile community, which is most at risk (and formely heavility impacted – including related high costs) from floods.

From a sustainability point of view, capacity building of government institutions will improve the long-term impact of the project, including associated avoided costs related to floods and drought impacts. The same accounts for the partnering with the Water research centre, university of Khartoum.

Cost-effective rationale component 2: community-level capacity building and planning activities are proposed to ensure ownership and sustainability of the project and proposed activities, including establishing operation and maintenance arrangements, which in turn will avoid costs

[20] http://khartoumspace.uofk.edu/handle/123456789/9244

when infrastructure is not used and maintained properly. Because the cost-effectiveness of flood resilient houses can be arbitrair in areas that don't experience extreme flood impacts, community members will be trained to construct these houses themselves.

Alternatively, interventions are solely planned from state or municipal level, but this would reduce ownership of the project and interventions and thus have negative effect on sustainability and related costs.

Cost-effective rationale component 3: The construction of dams / water reservoir to provide water to upstream villages while reducing flood impacts downstream in East Nile community, which is most at risk (and formely heavility impacted – including related high costs) from floods, is a cost-effective way of increasing both flood and drought resilience.

Alternatively, the East Nile community could be relocated or drainage channels improved. However, due to the extreme flood impacts, this would require relocating the whole community, which is not feasible, or constructing large drainage channels, which is more costly and for which is little space available. Moreover, this would not lead to the water supply benefits upstream. Establishing only a flood early warning system is also not feasible because of the remaining extreme flood rsks and impacts.

Table 10: Cost-benefit analysis of proposed inerventions

Interventions / activities		Target Community	Estimated nr of beneficiaries	Estimated cost (US$) and cost-effectiveness of direct beneficiaries
Priority investments	**Detailed activities**			
1. Institutional capacity strengthening of Khartoum state and municipal government	1.1. One Khartoum state / city integrated urban watershed management strategy	Khartoum state / metropolitan area	8 million 6.2 million	476,000 = 0,06 pp 400,000 = 0,05 pp
	1.2. One Khartoum metropolitan area spatial / urban strategy	Khartoum metropolitan area	6.2 million	400,000 = 0,05 pp
	1.3. Three wadi early warning systems established (Locality level)	East Nile Loc Karari Loc Omdurman Loc	1,078,498 1,293,195 698,900	150,000 = 0,1 pp 150,000 = 0,1 pp 150,000 = 0,2 pp
2. Community-level action planning	2.1. Seven downstream community-level early warning systems established	El Kariab El Marabie Al Huda Al-fateh Al-Thowrat Al Salha Al Gea'a Total:	28.500 26.370 14,800 53,632 TBD 25,000 13,810 >162,000	50,000 = 2 pp 50,000 = 2 pp 50,000 = 3 pp 50,000 = 1 pp 50,000 = TBD 50,000 = 2 pp 50,000 = 3 pp
	2.2. Eleven community plans developed, and community members (especially women and youth) trained	El Kariab El Marabie Al Huda El sheikh Alamin AL Bayada	28.500 26.370 14,800 7,200 3,600	50,000 = 2 pp 50,000 = 2 pp 50,000 = 3 pp 50,000 = 7 pp 50,000 = 14 pp

		Um Ketra Um Ushyra Al-fateh Al-Thowrat Al Salha Algea'a Total	TBD TBD 53,632 TBD 25,000 13,810 >200,000	50,000 = 0,9 pp 50,000 = TBD 50,000 = 1 pp 50,000 = TBD 50,000 = 2 pp 50,000 = 3 pp
	2.3. Community members trained in seven downstream communities to construct flood resilient and environmentally friendly houses	El Kariab El Marabie Al Huda Al-fateh Al-Thowrat Al Salha Al Gea'a Total:	28.500 26.370 14,800 53,632 TBD 25,000 13,810 >162,000	50,000 = 2 pp 50,000 = 2 pp 50,000 = 3 pp 50,000 = 1 pp 50,000 = TBD 50,000 = 2 pp 50,000 = 3 pp
3. Physical interventions to increase flood and drought resilience of communities	3.1. Two dams / water reservoirs constructed up-stream of Wadi Soba, leading to upstream villages water and livelihood security and downstream communities flood reduction, including technical knowledge products produced	East Nile Loc Especially: Soba Sharq Administrative unit And upstream villages Total	1,078,498 113,433 TBD >130,000 direct	5,8 mill = 5,3 pp 5,8 mill = 51 pp TBD

Overall, alternative intervention to land use planning strategies, coupled with early warning systems to reduce flood impact have been considered, including relocation and infrastructure interventions such as the construction of upstream dams / water reservoirs, strengthening of drainage channels and construction of resilient houses. Although the construction of upstream dams / water reservoirs is the most effective way of reducing downstream floods compared to the more costly option of constructing large drainage systems, this has only been prioritized (by the government) for the highly flood vulnerable East Nile sub-region. Due to limited funds, the government then requested to at least warn other flood vulnerable areas for future flood events and to reduce urban development in flood prone areas through spatial planning strategies. Relocation has not been considered as a feasible option because this is not in line with the ESP.

During the full proposal development phase, more details will be provided, including direct and indirect beneficiaries, etc. However, with the large proportion of children and youth and large numbers of (ex-)DPs, consultations during the full proposal will focus on their, and that of women, specific benefits / needs and concerns.

Altogether, the project will be cost-effective by:

- ❑ Avoiding future costs associated with damage and loss due to climate change impacts (especially floods and drought) and to ensure the interventions are sustainable;
- ❑ Efficient project operations because of 'in-house' technical support options and capacity building expertise and because of direct partnering with government institutions and university (thereby building their capacity as well as reducing costs);
- ❑ Community involvement through community capacity building and planning

- ❑ Selecting technical solutions based on cost-, feasibility and resilience/sustainability criteria

D. Consistency with national or sub-national strategies

This project has been designed to align with below national, sub-national and sectoral development policies, strategies and plans on development, climate change and disaster resilience.

Soon after the Earth Summit in 1993, Sudan signed and ratified the UNFCCC and committed itself to active cooperation within the global community to address the problem of climate change. Sudan submitted its 1st National Communication in 2003, prepared a NAPA in 2007, submitted its 2nd National Communication in 2013, prepared a NAP in 2014 and submitted its INDC in 2015. The strategic goals of Sudan's 25-year vision, as well as ongoing national policy processes have parallel goals to climate change adaptation (i.e poverty reduction strategy paper). Below table provides an overview of the main national, sectoral and sub-national strategies and how the project aligns with these. During the full proposal development phase, more details on sectoral and sub-national strategies will be provided.

Sudan Council of Ministers approved the National Communication and NAPA and directed Sudan Higher Council for Environment and Natural Resources (HCENR) to coordinate NAPA implementation. Since the HCENR is the Key implementing agency of the project, it will incorporate and coordinate the project with other NAP ongoing project using the already established coordination mechanism.

Moreover, the project interventions will be coordinated within the UNDAF - Environment, Climate Resilience and Disaster Risk Management Working Group where UN-Habitat is active member. The Working Group is mandated with coordination among stakeholders on environment and climate change projects/interventions in Sudan. The keg agencies engaged are: UNEP, UNDP, UN-Habitat, IFAD, UNSECO, WFP, UNCEF and FAO in addition to the Government (Ministry of International Cooperation) and line ministries.

Table 11: summary of the main climate change related policies and national and sectoral policy priorities that align with this project. In **bold** is particularly relevant for this project.

Policy / Document	Year submitted / ratified	Policy priorities that align with this project
Climate change priorities		
National Adaptation Programme of Action (NAPA)	2007	Three highest priority sectors identified: ☐ Agriculture ☐ Water ☐ Public health Key Adaptation Activities in Agriculture relevant for this project ☐ Drought early warning systems for disaster preparedness Key Adaptation Activities in Water Resource Management relevant for this project

		☐ Introduction of new water harvesting/spreading techniques making use of intermediate technologies; ☐ Promotion of greater use of effective, traditional water conservation practices; ☐ Rehabilitation of existing dams as well as improvements in water basin infrastructure for increased water storage capacity, particularly in central and western Sudan; ☐ Construction of dams and water storage facilities in some of water valleys, particularly in western Sudan; ☐ Extension services in capacity strengthening in water capture and storage techniques for small-scale farmers. ☐ Key Adaptation Activities in Public Health relevant for this project: ☐ Provision of alternative water supply systems for domestic use that do not involve open standing water areas. Several policy issues were identified, of which the following are most relevant for this project: ☐ Policies for water resource management and agriculture should stress provision of safe potable water at the level of rural area, towns and migrating tribes' routes. The latter is particularly important for the reduction and avoidance of conflicts and friction between farmers and herders. ☐ A national land use plan should be adopted. ☐ A national early warning system should be established.
2nd National Communication (SNC)	2013	Focus sectors: ☐ Water resource ☐ Coastal zone Water resource - Framework for climate change adaptation: In the immediate near-term, government policy should be modified to promote the following adaptation actions regarding small-scale agricultural practices: ☐ Water supply: These include the introduction of new water harvesting/spreading techniques making use of intermediate technologies ☐ Water demand: These include the promotion of greater use of effective, traditional water conservation practices For large-scale agriculture, government policy should be modified to promote the following adaptation actions in the immediate near-term: ☐ Water supply: These include the rehabilitation of existing dams as well as improvements in water basin infrastructure for increase water storage capacity ☐ Water demand: They also include the improvement of on-farm water management such as the use of modern irrigation systems (sprinkler and drip) and modernization of surface irrigation system through the adoption of canal lining, long furrow irrigation and optimization of field configurations.

National Adaptation Plan (NAP)	2014	Focus on: ☐ Agriculture ☐ Water ☐ Health ☐ Coastal zones Khartoum state: Rapid urban growth combined with rising temperatures, rainfall variability, and river fluctuations have placed serious pressure on Khartoum's resources. Vulnerable locations: Water: East Nile locality
Intended Nationally Determined Contributions (INDC)	2015	Focus on: ☐ Agriculture ☐ Water ☐ Health ☐ Coastal zones Water sector relevant priorities: ☐ Integrated Management of the water resources to meet the current and future challenges/needs ☐ Water harvesting (dams, hafirs, terraces, etc.) to assist vulnerable communities to adapt and build their resilience facing increasing vulnerability of water sources/resources ☐ Establishment of rain gauge stations to monitor and provide hydrological information ☐ Introduction of a revolving micro-credit fund to support implementation of small water harvesting projects
General development priorities		
Sudan's 25-year strategy 2002-2027		The strategy regognisez, through plans for irrigated agriculture, that apart from any climate change considerations, future water demands to satisfy development goals are well in excess of water supply.
Sectoral priorities		
Disaster Risk Reduction plan or policy, incl. Early warning systems		The policy for disaster risk reduction is under preparation together with the early warning system for the river
Sub-national priorities (Khartoum state and city)		
Khartoum structural plan 2008-2033	2008 - 2033	Provides framework for development. Watershed and spatial planning strategies should be integrated / mainstreamed into it.
Khartoum State strategic plan	2017 - 2030	Identified priorities: ☐ poverty ☐ Water ☐ Health ☐ Environment ☐ Energy

Khartoum 4 years plan	2017 - 2020	☐ Rehabilitation of drainage system and construct new ones ☐ Increase the green areas and coverage ☐ Trees plantation in streets ☐ Plantation of green-belts around Khartoum

E. Compliance with relevant national technical standards

In line with national standards / requirements, an environmental and social risks and impact assessment will be conducted in line with AF ESP and GP during the full proposal development phase for output 3.1. (construction of dams / water reservoirs). The EIA compliance procedure will be as follows:

Screening process
At the start of the EIA process, the proponent submits a policy brief containing an initial environmental evaluation to the HCENR. The HCENR then reviews the document and decides if an initial permit is granted for the project or if it is rejected. For projects which have obtained such a permit, an EIA report is then prepared.

Provision for sensitive areas
According to the EPA 2001, all development projects outside environmentally protected areas and in environmentally sensitive areas require an EIA.

Contents of the EIA report
According to the Act, EIA studies must contain the following:

- Description of the existing environmental conditions as a baseline.
- Description of the project.
- Assessment of potential environmental impacts, both positive and negative throughout the project phases.
- Provision of recommendations to mitigate the negative environmental effects.

Also negative impacts that can be evaded upon execution of the project shall be identified and project alternatives should be proposed.

Review process
The EIA report is reviewed by HCENR. A committee of experts then checks the contents of the EIS against the review checklist that was formulated by HCENR. The process is not open to the public. The review checklist consists of 7 areas:
(1) baseline conditions;
(2) description of the planned project and alternatives;
(3) assessment of the impacts and effects on the environment, public health and management of natural resources and how the different effects are connected to how the surroundings may react;
(4) mitigating measures;
(5) layout and readability;
(6) complementary questions, such as how public participation and opinions are dealt with; and
(7) the adequacy of the whole statement
Integration of EIA into decision-making

It is not clearly stated in the legal text how EIA is integrated into decision-making, but upon review recommendations and approval of the EIA report by HCENR, the project proponent is given permission to implement the project.

Consultations have been conducted with HCENR,[21] also for coordination and national technical standards compliance purposes, especially related to EIA requirements and procedures.

During the full proposal development phase, more details on relevant rules, regulations and standards and the procedure to comply to these, including cooperation with authorizing offices, will be provided standards

Table 12: Compliance with relevant notional technical standards

Expected concrete output/intervention	Relevant rules, regulations, standards (to comply to AF principle 1)	Compliance, procedure and authorizing offices
1.1. One Khartoum state / metropolitan area integrated urban-rural watershed management strategy	Irrigation and Drainage Act, 1990; The Water Resources Act, 1995; The Groundwater Regulation Act (1998); The Public Water Corporation Act (2008).	Coordinate procedures for surface and underground water uses for protection, irrigation and drinking. Authorizing offices: National Council for Water Resources Ministry of Irrigation and Electricity, Ministry of Infrastructure , Roads and Drainage • Regulation of water for different uses and ensure non-contamination • Monitoring and supervision of uses in accordance with the rules • Approval of dams construction for protection, water storage and electricity
1.2. One Khartoum metropolitan area spatial / urban strategy	Urban Planning and Disposal of land Act 1994 Land Resources Regulation Article 186 - Right-based	Coordinate (regular Meetings of state Planning Committees) development and procedures with National Council for Physical Development, State Ministries of Physical Planning and Public Utilities
1.3. Three wadi early warning systems established	Civil Defence Act 2005	Coordinates plans and measurements related related to disaster, emergency and relief; Raise awareness and communicate information to the people in risk areas
2.1. Seven community-level early warning systems established 2.2. Eleven community plans developed 2.3. Community members trained	Civil Defence Act 2005 Not relevant – following local goverannce procedures International Build Back Better principles will applied	Coordinates plans and measurements related related to disaster, emergency and relief; Raise awareness and communicate information to the people in risk areas

[21] See section section H (outcomes consultations with government stakeholders).

1.1. Two dams / water reservoir constructed up-stream of Wadi Soba, leading to upstream villages livelihoods and water security and downstream communities flood reduction, including technical knowledge products produced	Irrigation and Drainage Act, 1990; The Water Resources Act, 1995; The Groundwater Regulation Act (1998); The Public Water Corporation Act (2008). Above establishes procedures for surface and underground water uses for protection, irrigation and drinking	Coordinate procedures for surface and underground water uses for protection, irrigation and drinking Authorizing offices: National Council for Water Resources Ministry of Irrigation and Electricity, Ministry of Infrastructure , Roads and Drainage • Regulation of water for different uses and ensure non-contamination • Monitoring and supervision of uses in accordance with the rules • Approval of dams construction for protection, water storage and electricity

F. Duplication with other funding sources

The following existsing coordination mechanism will be used for implementing the project: the UNDAF Environment, Climate Resilience and Disaster Risk Management Working Group focusses on, among other:

- Contributing to the implementation and coordination of climate change adaptation and mitigation strategies and applying 4Ws tools (who does What Where and when to identify synergy and avoid duplication) with regular and ad-hoc meetings and reporting to RCO and Government on progress and achievements as well as leveraging of environment funding for Sudan (GCF, Adaption Fund, UNREDD, GEF, etc.).
- Strengthening disaster risk management (preparedness, response, recovery) and early warning systems at all levels (policy level, community preparedness etc).
- Cross-cutting areas: Awareness raising (education), capacity development, information/data and knowledge exchange and management, coordination, gender and youth

Table 13: relevant projects, relevant project interventions and lessons learned and complimentary potential and non-duplication information

Relevant projects/programme, executing entity and budget	Relevant interventions and lessons learned	Complimentary potential and non-duplication
- Watershed / water resource management - Water supply		
Eastern Nile Watershed management project[22] USD 35 million (WB) 2009-2015	- Adoption by the Eastern Nile countries of sustainable land and water management practices in selected micro-watersheds in the Eastern Nile Basin - Required good engagement / participation stakeholders - Sustain knowledge through research institutions	Complimentary potential: - Use lessons learned, including guidelines for community watershed management - According to the government of Sudan, the government has no experience in developing a

[22] http://projects.worldbank.org/P111330/eastern-nile-watershed-management-project?lang=en
http://documents.worldbank.org/curated/en/141341485192193778/pdf/ICRR-Disclosable-P111330-01-23-2017-1485192177638.pdf

		comprehensive development and management for the the 'watershed' area such as in / around Khartoum. This project will establish such a 'model'. Non-duplication: - Other location and project ended - Thus, taking this approach in the target areas is unique
Reduction of Risks and Vulnerability Based on Flooding and Droughts in the Estero Real River Watershed[23] USD 5,5, million (AF / UNDP) 2011-2016	- Infrastructure for storing and using rain and surface water in eight micro-watersheds in the upper watershed of the Estero Real River; introducing more efficient use of water in all production processes, increasing infiltration, strengthening soil structure, and stabilizing slopes; institutional development and capacity building in micro-watersheds, municipalities, and participating national institutions; ongoing monitoring and analysis of climatic conditions and changes in land use, water flows and soil quality	Complimentary potential: - Use lessons learned regarding approach and techniques - This project will provide additional lessons regarding up-stream water harvesting techniques compared to downstream river options Non-duplication: - Other countries - Thus, taking this approach in the target areas is unique
- Spatial / urban planning		
UN-Habitat Institutional Capacity Development of Darfur on Urban and Regional Planning USD 2,128,315 (USAID-OFDA) 2011-2013	- Institutional capacity successfully enhanced at the State Ministries of Planning and Urban Development (MPUDs), through on-the-job training and provision of up-to-date ICT equipment. - A Regional Spatial Strategy for reintegration of DPs in Darfur successfully developed, providing guidance to the government authorities and the local leaders for supporting decision making on where to invest and carry out the reconstruction process. It integrated macro level of hazard mapping of drought and flood	Complementary - Approach can be replicated in Khartoum, including a youth approach for improving resilience of houses - Spatial planning strategies to be developed in target areas will provide additional lessons as flood and drought risks will be analysed Non-Duplication - Project was in Darfur - Project was in Blue Nile state

[23] https://www.adaptation-fund.org/wp-content/uploads/2015/01/Proposal%20plus%20annexes.pdf

UN-Habitat Participatory and Gender-Balanced Urban and Regional Planning, Land Management, Environmental Friendly Construction and Sustainable Livelihood in Blue Nile State USD 1,900,000 (Norwegian Ministry of Foreign Affairs) 2013-2015	- Capacity of the state government successfully improved to better plan and manage urban settlements for better provision of services and integration of displaced people and improve access to basic services and sustainable livelihood for displaced people and recipient communities in Blue Nile State. - Regional Spatial strategy developed to guide the government in BNS on where best to invest to bring about a higher impact. The plan considered community-based hazard mapping particularly floods) - Youth befitted from establishment of youth centre and vocational training	- Thus, taking this approach in the target areas is unique
- Disaster risk reduction - Flood and drought management - Early warning systems - Resilient housing		
UN-Habitat Construction of Public Buildings/Facilities and Housing in Return Sites and Urban Setting USD 5,194,014 (UNDF - Qatar fund) 2016-2018	- Slum upgrading and Housing (using SSB is environmentally friendly construction technology with reasonable cost comparing burning brick as a typical construction material. SSB does not need to cut and burn trees that has been accelerating drought and floods)	Complementary - Target communities / youth can be trained in current project to build houses applying SSB for increasing resilient housing design - Experience to avoid high risk areas can be used - UN-Habitat has a strong track record of constructing resilient houses – this can be utilized in a the unique target areas through provision of trainings Non-Duplication - Project is in other area - Project is in Blue Nile State - Project is in White Nile State - Thus, taking this approach in the target areas is unique
UN-Habitat Promote Peace Building and Stability in the Blue Nile State USD 585,197 (The Government of Norway) 2016-2018	- Financing urbanization, urban economy and livelihoods (using SSB for the development of DP relocation sites and the infrastructure). The locations have been considered avoiding high hazard areas)	
UN-Habitat Support to Hosting Communities Affected by South Sudanese Refugees in White Nile State USD 900,000 (Government of Japan) 2018-2019	- Urban Planning and Design, and Urban Economy and Basic Services (Using SSB for the improvement of market places and public spaces)	

Flood Forecasting and Analysis Model (IFAS) for Wadi Flash Flood in Sudan, Eritrea and Etheopia By Water Research Centre, university of Khartoum.	- Satellite images worked well to predict floods but for Khartoum water gauges should be used for establishment of EWSs (see also figure 15)	Complementary - Basic model could be applied to flash flood EWS in Khartoum - Through cooperation with the university of Khartoum, their approach used in east Sudan and neighboring countries can be used in Khartoum state Non-Duplication - The project focused on east Sudan + neighbouring countries - Thus, taking this approach in the target areas is unique
- Dam / water reservoir construction - Drainage - Irrigation		
Several national project on water harvesting	- Water- harvesting techniques have been implemented for nine areas in several states (North Darfur, Nile, North Kordofan, and West Kordofan). These projects have increased community access to reliable water, increasing their capacity to cope with the impacts of reduced precipitation, increased temperature and drought	Complementary - Work with government to develop best practice for dam / water reservoir construction and management – especially in context of integrated watershed management, which is a unique approach in Sudan - Use lessons learned regarding techniques Non-Duplication - There is no dam upstream of East Nile community / Wadi Soba - Thus, taking this approach in the target area is unique
Green Belt Khartoum State USD 12 million (Higher Council of Environment, urban and rural promotion) 2016 - current	- The Green Belt Initiative should surround the capital by a green wall of trees some 200 metres thick, covering some 280 km, an environmental undertaking to combat desertification.	Complementary - The project will intergrate possible impacts of the green belt in project design Non-Duplication - The green belt will pass through Wadi Soba but will not affect interventions

UN-Habitat Peace Building in Darfur through Resource Management and Livelihood USD 1,293,892 (Darfur Community Peace and Stability Fund (DCPSF) 2013-2017	- Access to water supply successfully enhanced through establishment of a water yard and upgrading of a water dam	Complementary - Use UN-Habitat experience of water supply for current project, which will be in a unique location Non-Duplication - Project was in Darfur - Thus, taking this approach in the target areas is unique
- Other		
Development of 3rd national communication[24] USD 1,3 million (GEF / Higher council for Environment and Natural Resources) 2016-2020	- Forthcoming	Complementary - Where possible, share lessons learned and cooperate with higher council Non-Duplication - No geographical overlap - Thus, taking this approach in the target areas is unique

G. Learning and knowledge management

Within each component, activities to capturing and share lessons are included. The planned activities under component 1 will provide government institutions with evidence and a knowledge base to make better jusgements and decisions on future climate adaptation measures and urban resilience issues in and around Khartoum. The straetgies and knowledge products developed can also be used / replicated by other states. This will be done through ministry focal points The planned activities under component 2 will provide communities with a better understanding of climate change impacts and how to respond to these. As for the planned intervention under component 3, technical lessons will be captured which can be used elsewhere in the country.

At the regional level, the lessons, tools, methodologies and guidelines from the project will be consolidated and added to the regional knowledge database and shared with the Regional Climate Change focal point/team and other country offices through the Knowledge Management focal point within the UN-Habitat Regional office for Africa.

At the international level, the lessons from the project will be shared with the UN-Habitat best practices unit within HQ through the Knowledge Management focal point for dissemination to all countries; and similarly through the Regional Climate Change focal point/team with the Climate Change Planning Unit within the Urban Planning and Design Branch for consolidation of all knowledge products related to Climate Change.

[24] https://www.thegef.org/project/third-national-communication-tnc-and-first-biennial-update-report-bur

Table 14: Learning and knowledge management

Expected concrete output/intervention	Learning objectives (lo) & indicators (i)	Knowledge products
1.1. One Khartoum state / metropolitan area integrated urban-rural watershed management strategy	LO: there is limited government experience in developing integrated watershed management strategies – especially comprehensively for a state or urban area - this can be used as an example for replication I: Strategy published online and shared nationally through workshop	One Khartoum state / city integrated urban watershed management strategy
1.2. One Khartoum metropolitan area spatial / urban strategy	LO: there is limited capacity to develop spatial / urban plans – especially taking into consideration climate change related risks - this can be used as an example for replication or to feed into a national spatial strategy I: Strategy published online and shared nationally through workshop	One Khartoum metropolitan area spatial / urban strategy
1.3. Three wadi early warning systems established	LO: capture and share best practice for EWSs set-up and feed into larger system I: Manual published online and shared at city-level through workshop	Manual explaining how to set up and operate an of early warning system
2.1. Seven downstream community-level early warning systems established	LO: capture and share best practice for EWSs set-up at community level, especially for (ex)informal relatively unorganized communities I: Manual published online and shared with other communities in Khartoum through workshop	Practical and simple manual explaining how to set up and operate an of early warning system at community level
2.2. Eleven community plans developed, and community members (especially women and youth) trained	LO: community members have the technical capacity to operate and maintain EWSs and / or water supply / irrigation systems I: Trainings conducted and people attending them	Technical manuals produced
2.3. Community members trained in seven downstream communities to construct flood resilient and environmentally friendly houses	LO: community members have the technical capacity to construct resilient houses I: Trainings conducted and people attending them	Technical manuals produced

3.1. Two dams / water reservoirs constructed	LO: National, state and city government have capacity to plan, construct, maintain and replicate best practice dam / water reservoir I: Manual published online and shared nationally through workshop	Manual to plan, construct, maintain and replicate best practice dam / water reservoir as part of integrated watershed management strategy and spatial planning strategy

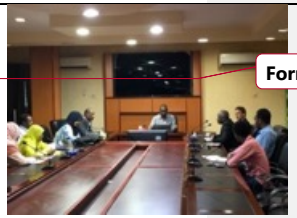
H. Concultative process

The project has been designed based on the outcomes of consultations at the national-, state-, city- and community level. Consultations with UN agencies, NGO's, etc. took place to understand climate change impacts in Sudan, to identify potential focus and target areas and to identify potential risks for vulnerable groups and compliance to human rights, Labour standards, etc. At the national, state- and city-level, consultations focused on ensuring that the project aligns with national and sub-national priorities. At the community level, consultations focused on understanding local climate change impacts and effects, barriers to adapt and possible interventions to address negative impacts. Consultations with women took place to identify specifc climate change impacts and needs and to develop a specific women approach and baseline to ensure equal distribution of benefits (see annex 2).

During the full proposal development phase, community and vulnerable groups consultations will take place, including with youth and DPs / indigenous groups (additional to women) to identify potential environmental and social risks and impacts related to proposed activities.

Below table provides an overview of stakeholders consulted, consultation objectives, outcomes, conclusions and consultation evidence. Annex 1 provides details of community group consultations (i.e. complete surveys) and evidence (i.e. attendance sheets).

Table 15: overview of consultations consulted with government, UN agencies, NGO's, university, etc.

Stakeholder, incl. role/function	Objective	Outcome	Conclusion	Evidence
Dr. Noureldin Ahmed Abdalla AF DA and Secretery Geneneral Ministry of Environment, Natural Resources & Physical Develeopment Higher Council for environment & Natural Resources (HCENR) **Nagmeldin Gutbi Elhassan** Senior researcher Higher Council for environment & Natural Resources (HCENR)	- Align proposed project with national priorities - Agree on way forward	- Suggested focus on flash flood issues in Khartoum - Suggested focus on improving Khartoum urban planning and housing construction to respond to flood / cc issues	- Incuded suggested focus in the proposal	 Date: 21-05-2018 Method: interview
Dr. Eng. Khalid Mohamed Khair Minister Ministry of infrastructure and transportation **Eng. Elsafi Ahmed Adam** General manager Ministry of infrastructure and transportation. Roads, bridges and dranage cooperation **Maha Mustafa El Tahir** Consultancy office Ministry of infrastructure and transportation. Roads, bridges and dranage cooperation	- Align proposed project with national priorities - Identify main climate change impacts, issues and needs - Identify possible governance / management options	- Ministry is responsible for floods, drainage, etc. - Emergency committee (DRR but also covers CC) has representatives from all ministries - Need of EWSs for flash floods, comprehensive model for dams, drainage and protection and capacity building - There are no risk maps - Minstry has models for dams (which store water for irrigation and even drinking) - There are some good examples of community savings for disaster reduction measures, roads, wells, etc.	- Work with emergency committee for EWSs - Integartion of identified needs in proposal	 Date 22-05-2018 Method: interview
Dr. Nadir M. Awad President Sudanese Environment conservation Society (NGO) **Ali M. Ali** Vice president Sudanese Environment conservation Society (NGO) **Dr. Sumia M. Elsayed**	- Understand main climate change / flood impacts, needs and issues in Khartoum - Identify lessons learned from other projects	- Experience with boreholes and small dams - Khartoum is dependent on rain for drinking, irrigation, cattle, etc. There is enough water, but it is creating problems – not solutions - Urban expension issues: land provided in high risk areas and	- Consider using dams / water collection ponds to reduce flooding and provide water in dry season - Need strategic land use approach to reduce land allocation in high risk areas	

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Chairperson, Environmental Rehabilittaion Program Sudanese Environment conservation Society (NGO)	- Identify potential target areas	buildings (build by inhabitants) are very vulnerable - There are some health issues related to floods (malaria and contamination and accidents due to pit latrines)	- Need of improving resilience design of houses - Consider issue of pit latrine contamination	Date: 21-05-2018 Method: interview
Abeer Elhag Monitoring and Evaluation Analyst UN Women	- Collect info for gender approach - Understand possible risks related to women rights	- There are no 'women' focal points in ministries - Legal status: Sudan did not ratify CEDAW - Cultural / religious status: productive but conservative; consider women prefer to work close to home (because of family) and not walk far (because of safety) - Agents of change: best at community level (CBO's / popular committtes); opportunities with selling / marketing when trained.	- Focus on change at community level	 Date: 22-05-2018 Method: interview
Suzan E. Abdelslam National project coordinator ILO	- Understand possible risk related to Core Labour Rights	- Relevant Core Labour Rights Not ratified by Sudan: C087; C129; C144 - Possible risks related to possible construction works: social protection, child labour, safety, no proper contracts	- Link to ministry of labour and workers union - Training on-site in vocational training centers (5 in Khartoum) of supreme council under ministry of labour + human resources - Possible involve ILO for maintenance arrangements communities and ministry of engineering	 Date: 22-05-2018 Method: interview

Adil Mohamed DRR Consultant Executive Director ACCEDR Alequlimi Consultative center for environmental & Disaster Risk Reduction Research	- Understand main climate change / flood impacts, needs and issues in Khartoum - Identify lessons learned from other projects - Identify potential target areas	- Migrants live in high risk areas - Community leaders allocate land for houses in high risk areas - Recurring floods destroy houses and lock people into poverty - Water from flash floods should be utilized and not only drained (as it is more than from floods from Nile) - Popular committee at community level is responsible for services + disaster (communication) – 1000 people per committee - There are officially no temporary (class 4) community anymore in Khartoum - There are some issues of land disputes caused by selling land to multiple people - Combination dams + drainage have reduced floods in certain areas - Possible target areas: - Flash floods and vulnerable groups: East Nile – Marabe / Kiriab (informal); El Fateh (relocated); El Saleh (mixed) - Nile floods and vulnerable groups: White Nile – Lamab	- Need of strategic approach, comprehensive 'risk' map of Khartoum and criteria for allocating land in 'safe' areas - Need to improve resilience design of houses - Focus on Polular committee for e.g. EWSs and community leaders and women - Consider intervention of dams and drainage - Study possible target areas	 Date: 22-05-2018 Method: interview
Dr. Babiker I Barsi Hydorlogy stues Water research centre university of Khartoum.	- Understand flash floods risks and needs in Khartoum	- Main issue is urbanization in flood plains / wadi's (seasonal streams) and not properly designed infrastructure + extreme events getting worse - In Marabe, flash floods were 1-2 meter 3 years ago.	- Flood risk maps and other data collection and communication is required to set up EWS with gauges - Dams / water reservoir can reduce	

Prof. Dr. Gamal M abdo Director Water research centre university of Khartoum		- 88 flood event was a one in 800 years event - In last 50 years, there were 30 extreme events (floods and droughts) - Need of EWS for flash floods and dams / water conservation for cattle, agriculture and groundwater recharge - For this, flood risk maps are required - Also need to mainstream cc into action plans, thus e.g. consider floods and future issues in land use planning	flooding whie providing water in dry season. - Conisder option of working together with university on risk mapping and setting up EWS	 Date: 23-05-2018 Method: interview
Dr. Eltigani Sh. Alasam Secretary general High council for Environmental & urban & rural promotion, Khartoum State (HCENR)	- Understand priorities in Khartoum state - Understand main climate change / flood impacts, needs and issues in Khartoum - Identify lessons learned from other projects - Identify potential target areas	- High council focuses on ecosystems in / around Khartoum - Council studied climate change impacts and ecosystems in 112 villages around Khartoum - Green belt project around Khartoum addreses deserfication - East Nile most vulnerable in terms of flash floods - Environmetal and social impact assessment is required for output 3.1.	- Use climate change impacts and ecosystems study in 112 villages around Khartoum - Conduct EIA for output 3.1. in cooperation with HCENR	 Date: 24-05-2018 Method: interview
Mini workshop Ministry staff	- Reach consensus on most impacted areas (by river floods, flash floods, droughts) - Reach consensus on main vulnerabilities - Reach	- See results below	- Integrate outcomes into the project doc	

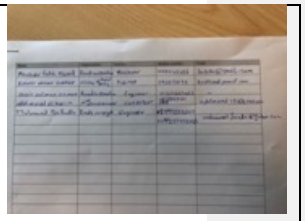
	consensus on main needs / interventions to address vulnerabilities to flash floods and droughts			 Date 24-05-2018 Method: workshop / discussion

Table 16: government mini workshop results: Selection of three most vulnerable localities to the risk of floods in Khartoum

Name of Locality /	Selection-ranking	Reasons for selection with mentioning specific vulnerable locations
Khartoum		Since it is located between the white and Blue Niles there is a risk of river flood and local flash floods)
Omdurman	❷	1. Frequent flooding from Wadi[25] Algea'a 2. Two flood prone areas severely affected in South Omdurman namely: • Al Salha • Algea'a Additional factors aggravated the effect of the flash floods: • the construction of roads lacking the proper crossing structures (e.g. culverts and/or bridges), • Al-Salha is a mixture of formal and informal settlements
Karari	❸	Two flood prone areas: 1. Al-fateh (relocation areas) 2. Al-Thowrat (block 22 and 23) Sources of flash floods: Khor Shambat and Khor Omer. Additional factors aggravated the effect of the flash floods: • Use of low quality building materials (mud) by poor people • High level of unemployment and poverty • Al-fateh is re-location areas where the informal settlements pockets within urban areas re-located to Al-fateh 1,2,3 & 4
East Nile	❶	Three flood prone areas in East Nile Locality severely affected and caused huge damages in housing, and basic services infrastructures, those areas are: 1. Marabie Al- Shareef (informal settlement) 2. Al-Kirayab (informal settlement -displaced from drought) 3. Al Huda (planned residential area) In addition to flash flood, from **Wadi Soba**, the situation is aggravated by: • Building of informal houses of the poor within the Water-ways in Soba Sharg • Use of low quality building materials (mud) by poor people • The construction of roads lacking the proper crossing structures (e.g. culverts and/or bridges

Select three most important interventions for reduction of negative impact of floods in Khartoum

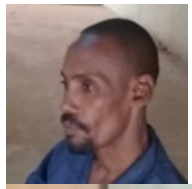
Theme/ مجال التدخل	Selection – ranking	Reasons for selection
Water harvest (dam)	❶	• Villages a long Wadis and Khors suffer from drought after the short rainy season where animal rearing and agriculture are main sources of living in those villages • Construction of water harvest (dams) at Wadi Soba and wadi Algea'a for protection and provision of water during dry season for animals, agriculture, recharge of water table and tourism.
Early warning system	❷	• Lack of reliable information on flash floods along Wadis and Khors • Need for early warning system supported by flood gauges along the Wadis connected to central database to have real time data
Drainage system model	❸	• Khartoum is flat and the peak of the river floods is coincided with the peak of rainfall in August every year • Pumping of water to the river is inevitable to avoid the river water from inundating the areas adjacent to the river banks • Drainage capacities is insufficient and incomplete. A demonstration drainage system model need to be tested and replicated by the government

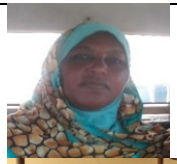
[25] Wadi and Khor local names means: seasonal water streams

Table 17: Overview of community and vulnerable groups consultations conducted

Stakeholder, incl. role/function	Objective	Outcome	Conclusion	Evidence
Mohamed Ahmed Mustafa Chairperson of El Kariab Popular Committee Members of El Kariab Popular Committee attended Consultation: 1. Batoul M. Ahmed - F 2. Fatehi M. Issa - M 3. Mekki O. Mohamed -M 4. Aisha Yacoub F 5. Khadeiga Ahmed - F 6. Wedad Hassan - F 7. Mohamed Ali - M 8. Mohamed Wagei Alla - M **9.** Hassan Ibrahim - M Popular Committee is elected voluntary body at community level responsible for supervision of services delivery and spearhead at times of disaster and emergency	- To understand community perception of climate change hazards in the past and for communities to become aware of changes - To understand constraints and barriers and underlying climate change vulnerabilities of the affected community - To identify needs to address climate change impacts - To identify specific needs of women	- There are specific indigenous customs of community solidarity through collective support to individuals during emergency (called Nafeer) or social events (marriage, Funeral etc) both in cash and kind. - Suggested focus on improvement of flash flood reduction infrastructure and local drainage system issues at community level and upstream - Suggested focus on strengthening community level and individuals' knowledges, institutional and organizational and skills to respond effectively to flood - Early warning and monitoring system along Wadi Soba developed and functioning and an emergency room created at community level - Target communities broadly represented and effectively participated in the state plan for adaptation to climate change		  Date: 2- 07- 2018 Method: Community/Group discussion
Ms. Awadia Abdel Rahman Head of Women Union El Kariab Members of the Women Union attended the consultation • Ms. Awadia Abdel Rahman • Ms. Nura El Mubarak • Ms. Manal abdel Rahim • Ms. Wedad Hassan Women Union is a branch of state and national Women Union		- The women union has strong solidarity and working together through women group savings (locally called Sanduq) on a rotational manner - Develop the capacity of the community; knoweledge and skills, organizing and planning capacity - Develop an early warning system - Establish communication, coordination and information sharing mechanizims		 Date 02-07-2018 Method: Focus group Discussion
• Adil Ahmed East Nile Locality - Soba East Administrative		• There are specific indigenous customs of community solidarity through collective support to individuals during		

Unit El Marabie block No 1 Phone # +249912369076 • Amgad Nouh Shoukry East Nile Locality - Soba East Administrative Unit El Marabie block No 2 Phone # + 24912351875 • Atif Abdallah East Nile Locality - Soba East Administrative Unit El Marabie Block No 3 Phone # +249912281288		emergency (called Nafeer) or social events (marriage, Funeral etc) both in cash and kind. • Suggested focus on improvement of flash flood reduction infrastructure and local drainage system issues at community level and upstream • Suggested focus on strengthening community level and individuals' knowledges, institutional and organizational and skills to respond effectively to flood • Early warning and monitoring system along Wadi Soba developed and functioning and an emergency room created at community level • Target communities broadly represented and effectively participated in the state plan for adaptation to climate change	 Date: 04-07-2018 Method: Community/Group discussion
Members of the Popular Committees • Mohamed Abdel Magid • Mohamed El Balula • Mohamed A. Mohmed • Omar Eltayeb Mohamed • Abdalla Mohmed Ahmed • Sidig Salah Eltigani • Adam Hassan Adam • Mohamed Fateh Elrahman • Khalid Abdel rahman Musa • Faris Abdallah			
Ms. Bakhita El Bakhit Hamid East Nile Locality - Soba East Administrative Unit Community - El Marabie Phone: +2499225590399 Women Union members attended the consultation: • Omyma Babiker M Sidig • Ebtisam Elzain Ali • Sumyia Abdallah • Amira El Basher • Neimat Abdel Ghafar • Mawada Nasir • Inas Abdel Rahman		- The women union has strong solidarity and working together through women group savings (locally called Sanduq) on a rotational manner - Women could be agents of change with some traditions and customs. **<u>Infrastructure:</u>** - Focus on addressing floods upstream and: - Consider rehabilitation of the culvert in El Marebie specially the eastern part of the culvert - Open streams to drain the internal water - Construction box culverts in the Wadi and the main streams to ease the movement and the accessibility **<u>Capacity development</u>**:	

• Taghwa Babiker • Ikhlas Mohmed Ahmed • Muna Sidig • Zeinab ahmed Hassan • Malkah Mahmoud Nasr • Daw Eddin Seid Ahmed		- Develop the capacity of the community; knowledge and skills, organizing and planning capacity - Develop an early warning system - Establish communication, coordination and information sharing mechanizims - Costrcution of Primary Health Care center - Hygiene promotion and sanitation - Awareness raising campaign	 Date: 04-07-2018 Method: Focus group discussion
Amir Mohamed Ahmed Suliman of Popular Committeee in El Fateh East Administrative Unit of Karari Locality Address: block # 17 El Fateh East Adminstrative Unit Phone # +249128498497		- El Fath was flooded in 2013 due to heavy rains and floods from the two Wadis. Water also came from the nearby mountains - Suggested focus on strengthening community level and individauls knowledges, institutional and organizational and skills to repsond effectively to flood - Suggested focus on improvement of flash flood infrastructure and local drainage system issues at community level, especially water pools inside residentail areas where number of children drown cases reported - Poverty is over 70%, water connection for 48% others depend on water vendor for inferior water with high price. - Most (80%) of the houses are built of mud and damaged during flood of 2013. - Target communities broady represented and effectively participated in the state plan for adaptation to climate change **<u>Infrastructure</u>** - Plan and implement Flood drainage network and construction of culverts - Improve water and sanitation by completion of water network to all area and improve pit latrines - Improvement of the quality of poor construction material by promotion and dissemination of environment friendly- flood resistance Stablized soil block - Create employment opportunity for unemployed youth	  Date: 24-07-2018 Method: Focus group discussion

		<u>Capacity development</u>: - Introduce income generation activities to alleviate high poverty - Develop the capacity of the community; knoweledge and skills, organizing and planning capacity - Develop an early warning system - Establish communication, coordination and information sharing mechanizims	
• Suad Salih • Coordinator of the Women Union in El Fateh • Participants are 32 women representing the different blocks in El Fateh		- The women represent different people. Originally settled in unplanned settlements El Fateh was demarcated by the government and distributed to 50 blocks where those people have settled - Women in El Fath are active, communicative and have strong social relations in spite of their different ethnicities - Women have clear role in in risk management, but their intervention is traditional and limited - Women in El Fateh are working in marginal jobs most of them are labors; tea or food sellers, cleaners, ..etc. They have skills some are well trained but lack income - Children and elderly people and women are the most affected groups by floods. - Raise the awareness of water and sanitation and garbage management - Youth employment opportunities - Gender sensitive risk management knowledge and skills	  24/07/2018 Group discussion

• Elsheikh Abbass Tageldin • Charirperson of the Popular Committee – Elsheikh Alamin East		- Construction of small dam north-east of the village at one of the tributaries of Wadi Soba - Rehabilitation and improvement of community existing Hafir (water reservoir as the underground water is salty 15:5586 N- 32:8374 E - Construction of culverts over the Wadi tributaries as the villages in the area facing cases of cut-off during the peak of flooding period - Introduction water saving technology for irrigation from expected water reservoir behind the dam taking into account the high evaporation during dry season - Introduction and promotion of environment and flood resistance building materials for community (stabilized soil block) - Introduction of Women income generation activities - Capacity building of popular committee and youth in flood disaster (prepareness and management)	  Women Photo not possible of local custom 31/07/2018 Group discussion

I. Justification of funding request

The proposed project components, outcomes and outputs fully align with 1) national and local government / institutional priorities and gaps identified, with 2) identified community and vulnerable groups needs and 3) with the Adaptation Fund outcomes. This alignment has resulted in the design of a comprehensive approach in which the different components strengthen each other and in which outputs and activities are expected to fill identified gaps of Sudan's and Khartoums's current climate change response and corresponding institutional capacities. In fact, the selected interventions / activities are directly confirmed and / or proposed by the national, state and municipal governments and inhabitants of target communities through consultations, as reported in Part II.H above.

The project aims to maximizing the funding amount for concrete adaptation interventions: the establishment of early warning systems and the interventions under component 3; funding allocation to components 1 and 2 is required to support the execution of component 3: to sustain interventions as well as to respond to government priorities / requests. The table below provides a justification for funding requested, focusing on the full cost of adaptation reasoning, by showing the impact of AF funding compared to no funding (baseline) related to expected project outcomes.

Table 18: Overview of impact of AF funding compared to no funding (baseline) related to expected project outcomes

Expected concrete output / intervention	Baseline (without AF)	Additional (with AF)	Comment and alternative adaptation scenario's
1.1. One Khartoum state / metropolitan area integrated urban-rural watershed management strategy 1.2. One Khartoum metropolitan area spatial / urban strategy 1.3. Three wadi early warning systems established (Locality level)	Comprehensive and detailed drought and flood risks and impacts information / evidence (i.e. maps) is not available for Khartoum (state), which means the government and communities can't properly plan for adaptation / resilience measures; An integrated watershed management does not exist in Khartoum, which means the government can't plan in a comprehensive way; Spatial / urban planning strategies in Khartoum don't consider climate change risks and impacts and current urban trends, which means the government lacks information to plan developmet in safe and appropriate areas; Early	The proposed activities / interventions under componnet 1 will allow Khartoum state and municipal government to collect detailed cliamte change (especially drought and flood) risks and impacts information, which is required to plan development in the state and municipality in a resilient and omprehensive way.	Without relevant drought and flood risks and impacts information / evidence development can take place in unsafe areas (e.g. flood plain) and the chance of water shortage will be larger. Alternative adaptation scenarios are the development of ad hoc plans, not taking into account the 'whole' system and drought and flood risks and impacts.

	warning systems for floods from Wadi's around Khartoum dont exist, which means the government can't warn inhabitants for floods from these Wadi's		
2.1. Seven community-level early warning systems established 2.2. Eleven community plans developed, and community members (especially women and youth) trained 2.3. Community members trained in seven communities to construct flood resilient and environmentally friendly houses	Early warning systems for floods from Wadi's around Khartoum dont exist, which means the communities can't warn inhabitants for floods from these Wadi's; Communities in Khartoum don't have the capcity to plan, operate and maintain priority resilience building interventions	The proposed activities / interventions under component 2 will allow communities to plan, operate and maintain their own priority resilience building interventions	Alternative adaptation scenarios are resettlement or the construction of larger drainage channels, which are not feasible from a cost perspective and environmental and social risks point of view and will also not have the benfit of water supply. Due to the severe historical flood impacts, community-level flood reduction interventions won't reduce flood impacts enough.
3.1. Two dams / water reservoirs constructed	Without flood reduction interventions East Nile community will continue to be at high risk of floods and up stream communities will continue to be of high risk of droughts, affecting agriculture and cattle and drinkwater supply. The state and municipal government don't have the resources and capacity to construct a multi-purpose water dam / reservoir.	The proposed activities / interventions under componnet 3 will allow the state and municipal government to protect East Nile community and upstream communities from floods and drought impacts and to replicate the tehcnical intervention	

J. Sustainabilty

The project aims to sustain adaptation benefits achieved and replicate best practices (i.e. lessons) after the end of the project through a combination of anchoring activities into existing government programmes and strategies and community plans, including for infrastructure operation and maintenance and by sharing lesons and best practices (see part II.G).

Institutional sustainability
The project will pave the way for the national government and local authorities to sustain and up-scale the project to other cities by developing watershed management and spatial strategies, which have been requested by the government and which will be anchored into existing ministry and municipal programmes, such as the Khatoum state Structure Plan 2008 - 2033. Moreover, trainings will be conducted to strengthen relevant government capacities and best practices and lessons learned from all component outputs and outcomes will be shared at the national and sub-national level.

Social sustainability
By organizing and fully engaging community members and vulnerable groups in project activities, including assessments during project preparation and the development of plans / strategies and monitoring, the project aims to achieve long-lasting awareness and capacities of community members. Moreover, communities will develop plans and community members will be trained to operate and maintain early warning systems and to construct resilient houses and to sustain livelihoods that require water (agriculture and cattle) through water supply / irrigation systems operation and maintenance. Possible social risks and impacts will also be identified and assessed indetail and if needed, mitigation, during the full proposal development phase.

Economic sustainability
Investing in increasing the resilience of vulnerable assets is a sustainable economic approach. It will not only avoid future costs related to drought and flood impacts, but it will also sustain livelihoods that depend on water. The watershed management and spatial strategies, as well as community plans will consider economic opportunities.

Environmental Sustainability
The watershed management and spatial strategies, as well as community plans will also consider environmental impacts. Possible environmental risks and impacts will also be identified and assessed in detail and if needed, mitigation, during the full proposal development phase.

Financial sustainability
The proposed interventions are fully in lign with national and sub-national priorities and programmes and therefore, the government actively supports the project and interventions, including anchoring it to existing progammes, such as the Khatoum state Structure Plan 2008 - 2033.

Technical sustainability
The dams / water reservoir and houses will be designed and constructed using resilience and building back better principles. This will enhance the durability/sustainability significantly. Besides that, a feasibility study and environmental and social impact assessment will be conducted for the dams / water reservoirs during the full project development phase and a formal partnerships with Khartoum state and municipality will be established for the maintenance of the dams / water reservoirs, including commited maintance plan and budget. The Ministry of Infrastructure in Khartoum State already manages some dams and provides routine and periodic maintenance together with ministry of irrigation and water resources.

Below table provides an overview of project outputs and arrangements to sustain / maintain these. More details for the arrangments will be identified during the full project development phase.

Table 19: overview of outputs and arrangements to sustain / maintain these

Expected concrete output / intervention	Arrangements to sustain / maintain activities / interventions
1.1. One Khartoum state / city integrated urban watershed management strategy 1.2. One Khartoum metropolitan area spatial / urban strategy 1.3. Three wadi early warning systems established (Locality level)	- Formally aprove the strategy as part of Khatoum state Structure Plan 2008 – 2033 - Formally aprove the strategy as part of Khatoum state Structure Plan 2008 – 2033 - Formally aprove the early warning system and integrate it into Khartoum city flood warning system
2.1. Seven community-level early warning systems established 2.2. Nine community plans developed, and community members (especially women and youth) trained 2.3. Community members (especially carpenters) trained in seven communities to construct flood resilient and environmentally friendly houses	- Development of community plans for operation and maintenance and agreement establihsed between communities and municipal government about maintenance arrangement
3.1. Constructing dams / water reservoirs up-stream of Wadi Soba, leading to upstream villages water and livelihood security and downstream communities flood reduction	- The Ministry of Infrastructure in Khartoum State already manages some dams and provides routine and periodic maintenance together with ministry of irrigation and water resources. The proposed dams / water reservoirs will need to be approved as part of the minstries' programme, including a committed maintenance plan and budget

K. Environmental and social impacts and risks

The proposed project seeks to fully align with the Adaptation Fund's Environmental and Social Policy (ESP) and the Gender Policy (GP). Further to part II.E above on project compliance with national technical standards, outlined below is a summary of the findings of the initial (concept note stage) screening of all components and activities / interventions against the 15 AF principles to identify potential environmental and social risks and impacts. With this information, the entire project risk has been categorized.

Because of the nature of the proposed intervention under components 3 (dams / water reservoirs), the entire project is currently categorized as a medium risk (Category B) project. The proposed dam / water reservoir is a concrete intervention with possible adverse environmental and social impacts (see annex 2 and 3 for more info). Although the possible dam options can be regarded as large infrastructure interventions, identified potential environmental and social risks and impacts are expected to be reversible or to be avoided / mitigated (for details see annex 2 and the following environmental ans social impacts study in an area close to the target area: http://khartoumspace.uofk.edu/handle/123456789/9244 Moreover, the size of the currently discussed dams could be reduced which would result in the proposal of a larger number of small dams. Therefore, because the potential risks and impacts of possible dams reversable or possible to mitigate, the project has been categorized as a category B project.

Potential environmental and social risks related to proposed activities that have been identified at this stage (concept note) and will be avoided / mitigated, include equal access and benefits of proposed interventions, in particulat for women, youth and DP groups but also nomads. These groups are generally not well organized (for more detail see annex 2) and therefore the project will avoid these potential risks by ensuring equal representation of vulnerable groups, especially women, youth and DPs, but also nomads, during consultations, planning processes and for possible job opportunities. As for the set-up of EWSs, decision-making structures in which all groups are able to participate equally and which can be used for more than just setting-up EWSs, will be established.

Based on an initial analysis of the target area and the outcome of the Environmental and Socio-economic Impact study of Wadi Abu Soueid Water Harvesting and Spreading Project in Khartoum State, Sudan,[26] which is close to the target area, other potentially negative impacts include increase in the densities of the noxious Adar (Sorghum sp.) weed and semi-parasitic Buda (Striga hermonthica) plant, security problems (including trespassing on farmland and rangeland by nomadic groups from neighboring areas and animal thefts), and uncontrolled flooding of potentially productive farmland due to neglect of dam maintenance. Mitigation will be put in place to avoid these potentially negative impacts, including a government committed maintenance plan and budget. However, in the case of the proposed project, there are streams that allows to discharge water in case the dam exceeds its capacity (although unlikely because its will be designed for a 50 year flood event). The study also revealed positive impacts: an increase in production and productivity makes the sorghum residues available for supplementary feeding during dry season as well as cultivation of Abu Saba'een (Sorghum bicolor) from water reservoir to provide supplementary feeding to livestock, hence increase milk production and milk related products (cheese) for income generation.

During the full proposal development phase, all environmental and social risks and impacts will be identified, quantified and mitigated. The ministry of Ministry of Environment, Natural Resources & Physical Development is planning to hire a consultant to conduct an environmental and social risks and impact assessment of the proposed dams / reservoirs (or more smaller dams) in line with national technical standards and in compliance with the AF ESP and GP.

As per annex 2, any potential risk of resettlement is ruled out. The dams will be constructed on public land where nobody lives. Any (informal) land use, such as for agriculture, will be identified and assessed in detail during the the full proposal development phase. Some potential social risks identified during the concept note stage are related to equal access to (irrigation) water and avoidance of social tension to access this water. Mitigation measures will be put in place to reduce these risks. As for potential environmental impacts, these will be assessed in detail (i.e. quantified) during the full proposal development phase. For similar interventions in the Khartoum area no significant negative impacts were identified, except for potential maintenance commitment issues and equal access of water (see study of Wadi Abu Soueid Water Harvesting and Spreading Project. Follow-up activities mitigated these risks.

Although the proposed dams are government priorities to reduce flood impacts in East Nile and to reduce water scarcity and potential risks and impacts are expected to not be significant (see above and annex 2), the size / dimensions of the proposed dams could be reduced (although not preferred by the government) to reduce any potential environmental and social risks. In this case a larger number of smaller dams / water reservoirs could be proposed.

Deleted: Specific concerns related to equall access to water, use of agricultural land for construction and related compensations and negative impact on natural habitats, biodiversity and land and soil, etc. During the full project development phase, when detailed information of the location and design will be made available an environmental and social impact assessment will be conducted in line with national technical standards, which will provide information for an accurate categorization.

[26] http://khartoumspace.uofk.edu/handle/123456789/9244

As for the activities under component 1 and 2 potential risks concerns related to equall access to benefits and avoidance of adverse impacts on margnizaled and vulnerable groups and women, but these potential risks will be mitigated.

Deleted: are

During the full proposal development phase, detailed screening of all components and activities / interventions against the 15 AF principles will take place to identify all potential environmental and social risks, assess impacts in detail and propose mitigation meausures when needed. This will be done by collecting detailed information on proposed activities / interventions, conduct feasibility studies of concrete interventions and assess environmental and social impacts of potential risks, all through studies in line with national technical standards and community and vulnerable groups consultations.

A 'gender' baseline and approach / strategy is under development (see annex 2) to reduce potential risks and maximize benefits for marginzalized and vulnerable groups, including women, youth (and children) and DPs / indigenous groups and to ensure that project benefits will be allocated equally, that discrimination nor favouritism in accessing project benefits can take place and that adverse impacts are avoided. Besides that, potential environmental and social risks and impacts are assessed in more detail in the ESP compliance annex (annex 2).

Deleted: x

Deleted: , which will include an ESMP.

Below table provides an overview of the 15 AF principles and a checklist if further assessment is required during the full project development phase. In the ESP compliance annex 2, concept note stage screening outcomes of all project activities against the 15 AF principles are discussed in detail. In the final full proposal, no further assessments should be required because all details of activities will be provided and if risks exists, they will be mitigated to acceptable levels.

Table 20: checklist of the 15 AF principles:

Checklist of environmental and social principles	No further assessment required for compliance	Potential impacts and risks – further assessment and management required for compliance
Compliance with the Law	x	
Access and Equity		x
Marginalized and Vulnerable Groups	x	
Human Rights	x	
Gender Equity and Women's Empowerment		x
Core Labour Rights	x	
Indigenous Peoples	x	
Involuntary Resettlement	x	
Protection of Natural Habitats		x
Conservation of Biological Diversity		x
Climate Change		x
Pollution Prevention and Resource Efficiency		x
Public Health		x
Physical and Cultural Heritage	x	
Lands and Soil Conservation		x

PART IV: ENDORSEMENT BY GOVERNMENTS AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. Record of endorsement on behalf of the government[27]

Dr Noureldin Ahmed Abdalla, Secretary general, Higher Council for Environment and Natural resources	Date*: 29 July 2018*

Letter of Endorsement by Government

29 July 2018

To: The Adaptation Fund Board
c/o Adaptation Fund Board Secretariat
Email: Secretariat@Adaptation-Fund.org
Fax: 202 522 3240/5

Subject: Endorsement for Increasing the flood and drought resilience in Khartoum city and surrounding villages through integrated watershed management

In my capacity as designated authority for the Adaptation Fund in Sudan, I confirm that the above national project/programme proposal is in accordance with the government's national priorities in implementing adaptation activities to reduce adverse impacts of, and risks, posed by climate change in the country.

Accordingly, I am pleased to endorse the above project/programme proposal with support from the Adaptation Fund. If approved, the project/programme will be implemented by United Nations Human Settlements Programme (UN-Habitat) and executed by Ministry of Environment, Natural Resources and Physical Development, Higher Council for Environment & Natural Resources, and Ministry of Infrastructure & Transportation - Road, Bridges & Drainage - Khartoum State in the Government of Sudan.

Sincerely,

Dr. Noureldin Ahmed Abdalla
Secretary General,

National Focal Point for the UNFCCC & DA
for the Adaptation Fund, Higher Council for
Environment & Natural Resources

Tel: +249 183 784279 Fax: +249 183 787617 P.O. Box: 10488 Khartoum
Web: www.hcenr.net E-mail: hcenr2005@yahoo.com

[6] Each Party shall designate and communicate to the secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

B. **Implementing Entity certification**

I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans, including the Sudan INDC, NAP, SNC, Sudan's 25-year strategy and Khartoum structural plan, and subject to the approval by the Adaptation Fund Board, commit to implementing the project/programme in compliance with the Environmental and Social Policy of the Adaptation Fund and on the understanding that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.
for Rafael Tuts Director, Programme Division UN-Habitat Signature
Date: 06-August-2018 | Tel. and email: +25420762-3726 raf.tuts@un.org
Project Contact Person: Tarek Abdel Monem
Tel. And Email: +20237618812 tarek.abdel-monem@un.org

ANNEX 1: Detailed consultations reporting / evidence

Content:

- ☐ El Kariab community / popular committee
- ☐ El kariab women union
- ☐ El Marabie community / popular committee
- ☐ El Marabie women union
- ☐ El Fatah community / popular committee
- ☐ El Fatah women union
- ☐ El Sheikh Alamin community / popular committee + women Group jointly

RAPID COMMUNITY SURVEY
BUILDING URBAN CLIMATE RESILIENCE IN KHARTOUM, SUDAN
UN-HABITAT - ADAPTATION FUND
Focus: community / popular committee of El Kariab Block
Method: group discussion

1. Basic assessment information

Name community leaders (e.g. chairperson popular committee)	Mohamed Ahmed Mustafa Chairperson of El Kariab Popular Committee
Contact details and photo 	East Nile Locality - Soba East Administrative Unit El Kariab North Street No. 15 Phone: +249123033721 +24918879351
Date assessment conducted	2 July 2018
Attendance sheet filled	check
Photos of consultation made COORDINATES: 15.552N - 32.655 E	

2. Community profile

Municipality/ District name	East Nile Locality (Municipality) – Soba East Administrative Unit	
Community (popular committee) name		El Kariab Popular Committee
Location (on map)		
Total population (number)		28,500
Number or percentage	Female	14,090
	< age 14 (children)	12,141
	age 15-24 (youth)	5,614
	age 25-60	7,984
	> age 60 (elderly)	2821
	(ex) Refugees / displaced (from where?) ***Drought displaced but formalized recently through planning***	8,490 (Majority from Kordofan)

	Informal people	Formalized in 2014
	Indigenous people	20010 (Tribes from Darfur, Nubian)
	HIV positive	No Data
	Disabled population	886
Households (number) + average per household		5000 HH average HH size: 5.7
Poverty rate (%)		56%
Access to electricity (%)		100%
Access to clean water (%)		95%
Access to sanitation (proper toilet) (%)		90%
Main livelihoods / income		Casual labour, self-employment, farming, job with private and public sectors
Main community infrastructure-related issues and settlement photos and GPS points where possible	Floods (or risk areas)	1. Wadi Soba Intercept with irrigation canal syphoned beneath the Irrigation canal which creates a bottleneck and Inundation of residential areas 2. Earth embankment for protection residential areas Is weak and erodes and damages by flood water run-off particularly during 2013 flood 3. Road (highway) is more than 1meter higher than the level of residential areas and against contour lines.
	Drainage (issues)	1. Low land and lack of local drainage system 2. level of water in Wadi during high flooding is higher the level of water accumulated inside the residential areas
	Droughts (or risk areas)	
	WASH (issues)	1. vulnerable pit latrines to flood leads to damage of the latrines and contamination of water

3. Climate change – trends analysis

Purpose: to understand community perception of climate change hazards in the past and for communities to become aware of changes and how climate change differs from weather change.

Expected outcome: agreement on one or two climatic hazards, which have most impacted the community

Climate Change hazards	**In the last 10 years, has the community been affected by:**	**Has this issue been getting:**
Droughts (e.g. lack of water for household use, damage to crops)	i) Yes, a lot, ii) yes, a little, iii) □ **no**, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) □ **same**, iv) better, v) not relevant, vi) can't say.
Extreme heat (e.g. resulting in electrical problems, health impacts, crop/fisheries damage)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Flood (river flooding, local flooding due to poor drainage • Wadi (seasonal water stream) • Poor drainage	**i)** □ **Yes, a lot**, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, **ii)** □ **little worse**, iii) same, iv) better, v) not relevant, vi) can't say

Storms/cyclones (e.g. destruction to house or goods, disruption to services, access cut)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Diseases (e.g. dengue, diarrhea) Malaria, Diarrhea, Respiratory Infection and Typhoid	i) □ **Yes, a lot**, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) □ **little worse**, iii) same, iv) better, v) not relevant, vi) can't say

Top 3 most problematic climatic hazards

Hazard	**Occurrence between 2008 and 2018 (years)**	**Possible comment**
1. River (Wadi) and local flooding	2013 and 2016	The community mentioned the following two facts: • Road (highway) is more than 1meter higher than the level of residential areas and against contour lines has aggravated the magnitude of hazard in 2016 • Even though the 2016 flood was similar to 2013 but the negative impact was less due the use of durable building materials instead of mud, in addition to widening of some culverts and lessons learned from 2013 flood
2. Diseases: (Malaria, Diarrhea, Respiratory Infection and Typhoid)	2013 and 2016	
3.storm		• Its effect is limited to roof of schools and some houses

4. Climate change – questionnaire

These questions help to analyze current and future climate risks, barriers to adaptation and factors/resources facilitating the coping strategies used by community and way of improving their resilience.

What problems / effects does your community face because of the one or two most problematic climatic hazards (see result trend analysis) and how do these affect men, women, elderly, youth, disabled people, (ex) refugees in your community?

Most problematic climatic hazard	Problems / effects (e.g. agriculture destruction, lack of water or food for cattle, drinking water scarcity, disease, death, damages - need to move somewhere else, need to invest in protection, need to find other income)	Who (what group) is most affected?	How does hazard impact those most affected?
Floods	Destruction of houses, shortage and contamination of drinking water, loss of properties, death of animals	Children, women, elders, handicapped,	• Phycological stress, especially among children • The poorest and needy people increased • Affected families were displaced for a while.

Disease	Lack of access to health facilities, Difficulties of movement during flooding, Increased death rate, increased cost of medication	Childern and women	• Affect pupils attenance to school • Increase students drop-out rate
Storm	Collapsing roofs of schools and houses	Poor people living in poor housing	

The magnitude of barriers to adaptation

What stops your community from coping with current impacts of the most problematic climatic hazards (see result trend analysis)? These can be e.g. lack of knowledge / education, lack of skills, lack of money, lack of land tenure, lack of irrigation, lack of drinking water supply, health issues, bad infrastructure, lack of drainage system, lack of natural resources like forests, etc.).

Most problematic climatic hazard	☐ What is currently limiting your community from coping with or adapting to the impacts? (What makes it difficult for you to deal with them or makes it difficult to make changes to deal with them) ☐ in what ways has your community already adapted to deal with these issues?	Ranking most important factors
Floods from Wadi (water stream)	Answers to Question 1 a) inability of community to organize and mobilized its members due to lack of effective structure for participation b) lack of skills and knowledge related to the process of rescue c) lack of community-based emergency action plan and budget d) weak vertical and horizontal coordination and communication e) shortage of information before, during and after floods Answers to question 2 i. popular committee uses social media and Mosque loudspeakers for communication i. some members of popular committee trained on disaster response and mitigation i. Change of majority of mud houses into cement block houses	c, b, a, e, d I, iii, ii
Diseases	1. weak health services 2. vulnerable sanitation system and lack of suitable options 3. low land inside the residential areas and lack local drainage system	2, 1,3

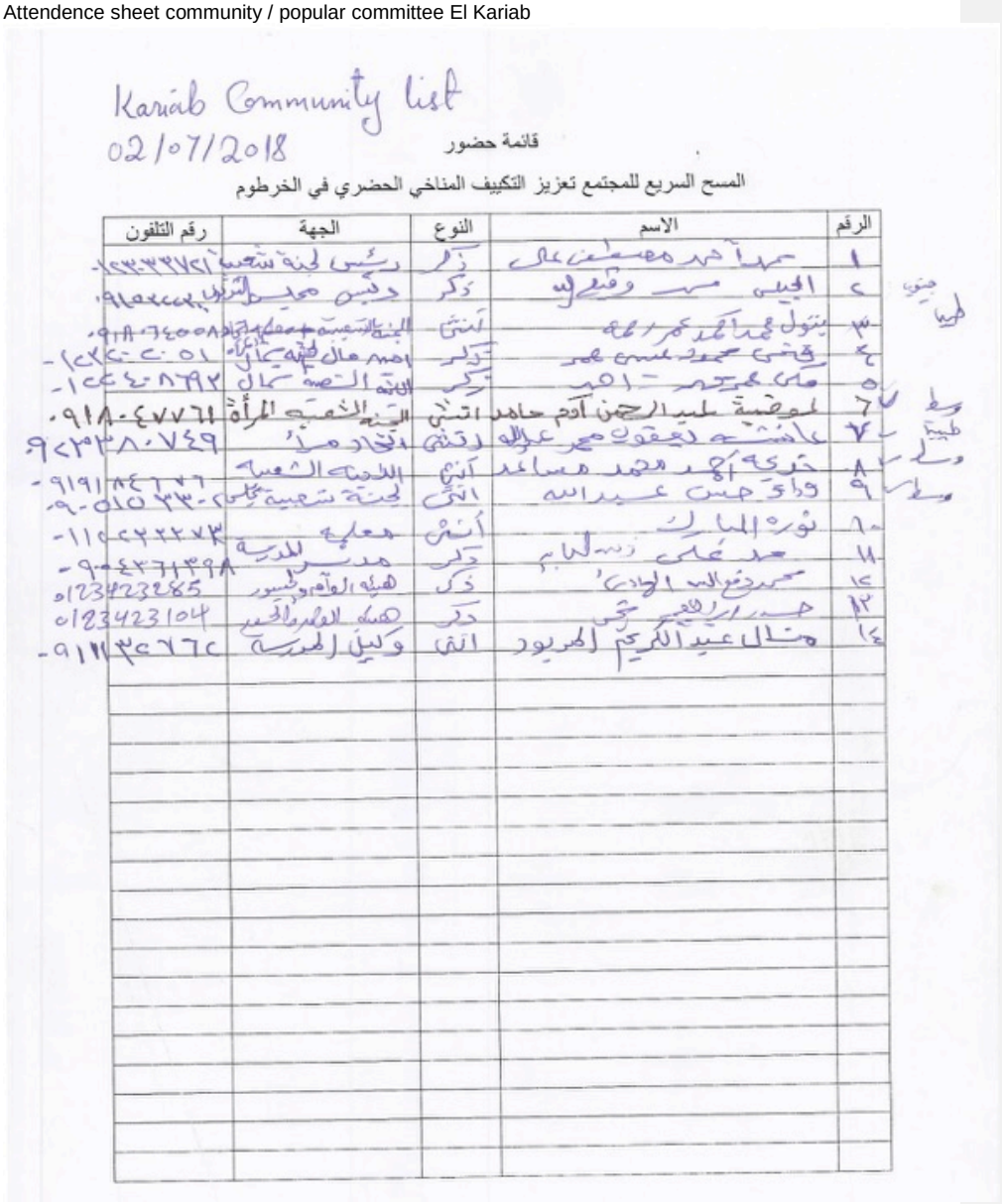
The priorities to be addressed in strengthening the adaptive capacity of the community.

What activities should take place or infrastructure constructed in order to improve your adaptive capacity to droughts, floods, landslides, heat, and diseases? What is most important for the community?

Most problematic climatic hazard	Activity and/or infrastructure	Ranking most important activity and/or infrastructure
floods	1. Lining of the wadi water course with stones for protection against erosion and breakage 2. Construct of inlet and outlet control door at the junction between the main drainage and the Wadi	3, 2, 1, 4, 5, 6, 7

	3. Design and development of effective local drainage system 4. Construction of culverts on the main drainage to facilitate movement during flood 5. Strengthen community knowledge, skills and organizational and planning capacities 6. Development of early warning and monitoring system and create an emergency room at community level 7. Strengthen vertical and horizontal coordination and communication	
Diseases	1. Improvement of vulnerable pit latrines which destroyed during flooding and led to contamination of water 2. Control of vectors (mosquito, flies) using environmentally friendly methods and scorpions 3. Improvement of primary health care units to be prepared and responsive to emergency – including training of selected community members.	

Attendence sheet community / popular committee El Kariab



Kariab Community list

02/07/2018

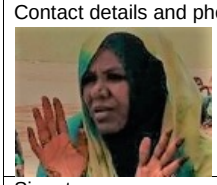
قائمة حضور

المسح السريع للمجتمع تعزيز التكييف المناخي الحضري في الخرطوم

الرقم	الاسم	النوع	الجهة	رقم التلفون
١		ذكر		
٢		ذكر		
٣		أنثى		
٤		ذكر		
٥		ذكر		
٦		أنثى		
٧		أنثى		
٨		أنثى		
٩		أنثى		
١٠		أنثى		
١١		ذكر		
١٢		ذكر		
١٣		ذكر		
١٤		أنثى		

RAPID COMMUNITY SURVEY
BUILDING URBAN CLIMATE RESILIENCE IN KHARTOUM, SUDAN
UN-HABITAT - ADAPTATION FUND
Focus: women in El Kariab
Method: focus group discussion

1. **Basic assessment information**

Name group representative	Khadiga Ahmed Mohamed Musaad
Contact details and photo 	East Nile Locality - Soba East Administrative Unit El Kariab North Street No. 15 Phone: +249919184676 +249999303017
Signature	
Date assessment conducted	02 July 2018
Attendance sheet filled	check
Photos of consultation made Coordinates: 15.552 N-32.655 E	

2. **Climate change – trends analysis**

Purpose: to understand groups perception of climate change hazards in the past and for communities to become aware of changes and how climate change differs from weather change.

Expected outcome: agreement on one or two climatic hazards, which have most impacted the community

Climate Change hazards	**a) In the last 10 years, has the community been affected by:**	**Has this issue been getting:**
Droughts (e.g. lack of water for household use, damage to crops)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say.
Extreme heat (e.g. resulting in electrical problems, health impacts, crop/fisheries damage)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Flood (river flooding, local flooding due to poor drainage	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Storms/cyclones (e.g. destruction to house or goods, disruption to services, access cut)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Diseases (e.g. dengue, diarrhea)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say

Top 3 most problematic climatic hazards

1. Flooding of Wadi Soba

2. Diseases (Diarrhea, Respiratory infection, Malaria and Bilharzia

3. **Climate change – questionnaire**

These questions help to analyze current and future climate risks, barriers to adaptation and factors/resources facilitating the coping strategies used by groups and way of improving their resilience.

What problems does your specific group (women) face because of the one or two most problematic climatic hazards (see result trend analysis)

Most problematic climatic hazard	Problems / effects (e.g. agriculture destruction, lack of food or water for cattle, drinking water scarcity, disease, death, damages - need to move somewhere else, need to invest in protection, need to find other income)	Who (what group) is most affected?	How does hazard impact your group specifically?
Floods	Houses damages, loss of assets, drinking water scarcity, disease, needs to move to somewhere else	Women Children, Elderly Disabled	Psychologically affected (panicking) Closure of schools Financially Socially affected
Diseases	Spread of disease High rate of death	Children Elderly	Deterioration of health conditions Absence of from the schools and work Increase of medication costs and its effect on the individual income

The magnitude of barriers to adaptation

What stops specifically your group (women) from coping with current impacts of the most problematic climatic hazards (see result trend analysis)? These can be gender roles, illegal status affecting tenure, illegal status affecting employment options, lack of knowledge / education, lack of skills, lack of money, etc.

Most problematic climatic hazard	1) What is currently limiting your community from coping with or adapting to the impacts? (What makes it difficult for you to deal with them or makes it difficult to make changes to deal with them) 2) in what ways has your community already adapted to deal with these issues?	Ranking most important factors
Floods	Residential area is low No local drainage and culverts Lack of action plans for response Lack of funds Lack of knowledge and skills for disaster preparedness and response Lack of effective vertical and horizontal communication and coordination	Knowledge and skills Financial resources Action plans and organization
Diseases	Shortage of health services and hygiene Lack of sanitation High poverty rate	Health services, hygiene and sanitation

The priorities to be addressed in strengthening the adaptive capacity of the group.

What activities / interventions should take place to adapt to climate change hazard impacts (e.g. address floods or droughts? What is most important for the group?

Most problematic	Activity / intervention	Ranking most

climatic hazard		important activity / intervention
Floods	<u>Infrastructure:</u> Rehabilitation and excavation of the Soba Wadi in the residential area Construction of entrance control in the joint points of the streams and the Wadi Construction of the drainage system Construction box culverts in the Wadi and the main streams to ease the movement and the accessibility	 3 2 1 4
	<u>Capacity development:</u> Develop the capacity of the community; knowledge and skills, organizing and planning capacity Develop an early warning system Establish communication, coordination and information sharing mechanisms	 1 2 3
Diseases	Construction of Primary Health Care center Hygiene promotion and sanitation Awareness raising campaign	1 2 3

If these activities, interventions are provided, what would be your main concern and need (e.g. related to employment, health, water access, food security, tenure security, resettlement, etc.?)

Activity / intervention	Concerns and needs	Rank
1) provision of credit facilities and training for self-employment of women 2) Relocation of vulnerable houses on flood prone areas 3) regularization of some plots of land still	• High level of unemployment especially among women with high dependency on the head of the family • high level of poverty (women potentials has not been tapped) • high illiteracy rates among women • customs and norms prevent women from effective participation • early marriage and high drop-out rate from school • Awareness campaigns for women rights to education and employment	

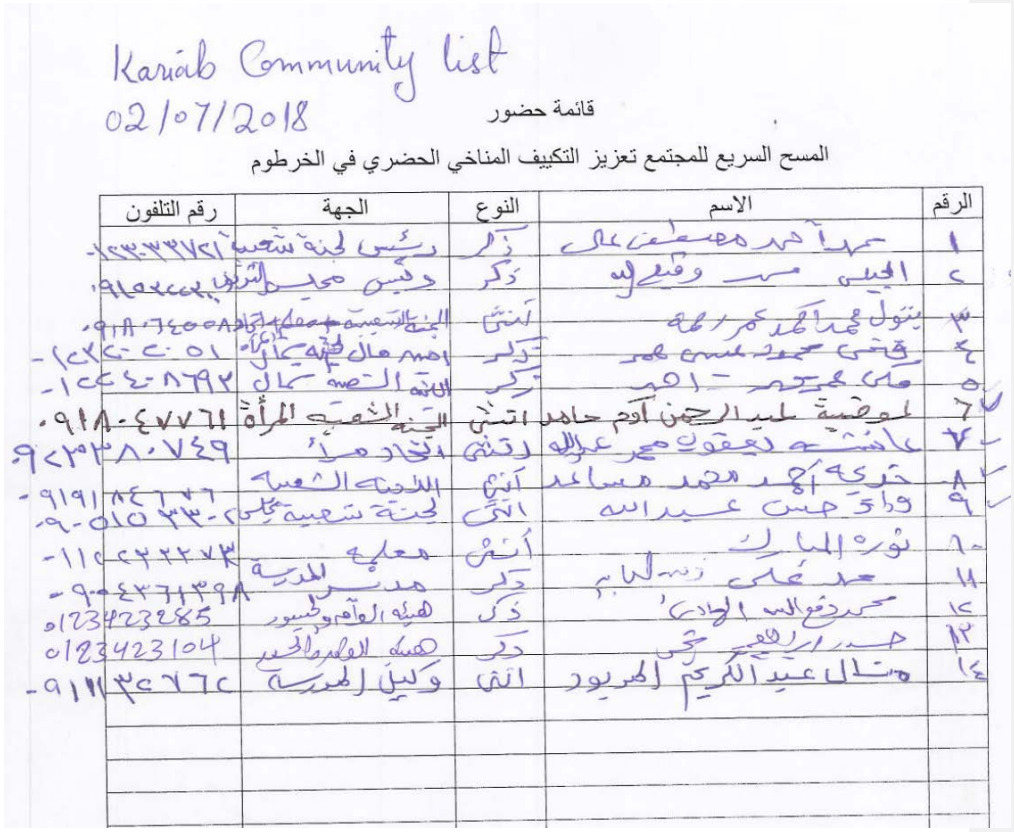
Group skills, strengths and leaders.

What the group good at doing or what are the strengths? (e.g. committees, successful projects working together, construction or organizing skills, good connections outside community)	1) How can this be used for the climate problems or general problems? 2) Who will be the leader for making this happen? (what community committees can help with this?)
1) women and community solidarity through collective support to individuals during emergency (called Nafeer) or social events (marriage, Funeral etc) both In cash and kind 2) Women group savings (called Sanduq) on a rotational manner	1) the same group could be trained to identify the most vulnerable Individuals/families and reasons for vulnerability and provide through Nafeer the needed support 2) saving groups can be developed into credit or microfinance local institution to help in creation of employment and hence alleviate poverty

Any other ideas, concerns / issues, needs

Ideas	Concerns	Needs
Planting of trees along the main roads and a close to residential areas	Erosion of soil by water, high heat during summer, wind-break	Training of community on tree planting and provision of seeds and seedlings

Attendence sheet Kariab women union consultation



Kariab Community list

02/07/2018

قائمة حضور

المسح السريع للمجتمع تعزيز التكييف المناخي الحضري في الخرطوم

الرقم	الاسم	النوع	الجهة	رقم التلفون
١		ذكر	رئيس لجنة شعبية	
٢		ذكر	رئيس مجلس الشرق	
٣		انثى		
٤		ذكر		
٥		ذكر		
٦		انثى		
٧		انثى		
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١٠		انثى		
١١		ذكر		
١٢		ذكر		
١٣		ذكر		
١٤		انثى		

RAPID COMMUNITY SURVEY
BUILDING URBAN CLIMATE RESILIENCE IN KHARTOUM, SUDAN
UN-HABITAT - ADAPTATION FUND
Focus: community / popular committee of El Marabie Block
Method: group discussion

1. Basic assessment information

Name community leaders (e.g. chairperson popular committee)	1. Adil Ahmed Bilal Chairperson of El Marabie Block (1) Popular Committee 2. Amgad Nouh Shoukry Chairperson of El Marabie Block (2) Popular Committee 3. Atif Abdallah Chairperson of El Marabie Block (3) Popular Committee
Contact details and photo  	• Adil Ahmed East Nile Locality - Soba East Administrative Unit El Marabie block No 1 Phone # +249912369076 • Amgad Nouh Shoukry East Nile Locality - Soba East Administrative Unit El Marabie block No 2 Phone # + 24912351875 • Atif Abdallah East Nile Locality - Soba East Administrative Unit El Marabie Block No 3 Phone # +249912281288
Date assessment conducted	4 July 2018
Attendance sheet filled	check
Photos of consultation made COORDINATES: 15.533N - 32.674	 

2. Community profile

Municipality/ District name	East Nile Locality (Municipality) – Soba East Administrative Unit	
Community (popular committee) name		El Marabie Popular Committee
Location (on map)		
Total population (number)		26,370
Number or percentage	Female	11,840
	< age 15 (children)	11,234
	age 15-24 (youth)	5,195
	age 25-60	7,384
	> age 60 (elderly)	2,557
	(ex) Refugees / displaced (from where?)	Formalized in 2014
	Informal people	Formalized in 2014
	Indigenous people	No data

	HIV positive	No data
	Disabled population	1054
Households (number) + average per household		4395 HH average HH size: 6.0
Poverty rate (%)		54%
Access to electricity (%)		85%
Access to clean water (%)		66%
Access to sanitation (proper toilet) (%)		70%
Main livelihoods / income		Petty trade and other micro-enterprises, in the informal economy, job with prive sector, soldiers and police
Main community infrastructure-related issues and settlement photos and GPS points where possible	Floods (or risk areas) N 15.540 - E 32.675 	1. Some houses are in flood prone areas (and may need to be relocation) 2. Wadi Soba Intercept with irrigation canal syphoned beneath the Irrigation canal which creates a bottleneck and Inundation of residential areas 3. Earth embankment for protection residential areas is weak and erodes and damages by flood water run-off particularly during 2013 flood 4. Road (highway) is more than 1meter higher than the level of residential areas and against contour lines.
	Drainage (issues)	1. Low land and lack of local drainage system 2. Level of water in Wadi during high flooding is higher the level of water accumulated inside the residential areas
	Droughts (or risk areas)	
	WASH (issues)	1. Vulnerable pit latrines to flood leads to damage of the latrines and contamination of water

3. **Climate change – trends analysis**

Purpose: to understand community perception of climate change hazards in the past and for communities to become aware of changes and how climate change differs from weather change.

Expected outcome: Agreement on one or two climatic hazards, which have most impacted the community

Climate Change hazards	**a) In the last 10 years, has the community been affected by:**	**Has this issue been getting:**
Droughts (e.g. lack of water for household use, damage to crops)	i) Yes, a lot, ii) yes, a little, iii) □ **no**, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) □ **same**, iv) better, v) not relevant, vi) can't say.
Extreme heat (e.g. resulting in electrical problems, health impacts, crop/fisheries damage)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say

Flood (river flooding, local flooding due to poor drainage • Wadi (seasonal water stream) • Poor drainage	**i) Yes, a lot**, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, **ii) little worse**, iii) same, iv) better, v) not relevant, vi) can't say
Storms/cyclones (e.g. destruction to house or goods, disruption to services, access cut)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Diseases (e.g. dengue, diarrhea) Malaria, Diarrhea, Respiratory Infection and Typhoid	i) **Yes, a lot**, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) **little worse**, iii) same, iv) better, v) not relevant, vi) can't say

Top 3 most problematic climatic hazards

Hazard	**Occurrence between 2008 and 2018 (years)**	**Possible comment**
1. River (Wadi) and local flooding	2013 and 2016	The community mentioned the following two facts: • Road (highway) is more than 1meter higher than the level of residential areas and against contour lines has aggravated the magnitude of hazard in 2016 • Even though the 2016 flood was similar to 2013 but the negative impact was less due the use of durable building materials instead of mud, in addition to widening of some culverts and lessons learned from 2013 flood
2. Diseases: (Malaria, Diarrhea, Respiratory Infection and Typhoid)	2013 and 2016	
3.storm		• Its effect is limited to roof of schools and some houses

4. **Climate change – questionnaire**

These questions help to analyze current and future climate risks, barriers to adaptation and factors/resources facilitating the coping strategies used by community and way of improving their resilience.

What problems / effects does your community face because of the one or two most problematic climatic hazards (see result trend analysis) and how do these affect men, women, elderly, youth, disabled people, (ex) refugees in your community?

Most problematic climatic hazard	Problems / effects (e.g. agriculture destruction, lack of water or food for cattle, drinking water scarcity, disease, death, damages - need to move somewhere else, need to invest in protection, need to find other income)	Who (what group) is most affected?	How does hazard impact those most affected?
Floods	Destruction of houses, cases of death result from falling of houses and flood, shortage and contamination of drinking water, loss of properties, death of	Children, women, elders, handicapped,	• Panicking, dark nights for 17 days and phycological stress, especially among children

	animals, bites of Scorpios and snakes and the lack of vaccines		• The poorest and needy people increased • Affected families were displaced for a while along the main highway resulted in some traffic accidents and death.
Disease	Lack of access to health facilities, Difficulties of movement during flooding, Increased death rate, increased cost of medication	Childern and women	• Affect pupils attenance to school • Increase in students drop-out rate
Storm	Collapsing roofs of schools and houses	Poor people living in poor housing	

The magnitude of barriers to adaptation

What stops your community from coping with current impacts of the most problematic climatic hazards (see result trend analysis)? These can be e.g. lack of knowledge / education, lack of skills, lack of money, lack of land tenure, lack of irrigation, lack of drinking water supply, health issues, bad infrastructure, lack of drainage system, lack of natural resources like forests, etc.).

Most problematic climatic hazard	☐ What is currently limiting your community from coping with or adapting to the impacts? (What makes it difficult for you to deal with them or makes it difficult to make changes to deal with them) ☐ In what ways has your community already adapted to deal with these issues?	Ranking most important factors
Floods from Wadi (water stream)	Answers to Question 1 a) Lack of proper planning for residential areas as some areas are prone to floods may need relocation b) The magnitude of flood was beyond the capacity of local community (reached two meters) which depended on external support in terms of rubber boats and small ferry boats to rescue vulnerable groups c) inability of community to organize and mobilized its members due to lack of effective structure for participation d) lack of skills and knowledge related to the process of rescue e) lack of community-based emergency action plan and budget f) weak vertical and horizontal coordination and communication g) shortage of information before, during and after floods Answers to question 2 i. popular committee uses social media and Mosque loudspeakers for communication ii. some members of popular committee trained on disaster responses and mitigation iii. Change of majority of mud houses into cement block houses	a, b, c, e, d, g, and f I, iii, ii
Diseases	1. weak health services 2. vulnerable sanitation system and lack of suitable options 3. low land inside the residential areas and lack local drainage system	2, 1,3

The priorities to be addressed in strengthening the adaptive capacity of the community.

What activities should take place or infrastructure constructed in order to improve your adaptive capacity to droughts, floods, landslides, heat, and diseases? What is most important for the community?

Most problematic climatic hazard	Activity and/or infrastructure	Ranking most important activity and/or infrastructure
floods	1. Lining of the wadi water course with stones for protection against erosion and breakage 2. Construct of inlet and outlet control door at the junction between the main drainage and the Wadi 3. Design and development of effective local drainage system 4. Construction of culverts on the main drainage to facilitate movement during flood 5. Strengthen community knowledge, skills and organizational and planning capacities 6. Development of early warning and monitoring system and creation of an emergency room at community level 7. Strengthen vertical and horizontal coordination and communication	3, 2, 1, 4, 5, 6, 7
Diseases	1. Improvement of vulnerable pit latrines which destroyed during flooding and led to contamination of water 2. Control of vectors (mosquito, flies) using environmentally friendly methods and scorpions 3. Improvement of primary health care units to be prepared and responsive to emergency – including training of selected community members.	

Attendence sheet community / popular committee El Marabie

EL Marabié Popular Committee consultation

قائمة حضور

المسح السريع للمجتمع تعزيز التكييف المناخي الحضري في الخرطوم

الرقم	الاسم	النوع	الجهة	رقم التلفون
١	محمد عبد الماجد مختار	ذكر	شباب الحي	٠٩١٤٤٧٥١٧٩
٢	محمد البلوله محمد ابراهيم			[illegible]
٣	د. محمد سعد [illegible]	ذكر	ناشط اجتماعي	٠١٢٣٧٨٤٦٨٩
٤	أحمد [illegible] شكري محمد	ذكر	رئيس لجنة مربع (2)	٠٩١٢٣٠١٨٧٥
٥	عادل احمد سعد	ذكر	رئيس لجنة [illegible]	٠٩١٢٢٦٩٠٧٦
٦	عمر الحسين [illegible] عبدالله	ذكر	شباب الحي	[illegible]
٧	[illegible] الله [illegible]	ذكر	[illegible]	٠٩١٤٤٢٧٦١٥
٨	[illegible] صلاح [illegible]	ذكر	شباب [illegible]	[illegible]
٩	ادم [illegible] ادم	ذكر	شباب بالحي	[illegible]
١٠	محمد فتح الرحمن	ذكر	شباب مربع ٩	٠١٢٥٨٨٠٢٩٩
١١	خالد عبدالرحمن [illegible]	ذكر	رئيس الشباب	٠٩١٨٨٠٩٠٨٠
١٢	فارس عبدالله طلحة	ذكر	شباب الحي	٠٩١٣٨٠١٧٩٣

RAPID COMMUNITY SURVEY
BUILDING URBAN CLIMATE RESILIENCE IN KHARTOUM, SUDAN
UN-HABITAT - ADAPTATION FUND
Focus: women in El Marabie
Method: focus group discussion

1. **Basic assessment information**

Name group representative	Bakhita El Bakhit Hamid
Contact details and photo 	East Nile Locality - Soba East Administrative Unit El Marabie Phone: +2499225590399
Date assessment conducted	04 July 2018
Attendance sheet filled	check
Photos of consultation made COORDINATE: 15.533 N - 32.675 E	

2. **Climate change – trends analysis**

Purpose: to understand groups perception of climate change hazards in the past and for communities to become aware of changes and how climate change differs from weather change.

Expected outcome: agreement on one or two climatic hazards, which have most impacted the community

Climate Change hazards	**In the last 10 years, has the community been affected by:**	**Has this issue been getting:**
Droughts (e.g. lack of water for household use, damage to crops)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say.
Extreme heat (e.g. resulting in electrical problems, health impacts, crop/fisheries damage)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Flood (river flooding, local flooding due to poor drainage	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Storms/cyclones (e.g. destruction to house or goods, disruption to services, access cut)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Diseases (e.g. dengue, diarrhea)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say

Top 3 most problematic climatic hazards

1. Flooding of Wadi Soba
2. Diseases (Malaria, Urine Infection, stomach bacteria)

3. **Climate change – questionnaire**

These questions help to analyze current and future climate risks, barriers to adaptation and factors/resources facilitating the coping strategies used by groups and way of improving their resilience.

What problems does your specific group (women) face because of the one or two most problematic climatic hazards (see result trend analysis)

Most problematic climatic hazard	Problems / effects (e.g. agriculture destruction, lack of food or water for cattle, drinking water scarcity, disease, death, damages - need to move somewhere else, need to invest in protection, need to find other income)	Who (what group) is most affected?	How does hazard impact your group specifically?
Floods	Houses damages, loss of assets, drinking water scarcity, disease, needs to move to somewhere else	Women Children, Elderly Disabled	Psychologically affected (panicking) Closure of schools Financially Socially affected - Unable to participate in social events
Diseases	Spread of disease High rate of death	Children Elderly	Deterioration of health conditions Absence of from the schools and work Increase of medication costs and its affect on the individual income

The magnitude of barriers to adaptation

What stops specifically your group (women) from coping with current impacts of the most problematic climatic hazards (see result trend analysis)? These can be gender roles, illegal status affecting tenure, illegal status affecting employment options, lack of knowledge / education, lack of skills, lack of money, etc.

Most problematic climatic hazard	☐ What is currently limiting your community from coping with or adapting to the impacts? (What makes it difficult for you to deal with them or makes it difficult to make changes to deal with them) ☐ In what ways has your community already adapted to deal with these issues?	Ranking most important factors
Floods	No internal drainge system Residential area is in low land No garbage management Lack of knowledge and skills for disaster preparedness and response Lack of effective vertical and horizontal communication and coordination	1 2 3 4 5
Diseases	Shortage of health services and hygiene Lack of sanitation	Health services, highine and sanitation

The priorities to be addressed in strengthening the adaptive capacity of the group.

What activities / interventions should take place to adapt to climate change hazard impacts (e.g. address floods or droughts? What is most important for the group?

Most problematic	Activity / intervention	Ranking most

climatic hazard		important activity / intervention
Floods	Infrastructure: Rehabilitation of the culvert in El Marebie specially the eastern part of the culvert Open streams to drain the internal water Construction box culverts in the Wadi and the main streams to ease the movement and the accessibility	 1 3 2
	Capacity development: Develop the capacity of the community; knoweledge and skills, organizing and planning capacity Develop an early warning system Establish communication, coordination and information sharing mechanizims	 1 2 3
Diseases	Construction of Primary Health Care center Hygiene promotion and sanitation Awareness raising campaign	1 2 3

If these activities, interventions are provided, what would be your main concern and needs (e.g. related to employment, health, water access, food security, tenure security, resettlement, etc.?)

Activity / intervention	Concerns and needs	Rank
	1. high rate of migration from rural areas - horizontal expansion with limited basic services Infrastructure 2. high level of poverty and lack of credit support and vocational skill 3. shortage of drinking water during summer time (March - June) 4. considerable number of the heads of families are casual labour (high vulnerable to Income	4, 2,1,3

Group skills, strengths and leaders.

What is the group good at doing or what are the strengths? (e.g. committees, successful projects working together, construction or organizing skills, good connections outside community)	1) How can this be used for the climate problems or general problems? 2) Who will be the leader for making this happen? (what community committees can help with this?)
1. women represent 25% of the popular committee members gained skills and knowledge 2. women saving groups has succeeded in meeting some of the family essential needs such as paying for school, medication…etc 3. women union branch exits at El Marabie which is an asset	1) Credit and small enterprises will be successful based on experience of women in saving and organizational skill gained from Popular Committee 2) head of women union at local level together with selected teachers can possibly lead the initiative 3) establishment of local development and emergency committee could be an appropriate body

Any other ideas, concerns / issues, needs

Ideas	Concerns	Needs
	Customs and tradition prohibit women from effective participation	Awareness and sensitization for whole community and women in particular

Attendence sheet Marabie women union consultation

04/7/2018 المرابيع

ELMarabie

Women group Consultation

قائمة حضور

المسح السريع للمجتمع تعزيز التكييف المناخي الحضري في الخرطوم

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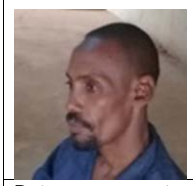
RAPID COMMUNITY SURVEY
BUILDING URBAN CLIMATE RESILIENCE IN KHARTOUM, SUDAN
UN-HABITAT - ADAPTATION FUND
Focus: community / popular committee of El Fateh
Method: group discussion

1. Basic assessment information

Name community leaders (e.g. chairperson popular committee)	1. Amer Mohamed Ahmed Ismail Coordinator of El Fateh Popular Committees
Contact details and photo 	Amer Mohamed Ahmed Ismail, Block No 17 El Fateh 1 Karari Locality Phone #: +249128498497
Date assessment conducted	24 July 2018
Attendance sheet filled	Check
Photos of consultation made COORDINATE: 15.808 N - 32.415 E	

2. Community profile

Municipality/ District name	Karari Locality (Municipality) – El Fateh Eastt Administrative Unit	
Community (popular committee) name		El Fateh Popular Committee
Location (on map)		
Total population (number)		53,632
Number or percentage	Female	26,521
	< age 15 (children)	23,062
	age 15-24 (youth)	10,726
	age 25-60	15,017
	> age 60 (elderly)	1,609
	(ex) Refugees / displaced (from where?)	About 46% (Darfur, Kordofan, East Sudan and Blue Nile)
	Informal people	All El Fateh is planned settlement with secured land title
	Indigenous people	21% maily from Darfur and Nuba Mountain
	HIV positive	No data
	Disabled population	1709
Households (number) + average per household		HH 8,939 average HH size: 6.0
Poverty rate (%)		75%
Access to electricity (%)		0 %
Access to clean water (%)		48%
Access to sanitation (proper toilet) (%)		51%

Main livelihoods / income		Casual Labour, self-employment, petty trade, food and tea selling, skills labour with private sector
Main community infrastructure-related issues	Floods (or risk areas) Drainage (issues)	- Suggested focus on strengthening community level and individauls knowledges, institutional and organizational and skills to repsond effectively to flood - Suggested focus on improvement of flash flood infrastructure and local drainage system issues at community level, especially water - Poverty is over 70%, water connection for 48% others depend on water vendor for inferior water with high price. - Most (80%) of the houses are built of mud and damaged during flood of 2013. - Target communities broady represented and effectively participated in the state plan for adaptation to climate change - Low land and lack of local drainage system
	WASH (issues)	- Vulnerable pit latrines to flood leads to damage of the latrines and contamination of water

3. **Climate change – trends analysis**

   Purpose: to understand community perception of climate change hazards in the past and for communities to become aware of changes and how climate change differs from weather change.

   Expected outcome: Agreement on one or two climatic hazards, which have most impacted the community

Climate Change hazards	**a) In the last 10 years, has the community been affected by:**	**Has this issue been getting:**
Droughts (e.g. lack of water for household use, damage to crops)	i) Yes, a lot, ii) yes, a little, iii) □ **no**, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) □ **same**, iv) better, v) not relevant, vi) can't say.
Extreme heat (e.g. resulting in electrical problems, health impacts, crop/fisheries damage)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Flood (river flooding, local flooding due to poor drainage • Wadi (seasonal water stream) • Poor drainage	**i)** □ **Yes, a lot**, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, **ii)** □ **little worse**, iii) same, iv) better, v) not relevant, vi) can't say

Storms/cyclones (e.g. destruction to house or goods, disruption to services, access cut)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Diseases (e.g. dengue, diarrhea) Malaria, Diarrhea, Respiratory Infection and Typhoid	i) □ **Yes, a lot**, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) □ **little worse**, iii) same, iv) better, v) not relevant, vi) can't say

Top 3 most problematic climatic hazards

Hazard	**Occurrence between 2008 and 2018 (years)**	**Possible comment**
1. River (Wadi Sayyidna) and local flooding	2009, 2013 and 2016	
2. Diseases: (Malaria, Diarrhea, Respiratory Infection and Typhoid)	2013 and 2016	
3.storm		• Its effect is limited to roof of schools and some houses

4. **Climate change – questionnaire**

These questions help to analyze current and future climate risks, barriers to adaptation and factors/resources facilitating the coping strategies used by community and way of improving their resilience.

What problems / effects does your community face because of the one or two most problematic climatic hazards (see result trend analysis) and how do these affect men, women, elderly, youth, disabled people, (ex) refugees in your community?

Most problematic climatic hazard	Problems / effects (e.g. agriculture destruction, lack of water or food for cattle, drinking water scarcity, disease, death, damages - need to move somewhere else, need to invest in protection, need to find other income)	Who (what group) is most affected?	How does hazard impact those most affected?
Floods	Destruction of houses, cases of death result from falling of houses and flood, shortage and contamination of drinking water, loss of properties, death of animals,	Children, women, elders, handicapped,	• Panicking, dark nights and phycological stress, especially among children • The poorest and needy people increased • Affected families were displaced
Disease	Lack of access to health facilities, Difficulties of movement during flooding, Increased death rate, increased cost of medication	Childern and women	• Affect pupils attenance to school • Increase in students drop-out rate
Storm	Collapsing roofs of schools and houses	Poor people living in poor housing	

The magnitude of barriers to adaptation

What stops your community from coping with current impacts of the most problematic climatic hazards (see result trend analysis)? These can be e.g. lack of knowledge / education, lack of skills, lack of money, lack of land tenure, lack of irrigation, lack of drinking water supply, health issues, bad infrastructure, lack of drainage system, lack of natural resources like forests, etc.).

Most problematic climatic hazard	☐ What is currently limiting your community from coping with or adapting to the impacts? (What makes it difficult for you to deal with them or makes it difficult to make changes to deal with them) ☐ In what ways has your community already adapted to deal with these issues?	Ranking most important factors
Floods from Wadi (water stream)	Answers to Question 1 a. Majority of houses built of low quality materials (mud) because of poverty (affordability) and lack of other options b. inability of community to organize and mobilized its members due to lack of effective structure for participation c. lack of skills and knowledge related to the process of rescue d. lack of community-based emergency action plan and budget e. weak vertical and horizontal coordination and communication f. shortage of information before, during and after floods g. high level of poverty Answers to question 2 i. popular committee uses social media and Mosque loudspeakers for communication ii. some members of popular committee trained on disaster responses and mitigation iii. Change of majority of mud houses into cement block houses	a, b, g c, e, d, f I, iii, ii
Diseases	1. weak health services 2. vulnerable sanitation system and lack of suitable options 3. low land inside the residential areas and lack local drainage system	2, 1,3

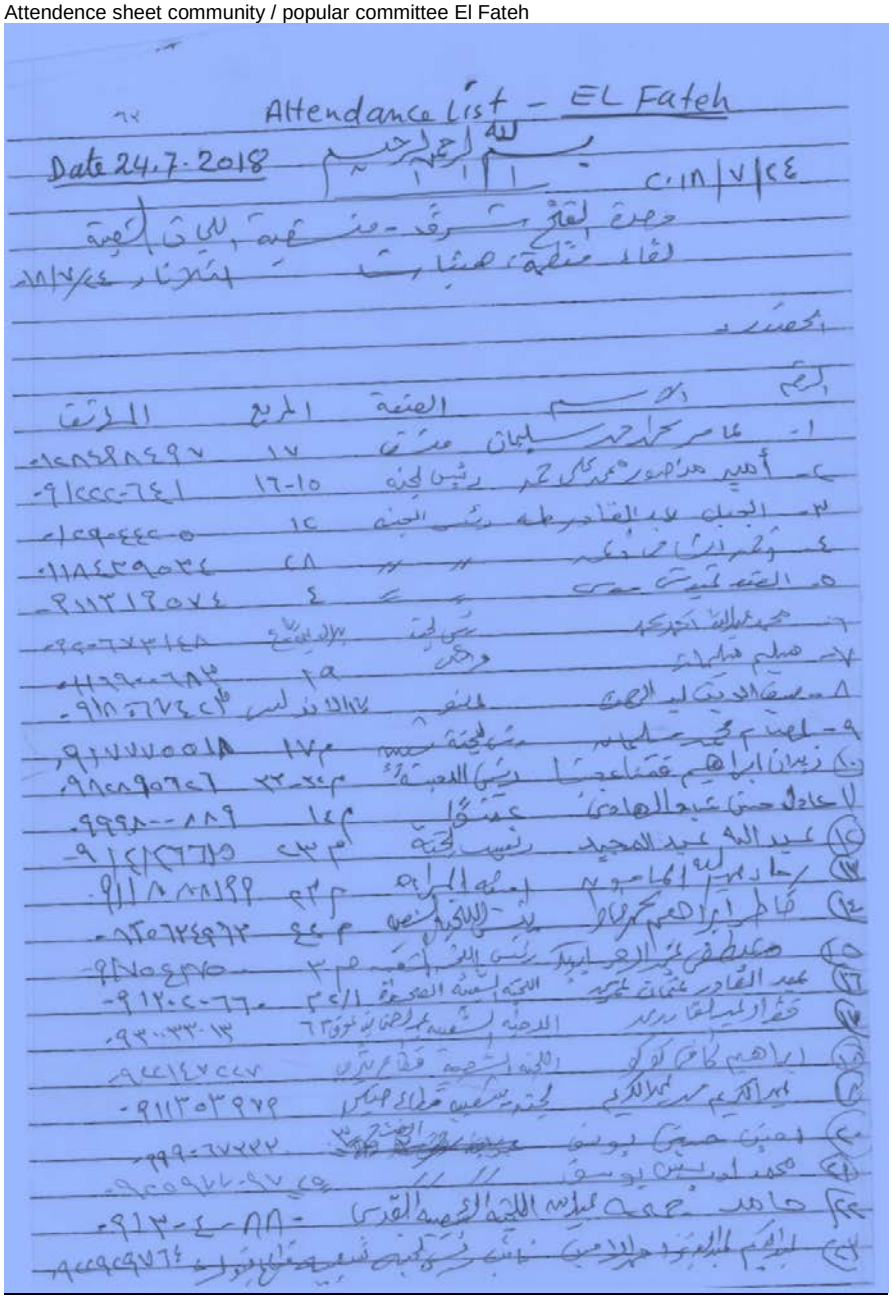
The priorities to be addressed in strengthening the adaptive capacity of the community.

What activities should take place or infrastructure constructed in order to improve your adaptive capacity to droughts, floods, landslides, heat, and diseases? What is most important for the community?

Most problematic climatic hazard	Activity and/or infrastructure	Ranking most important activity and/or infrastructure
floods	Infrastructure 1. Plan and implement Flood drainage network and construction of culverts 2. Improve water and sanitation by completion of water network to all area and improve pit latrines 3. Improvement of the quality of poor construction material by promotion and dissemination of environment friendly- flood resistance Stablized soil block 4. Create employment opportunity for unemployed youth Capacity development:	3, 2, 1, 7, 5, 6, 4 and 8

	5. Introduce income generation activities to alleviate high poverty 6. Develop the capacity of the community; knoweledge and skills, organizing and planning capacity 7. Develop an early warning system 8. Establish communication, coordination and information sharing mechanizims	
Diseases	1. Improvement of vulnerable pit latrines which destroyed during flooding and led to contamination of water 2. Control of vectors (mosquito, flies) using environmentally friendly methods and scorpions 3. Improvement of primary health care units to be prepared and responsive to emergency – including training of selected community members.	

Attendence sheet community / popular committee El Fateh

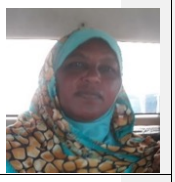

Attendance List - EL Fateh

Date 24.7.2018

بسم الله الرحمن الرحيم

RAPID COMMUNITY SURVEY
BUILDING URBAN CLIMATE RESILIENCE IN KHARTOUM, SUDAN
UN-HABITAT - ADAPTATION FUND
Focus: women group Al Fateh
Method: focus group discussion

1. Basic assessment information

Name group representative	Ms. Suad Salih Coordinator of the Women Union in El Fath
Contact details and photo	Karari Locality - El Fateh Administrative Unit Phone # +249 12888800 
Date assessment conducted	24 July 2018
Attendance sheet filled 34 participants	check
Photos COORDINATE: 15.808 N - 32.415 E	

2. Climate change – trends analysis

Purpose:
To understand groups perception of climate change hazards in the past and for communities to become aware of changes and how climate change differs from weather change.

Expected outcome:
Agreement on one or two climatic hazards, which have most impacted the community

Climate Change hazards	a) In the last 10 years, has the community been affected by:	Has this issue been getting?
Droughts (e.g. lack of water for household use, damage to crops)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say.
Extreme heat (e.g. resulting in electrical problems, health impacts, crop/fisheries damage)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Flood (river flooding, local flooding due to poor drainage	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Storms/cyclones (e.g. destruction to house or goods, disruption to services, access cut)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Diseases (e.g. dengue, diarrhea)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say

Top 3 most problematic climatic hazards

1. Flooding due to low land and bad local drainage
2. Diseases (Malaria, Diarrhea,
3. small children drown every year because of the water pools forms by rain and floods inside residential area

3. Climate change – questionnaire

These questions help to analyze current and future climate risks, barriers to adaptation and factors/resources facilitating the coping strategies used by groups and way of improving their resilience.

What problems does your specific group (women, elderly / disabled, youth, (ex)refugees, etc.) face because of the one or two most problematic climatic hazards (see result trend analysis)

Most problematic climatic hazard	Problems / effects (e.g. agriculture destruction, lack of food or water for cattle, drinking water scarcity, disease, death, damages - need to move somewhere else, need to invest in protection, need to find other income)	Who (what group) is most affected?	How does hazard impact your group specifically?
Floods	Houses damages, loss of life and assets, drinking water scarcity, disease,	Women Children, Elderly Disabled Youth	Psychologically affected (panicking) Feeling of homeless Closure of schools Financially Socially affected
Diseases	Spread of disease High rate of death	Children Elderly	Deterioration of health conditions Absence from the schools and work Increase of medication costs and its affect on the individual income

The magnitude of barriers to adaptation

What stops specifically your group (women, elderly / disabled, youth, (ex-)refugees, etc.) from coping with current impacts of the most problematic climatic hazards (see result trend analysis)? These can be gender roles, illegal status affecting tenure, illegal status affecting employment options, lack of knowledge / education, lack of skills, lack of money, etc.

Most problematic climatic hazard	1) What is currently limiting your community from coping with or adapting to the impacts? (What makes it difficult for you to deal with them or makes it difficult to make changes to deal with them) 2) in what ways has your community already adapted to deal with these issues?	Ranking most important factors
Floods	Internal drainge system need rehabilitation Residential area is in low land No garbage management Lack of knowledge and skills for disaster preparedness and response Lack of effective vertical and horizontal communication and coordination	1 2 3 4 5

Diseases	Shortage of health services and hygiene Lack of sanitation	Health services, hygiene and sanitation

The priorities to be addressed in strengthening the adaptive capacity of the group.
What activities / interventions should take place to adapt to climate change hazard impacts (e.g. address floods or droughts? What is most important for the group?

Most problematic climatic hazard	Activity / intervention	Ranking most important activity / intervention
Floods	<u>Infrastructure:</u> Rehabilitation of existing drainage construction of box culverts on main drains Introduction of stabilized soil block as flood proved construction to improve houses situation	 1 3 2
	<u>Capacity development:</u> Develop the capacity of the community; knoweledge and skills, organizing and planning capacity Develop an early warning system Establish communication, coordination and information sharing mechanizims	 1 2 3
Diseases	Hygiene promotion and sanitation Awarness raising campaign	1 2

If these activities, interventions (e.g. dam to reduce floods and provide water infrastructure or services) are provided, what would be your main concern and needs (e.g. related to employment, health, water access, food security, tenure security, resettlement, etc.?)

Activity / intervention	Concerns and needs	Rank
	1. Limited houses connected to water network (48%) and water contamination 2. high level of poverty and lack of credit support and vocational skill 3. shortage of drinking water during summer time (March - June) 4. considerable number of the heads of families are casual labour (high vulnerable to Income	1, 2,4,3

Group skills, strengths and leaders.

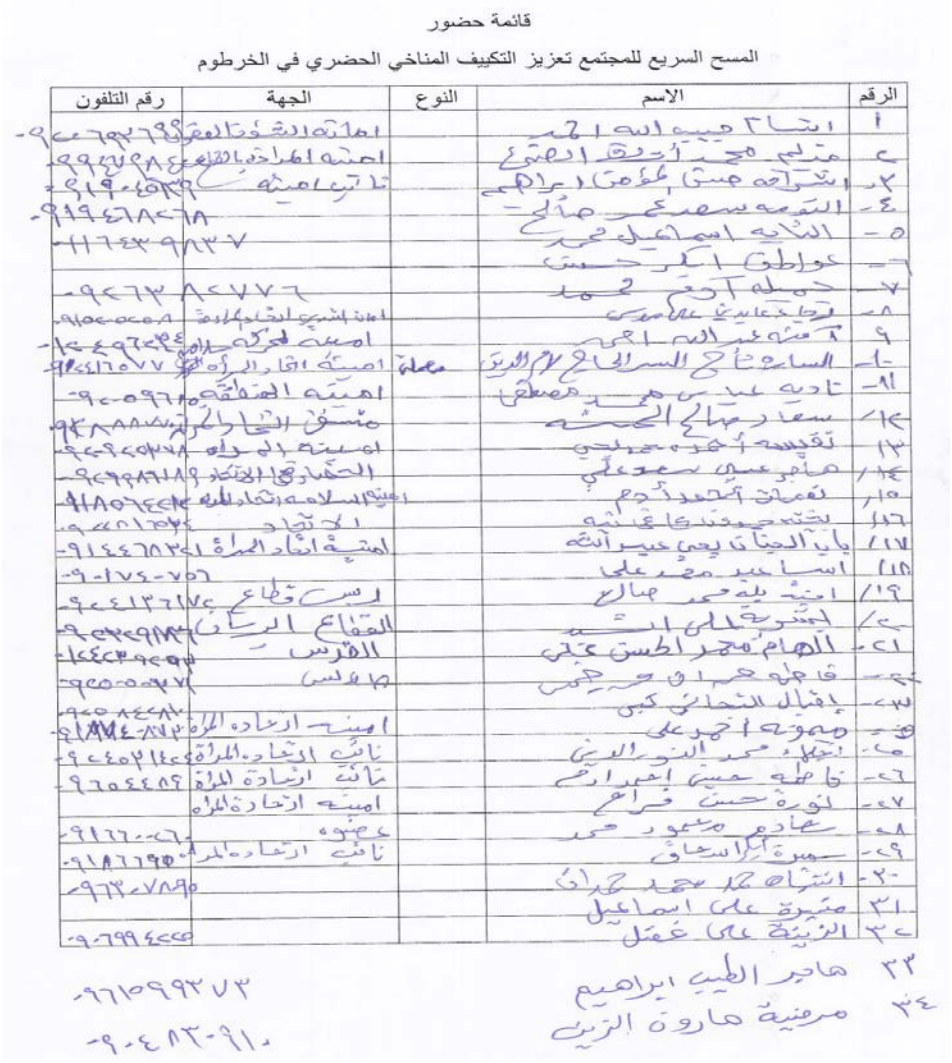
What the group good at doing or what are the strengths? (e.g. committees, successful projects working together, construction or organizing skills, good connections outside community)	1) How can this be used for the climate problems or general problems? 2) Who will be the leader for making this happen? (what community committees can help with this?)
1. women represent 25% of the popular committee members gained skills and knowledge 2. women saving groups has succeeded In meeting some of the family essential needs such as paying for school, medication…etc	1. Income generation activities for community resilience 2. Youth employment opportunities 3. Gender sensitive risk management knowledge and skills 4. Consideration of the special need groups Credit and small enterprises will be successful based on

3. women union branch exits at El Fateh different blocks	experience of women In saving and organizational skill gained from Popular Committee 5. head of women union at local level together with selected teachers can possibly lead the initiative 6. establishment of local development and emergency committee could be an appropriate body

Any other ideas, concerns / issues, needs

Ideas	Concerns	Needs
	Customs and tradition prohibit women from effective participation	Awareness and sensitization for whole community and women In particular

Attendence sheet Fateh women union consultation



قائمة حضور

المسح السريع للمجتمع تعزيز التكييف المناخي الحضري في الخرطوم

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RAPID COMMUNITY SURVEY
BUILDING URBAN CLIMATE RESILIENCE IN KHARTOUM, SUDAN
UN-HABITAT - ADAPTATION FUND
Focus: community / popular committee of E Elsheikh Alamin
Method: group discussion

1. Basic assessment information

Name community leaders (e.g. chairperson popular committee)	Elsheikh Abbass Tageldin Chairperson of Elsheikh Alamin Popular Committee
Contact details and photo 	East Nile Locality - Soba East Administrative Unit Elsheikh Alamin East Phone: +24914878939
Date assessment conducted	31 July 2018
Attendance sheet filled	check
Photos of consultation made COORDINATES: 15.5604º N - 32.8355º E	

2. Community profile

Municipality/ District name	East Nile Locality (Municipality) – Soba East Administrative Unit	
Community (popular committee) name		Elshekh Alamin Popular Committee
Location (on map)		
Total population (number)		7200
Number or percentage	Female	3636
	< age 14 (children)	3096
	age 15-24 (youth)	1,418
	age 25-60	2016
	> age 60 (elderly)	698
	(ex) Refugees / displaced (from where?)	0
	Informal people	0
	Indigenous people	1%
	HIV positive	No Data
	Disabled population	216
Households (number) + average per household		1241 HH average HH size: 5.8
Poverty rate (%)		41%
Access to electricity (%)		100%
Access to clean water (%)		100%
Access to sanitation (proper toilet) (%)		90%
Main livelihoods / income		Petty trade, casual labour, farming
Main community infrastructure-related issues	Floods (or risk areas)	1. Wadi Soba tributaries Intercept with road where the community experienced cut-off for a number of days

and settlement photos and GPS points where possible		15.5760 N --32:8262 E
	Drainage (issues)	The drainage inside the residential area is good
	Droughts (or risk areas)	• Shortage of water during summer time specially for animals • High evaporation of water March – June
	WASH (issues)	vulnerable pit latrines to flood leads to damage of the latrines and contamination of water

3. Climate change – trends analysis

Purpose: to understand community perception of climate change hazards in the past and for communities to become aware of changes and how climate change differs from weather change.

Expected outcome: agreement on one or two climatic hazards, which have most impacted the community

Climate Change hazards	**In the last 10 years, has the community been affected by:**	**Has this issue been getting:**
Droughts (e.g. lack of water for household use, damage to crops)	i) Yes, a lot, ii) yes, a little, iii) □ **no**, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) □ **same**, iv) better, v) not relevant, vi) can't say.
Extreme heat (e.g. resulting in electrical problems, health impacts, crop/fisheries damage)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Flood (river flooding, local flooding due to poor drainage • Wadi (seasonal water stream) • Poor drainage	**i) □ Yes, a lot**, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, **ii) □ little worse**, iii) same, iv) better, v) not relevant, vi) can't say
Storms/cyclones (e.g. destruction to house or goods, disruption to services, access cut)	i) Yes, a lot, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) little worse, iii) same, iv) better, v) not relevant, vi) can't say
Diseases (e.g. dengue, diarrhea) Malaria, Diarrhea, Respiratory Infection and Typhoid	i) □ **Yes, a lot**, ii) yes, a little, iii) no, iv) not relevant. v) can't say.	i) a lot worse, ii) □ **little worse**, iii) same, iv) better, v) not relevant, vi) can't say

Top 3 most problematic climatic hazards

Hazard	**Occurrence between 2008 and 2018 (years)**	**Possible comment**
1. River (Wadi) and local flooding	2013 and 2016	
2. Diseases: (Malaria, Respiratory Infection)	2013 and 2016	
3.storm		• Its effect is limited to roof of schools and some houses

4. Climate change – questionnaire

These questions help to analyze current and future climate risks, barriers to adaptation and factors/resources facilitating the coping strategies used by community and way of improving their resilience.

What problems / effects does your community face because of the one or two most problematic climatic hazards (see result trend analysis) and how do these affect men, women, elderly, youth, disabled people, (ex) refugees in your community?

Most problematic climatic hazard	Problems / effects (e.g. agriculture destruction, lack of water or food for cattle, drinking water scarcity, disease, death, damages - need to move somewhere else, need to invest in protection, need to find other income)	Who (what group) is most affected?	How does hazard impact those most affected?
Floods	death of animals, damage to farms, cut-off of the transportation	Children, women, elders,	• Affect the business between the village and capital of the locality • The poorest and needy people increased • Migration to main towns within the locality
Disease	Relatively remoteness of the settlement has difficult specially when the villages isolated from the rest main towns	Childern and women	• Increase students drop-out rate
Storm	Destroying roofs of schools and houses	Poor people living in poor housing	

The magnitude of barriers to adaptation

What stops your community from coping with current impacts of the most problematic climatic hazards (see result trend analysis)? These can be e.g. lack of knowledge / education, lack of skills, lack of money, lack of land tenure, lack of irrigation, lack of drinking water supply, health issues, bad infrastructure, lack of drainage system, lack of natural resources like forests, etc.).

Most problematic climatic hazard	☐ What is currently limiting your community from coping with or adapting to the impacts? (What makes it difficult for you to deal with them or makes it difficult to make changes to deal with them) ☐ in what ways has your community already adapted to deal with these issues?	Ranking most important factors
Floods from Wadi (water stream)	Answers to Question 1 a) lack of skills and knowledge related to the process of rescue b) lack of community-based emergency action plan and budget c) weak vertical and horizontal coordination and communication d) shortage of information before, during and after floods i) Answers to question 2popular committee uses social media and Mosque loudspeakers for communication	c, b, a, d

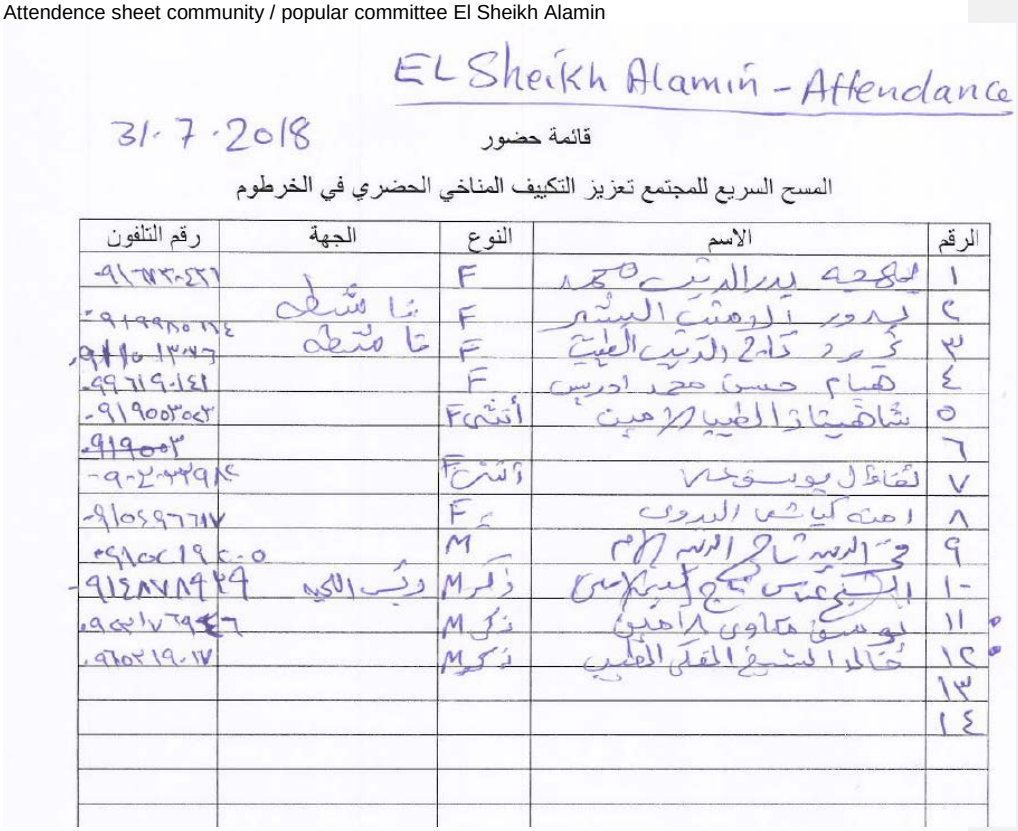
	ii) some members of popular committee trained on disaster response and mitigation iii) Change of majority of mud houses into cement block houses	I, iii, ii
Diseases	1. weak health services 2. vulnerable sanitation system and lack of suitable options	2, 1,

The priorities to be addressed in strengthening the adaptive capacity of the community.

What activities should take place or infrastructure constructed in order to improve your adaptive capacity to droughts, floods, landslides, heat, and diseases? What is most important for the community?

Most problematic climatic hazard	Activity and/or infrastructure	Ranking most important activity and/or infrastructure
floods	1. Construction of small dam north-east of the village at one of the tributaries of Wadi Soba 2. Rehabilitation and improvement of community existing Hafir (water reservoir as the underground water is salty 15:5586º N – 32:8374º E 3. Construction of culverts over the Wadi tributaries as the villages in the area facing cases of cut-off during the peak of flooding period 4. Introduction water saving technology for irrigation from expected water reservoir behind the dam taking into account the high evaporation during dry season 5. Introduction and promotion of environment and flood resistance building materials for community (stabilized soil block) 6. Introduction of Women income generation activities 7. Capacity building of popular committee and youth in flood disaster (prepareness and management) 8. Develop early warning system at the village level link with the locality	1, 3, 5, 4,2, 6, 8, 7
Diseases	Improvement of vulnerable pit latrines which destroyed during flooding and led to contamination of waterControl of vectors (mosquito, flies) using environmentally friendly methods and scorpions Improvement of primary health care units to be prepared and responsive to emergency – including training of selected community members.	

Attendence sheet community / popular committee El Sheikh Alamin



EL Sheikh Alamin - Attendance

31.7.2018

قائمة حضور

المسح السريع للمجتمع تعزيز التكييف المناخي الحضري في الخرطوم

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ANNEX 2: strategy to comply to the AF Environmental and Social Policy (ESP) and Gender Policy (GP)

Content:

1. Introduction

Purpose

The purpose of this annex is to demonstrate compliance of the project with the AF ESP and GP. In line with UN-Habitats Environmental and Social Management System and in line with the Adaptation Fund ESP and GP, UN-Habitat and partners need and will ensure that all proposed project activities and the project as a whole promote positive environmental and social benefits and mitigate or avoid adverse environmental and social risks and impacts and mainstreaming equal access among women and men, while building their resilience and capability to adapt to climate change impacts. This annex will be published for public consultation during the full proposal development phase. A summary of the project will then be included below.

Process to comply to the AF ESP and GP

At the full proposal phase, all project activities will be screened in detail against the 15 AF risk areas (i.e. safeguards) to identify all potential risks and to assess and quantify potential environmental and social impacts. At this stage (i.e. concept note),* an initial analysis / overview of the identified environmental and social risks and impacts and co-benefits and opportunities of the project activities with a special emphasis on gender is provided. In line with the GP, a gender approach and baseline are provided in a designated section. This is necessary in order to establish a data baseline at the project start against which implementation progress and results can be measured later. Data and analysis are provided based on community surveys, focus groups discussions, community planning and decision-making processes during the project proposal development phase.

Deleted: Besides that, an ESMP will be developed.

Deleted:

*This annex is a 'work in progress' annex. Thus, more details will be provided during the full proposal development phase.

Summary of project

To be inserted at full proposal development phase.

2. Environmental and social risks and impacts of the project and activities

Screening and categorization and environmental and social impact assessment

An initial screening has been carried out to identify potential environmental and social risks of proposed project activities and based on that, of the entire project. With this information, the entire project has been categorized. Because of the nature of the proposed intervention under components 3 (dams / water reservoirs), the entire project is currently categorized as a medium risk (Category B) project. The proposed dam / water reservoir is a concrete intervention with possible adverse environmental and social impacts (see annex 2 and 3 for more info). Although the possible dam options can be regarded as large infrastructure interventions, identified potential environmental and social risks and impacts are expected to be reversible or to be avoided /

mitigated (for details see annex 2 and the following environmental ans social impacts study in an area close to the target area: http://khartoumspace.uofk.edu/handle/123456789/9244 Moreover, the size of the currently discussed dams could be reduced which would result in the proposal of a larger number of small dams. Therefore, because the potential risks and impacts of possible dams reversable or possible to mitigate, the project has been categorized as a category B project.

Potential environmental and social risks related to proposed activities that have been identified at this stage (concept note) and will be avoided / mitigated, include equal access and benefits of proposed interventions, in particulat for women, youth and DP groups but also nomads. These groups are generally not well organized (for more detail see annex 2) and therefore the project will avoid these potential risks by ensuring equal representation of vulnerable groups, especially women, youth and DPs, but also nomads, during consultations, planning processes and for possible job opportunities. As for the set-up of EWSs, decision-making structures in which all groups are able to participate equally and which can be used for more than just setting-up EWSs, will be established.

Based on an initial analysis of the target area and the outcome of the Environmental and Socio-economic Impact study of Wadi Abu Soueid Water Harvesting and Spreading Project in Khartoum State, Sudan,[28] which is close to the target area, other potentially negative impacts include increase in the densities of the noxious Adar (Sorghum sp.) weed and semi-parasitic Buda (Striga hermonthica) plant, security problems (including trespassing on farmland and rangeland by nomadic groups from neighboring areas and animal thefts), and uncontrolled flooding of potentially productive farmland due to neglect of dam maintenance. Mitigation will be put in place to avoid these potentially negative impacts, including a government committed maintenance plan and budget. However, in the case of the proposed project, there are streams that allows to discharge water in case the dam exceeds its capacity (although unlikely because its will be designed for a 50 year flood event). The study also revealed positive impacts: an increase in production and productivity makes the sorghum residues available for supplementary feeding during dry season as well as cultivation of Abu Saba'een (Sorghum bicolor) from water reservoir to provide supplementary feeding to livestock, hence increase milk production and milk related products (cheese) for income generation.

During the full proposal development phase, all environmental and social risks and impacts will be identified, quantified and mitigated. The ministry of Ministry of Environment, Natural Resources & Physical Development is planning to hire a consultant to conduct an environmental and social risks and impact assessment of the proposed dams / reservoirs (or more smaller dams) in line with national technical standards and in compliance with the AF ESP and GP.

As per annex 2, any potential risk of resettlement is ruled out. The dams will be constructed on public land where nobody lives. Any (informal) land use, such as for agriculture, will be identified and assessed in detail during the the full proposal development phase. Some potential social risks identified during the concept note stage are related to equal access to (irrigation) water and avoidance of social tension to access this water. Mitigation measures will be put in place to reduce these risks. As for potential environmental impacts, these will be assessed in detail (i.e. quantified) during the full proposal development phase. For similar interventions in the Khartoum area no significant negative impacts were identified, except for potential maintenance commitment issues and equal access of water (see study of Wadi Abu Soueid Water Harvesting and Spreading Project. Follow-up activities mitigated these risks.

[28] http://khartoumspace.uofk.edu/handle/123456789/9244

Although the proposed dams are government priorities to reduce flood impacts in East Nile and to reduce water scarcity and potential risks and impacts are expected to not be significant (see above and annex 2), the size / dimensions of the proposed dams could be reduced (although not preferred by the government) to reduce any potential environmental and social risks. In this case a larger number of smaller dams / water reservoirs could be proposed.

As for the activities under component 1 and 2 potential risks concerns related to equall access to benefits and avoidance of adverse impacts on margnizaled and vulnerable groups and women, but these potential risks will be mitigated.

During the full proposal development phase, detailed screening of all components and activities / interventions against the 15 AF principles will take place to identify all potential environmental and social risks, assess impacts in detail and propose mitigation meausures when needed. This will be done by collecting detailed information on proposed activities / interventions, conduct feasibility studies of concrete interventions and assess environmental and social impacts of potential risks, all through studies in line with national technical standards and community and vulnerable groups consultations.

A 'gender' baseline and approach / strategy is under development (see annex 2) to reduce potential risks and maximize benefits for marginzalized and vulnerable groups, including women, youth (and children) and DPs / indigenous groups and to ensure that project benefits will be allocated equally, that discrimination nor favouritism in accessing project benefits can take place and that adverse impacts are avoided. Besides that, potential environmental and social risks and impacts are assessed in more detail in the ESP compliance annex (annex 2). For an overview of the outcomes of risk screening and impact assessment outcomes at the concept note phase, see table 21 below. For a description of the analysis see the section below the table.

Deleted: Because of the nature of the activities under component 3, the entire project is regarded as a medium risk (Category B) project. Therefore, an ESMP will be developed at the full proposal phase. Also, further details will be provided at the full proposal phase.

Table 21: Overview of initial (concept note) risk screening and impact assessment outcomes of project activities. For details, see below analysis per AF principle. Details of mitigation measures will be provided in the full proposal doc in accordance with fully quantified risks and impacts

Project activities		(Design) details				Risk screening outcome	Impact assessment
Component	Detailed activities	Location	Number of beneficiaries	Dimensions	Description		
1. Institutional capacity strengthening of Khartoum state and municipal government	1.1. One Khartoum state / city integrated urban watershed management strategy	Khartoum state / metropolitan area	8 million 6.2 million	One strategy for whole state / city	The strategies will consider watershed systems and climate change-related flood and drought risks in Khartoum state and metropolitan area comprehensively and in an integrated manner. Vulnerable groups need to be involved in assessment, planning and development phases to identify specific needs and concerns and all potential risks to natural habitats, biodiversity, etc. considered.	Strategies will comply to national laws, vulnerable groups need to be consulted and involved equally and potential risks and impacts of strategies / plans on vulnerable groups, nature, biodiversity, etc. considered.	Although the activity does not entail concrete / infrastructure interventions, it provides the 'base' to plan these for a large area with many inhabitants, which may have impacts on vulnerable groups, nature, etc.
	1.2. One Khartoum metropolitan area spatial / urban strategy	Khartoum metropolitan area	6.2 million	One strategy for the whole urban area			
	1.3. Three wadi early warning systems established (Locality level)	East Nile Loc Karari Loc Omdurman Loc	1,078,498 1,293,195 698,900	One early warning system per Locality	Early warning sytems will be developed with Locality government and coordinated with at community and metropolitan and state level	Early warning systems will comply to national laws and vulnerable groups need to be consulted and involved equally	Although the activity does not entail an infrastructure interventions, it need to be ensured vulnerable groups are involved and benefit equally; the number of direct training beneficiaries will be around 210 (30 per community)
2. Community-level action planning	2.1. Seven community-level early warning systems established	El Kariab El Marabie Al Huda Al-fateh Al-Thowrat Al Salha Al Gea'a	28.500 26.370 14,800 53,632 TBD 25,000 13,810	One early warning system per settlement / community	Early warning sytems will set-up with popular committees, women groups and youth and coordinated with at Locality and metropolitan and state level		
	2.2. Eleven community plans developed, and community members (especially	El Kariab El Marabie Al Huda El sheikh AL Bayada Um Ketra Um Ushyra	28.500 26.370 14,800 7,200 3,600 TBD TBD	One plan per settlement / community	A planning process will take place to involve groups equally and to develop plans and to train community members, especially women and youth to operate and maintain proposed activities.	Vulnerable groups need to be consulted and involved equally	Although the activity does not entail an infrastructure interventions, it need to be ensured vulnerable groups are

	women and youth) trained	Al-fateh Al-Thowrat Al Salha Algea'a	53,632 TBD 25,000 13,810				involved and benefit equally; the number of direct training beneficiaries will be around 330 (30 per community)
	2.3. Community members trained in seven communities to construct flood resilient and environmentally friendly houses	El Kariab El Marabie Al Huda Al-fateh Al-Thowrat Al Salha Al Gea'a	28.500 26.370 14,800 53,632 TBD 25,000 13,810	1-2 trainings per settlement / community	Community members will be trained to construct resilient houses	Community members will need to get equall chances to benefit from trainings	Although the activity does not entail an infrastructure interventions, it need to be ensured Community members will need to get equall chances to benefit from trainings; the number of direct training beneficiaries will be around 210 (30 per community)
3. Physical interventions to increase flood and drought resilience of communities	3.1. Constructing dams / water reservoirs up-stream of Wadi Soba, leading to upstream villages water and livelihood security and downstream communities flood reduction	East Nile Loc Especially: Soba Sharq Administrative unit And upstream villages For location options see annex 3.	1,078,498 113,433 TBD	See figures 17 and 18 and table 8	Upstream dams / water reservoirs will reduce downstream flood risks and impact in East Nile locality and especially in flood prone Soba Sharq Administrative unit in which El Kariab and El Marabie are the most flood prone communities. Upstream villages will benefit from water supply for agriculture, cattle and drinking purposed.	Communities and vulnerable groups that will benefit from the interventon need to be involved continuesly; further, quantification of risks and imapcts will be provided during full proposal phase, especially related to equal access, protection of natural habitats, conservation of biological diversity, climate change, pollution prevention and resource efficiency and land and soils conservation (see below and annex 3). The main potential risk is related to maintenance issues. For this prove of a government maintenance plan and budget will be provided in the full proposal	The construction of the dams / water reservoirs will have impact on the water stream and flood impacts downstream and water availa upstream. Because the intervention will not increase flood impact and increase water availability, risks are limited. However, the intervention can have some negative impacts on potential risk areas identified on the left. For ... see below and ... 3.

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Risk screening details 15 AF principles

AF principle 1: Compliance with the law
For all proposed activities, relevant rules, regulations and standards and procedures have been identified and procedures to comply to these (see part II.D). During the full proposal development phase, more details will be provided about how all proposed activities comply with national laws.

In line with national standards / requirements, an environmental and social impact assessment will be conducted for output 3.1. (construction of dams / water reservoirs). For more info see Part II.D and annex 3.

AF principle 2: Access and equity
The project will ensure that project benefits will be allocated equally and that discrimination nor favoritism in accessing project benefits can take place. This is done through detailed stakeholder mapping, including identification of specific concerns and needs of beneficiaries and specific groups, the development of a specific 'gender' approach and baseline, and to propose measure to avoid unequal access or favoritism. Although the basis for this has been set-up during the concept note development phase, detailed assessments will be conducted during the full proposal development phase, including consultations with vulnerable communities and groups focused on identifying and confirming potential risks and impacts of all proposed activities.

Risk identification at concept note phase: for all proposed project activities, there is a potential risk that project benefits are not allocated equally between beneficiaries. The avoid this risk, the project will therefore ensure equal representation of vulnerable groups, especially women, youth and DPs during consultations, planning processes and for possible job opportunities.

AF principle 3: Marginalized and vulnerable groups
The project will ensure that possible adverse impacts of all project activities on marginalized and vulnerable groups are identified and avoided / mitigated. This is done through detailed stakeholder mapping, including identification of specific concerns and needs of beneficiaries and specific groups, the development of a specific 'gender' approach and baseline, and to propose mitigation measures, when needed, to reduce the risks. Although the basis for this has been set-up during the concept note development phase, detailed assessments will be conducted during the full proposal development phase, including consultations with vulnerable communities and groups focused on identifying and confirming potential risks and impacts of all proposed activities. All potential adverse impacts will then be identified, taking into consideration the specific needs, limitations, constraints and requirements of each group.

Risk identification at concept note phase: for all proposed project activities, there is a potential risk of adverse impacts on marginalized or vulnerable groups, especiall risks related security problems, including trespassing on farmland and rangeland by nomadic groups from neighboring areas and animal thefts. To avoid this risk, the project will therefore ensure equal representation of vulnerable groups, especially women, youth and DPs, during consultations, planning processes and for possible job opportunities and to consult beneficiaries with the purpose of identifying risk mitigation measures.

AF principle 4: Human rights
The project will ensure that possible human rights issues relevant to all proposed project activities are addressed. This is done through an identification and analysis of relevant human rights in the special procedures and by making human rights a subject during consultations. Human rights issues have been an explicit part of consultations during the concept note phase (see outcomes

consultations in part II.H and annex 1 (especially consultations with ILO and UN Women). At the full proposal phase, potential human rights issues relevant to all proposed project activities will also be explicitly part of community and vulnerable groups consultations.

Risk identification at concept note phase: an analysis of potential relevant human rights issues that are identified in the Special Procedures are included below, as well as a description of how the project will address potential risks related to these relevant human rights issues:

- ☐ Gender: Sudan is not a signatory on the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW). As reported by OCCHR in 2018[29] there are still issues of violence against women. OHCHR visited Sudan to examine in situ the progress and obstacles to the enjoyment of human rights regarding violence against women, its causes and consequences in 2015[30] and recommended that the donor community focus international assistance programmes on the empowerment of women and girls. OHCHR also visited Sudan to examine in situ the progress and obstacles to the enjoyment of human rights regarding extreme poverty in 2014[31] and recommends improving access to finance and will be achieved by enhancing women's rights and their role in the production sector, as well as their access to all levels of education.

  The project will take a specific gender approach for women. The project will therefore ensure equal representation of this group during consultations, planning processes and for possible job opportunities. Potential risks mitigation measures include having focal points in (ministry) executing partners, reduce potential risks of violence against women (e.g. by organizing activities in groups) and by promoting women as agents of change, where possible without risks.

- ☐ Vulnerable and marginalized groups: Sudan is not a signatory on the CMW - International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families. OHCHR visited Sudan to examine in situ the progress and obstacles to the enjoyment of human rights regarding DPs in 2012[32] and recommended to improve assistance and protection services. OHCHR visited Sudan to examine in situ the progress and obstacles to the enjoyment of human rights regarding freedom of religion or belief in 1996[33] and recommended to respect religious, ethnic and cultural diversity, especially of non-moslims in various practices.

  The project will take a specific approach for DPs / migrants by regarding this groups as vulnerable group. The project will therefore ensure equal representation of this group during consultations, planning processes and for possible job opportunities.

- ☐ Indigenous people: Sudan is not a signatory of C169 - Indigenous and Tribal Peoples Convention, 1989 (No. 169).

  The project will ensure all indigenous groups in target areas are identified during the full proposal phase. At the concept note stage, no indigenous groups have been identified. The reason is that populations of target areas mostly exist of DPs. If specific indigenous

[29] http://www.ohchr.org/en/NewsEvents/Pages/DisplayNews.aspx?NewsID=23101&LangID=E
[30] https://documents-dds-ny.un.org/doc/UNDOC/GEN/G16/079/16/PDF/G1607916.pdf?OpenElement
[31] https://documents-dds-ny.un.org/doc/UNDOC/GEN/G04/111/24/PDF/G0411124.pdf?OpenElement
[32] https://documents-dds-ny.un.org/doc/UNDOC/GEN/G13/149/86/PDF/G1314986.pdf?OpenElement
[33] https://documents-dds-ny.un.org/doc/UNDOC/GEN/N96/315/31/IMG/N9631531.pdf?OpenElement

groups are identified, the project will therefore ensure equal representation of this group during consultations, planning processes and for possible job opportunities.

Reference to – and agreement to comply to – universal human right will be made in all contract and MoUs and AoCs.

As for output 3.1. (construction of dams / water reservoirs) there is a potential risk that the area required to construct the dam will cover agriculture land. If this is the case, it need to be ensured that land owners agree with the intervention and that appropriate compensation is provided.

AF principle 5: Gender

The project will ensure that gender equality and women's empowerment is ensured for all project activities. This is done through detailed stakeholder mapping, including identification of specific concerns and needs of women, the development of a specific 'gender' approach and baseline, and to propose mitigation measures, when needed, to reduce the risks. Although the basis for this has been set-up during the concept note development phase (including women focus groups discussions), detailed assessments will be conducted during the full proposal development phase, including consultations with women focused on identifying and confirming potential risks and impacts of all proposed activities. All potential adverse impacts will then be identified, taking into consideration the specific needs, limitations, constraints and requirements of each group.

Risk identification at concept note phase: for all proposed project activities, there is a potential risk of unequal benefits to women. The project will therefore take a specific gender approach for women and youth (see below). The project will ensure equal representation of this group during consultations, planning processes and for possible job opportunities. Potential risks mitigation measures include having focal points in (ministry) executing partners, reduce potential risks of violence against women (e.g. by organizing activities in groups) and by promoting women as agents of change, where possible, without risks.

AF principle 6: Core Labour rights

The project will ensure that possible core labour rights issues relevant to all proposed project activities are addressed. This is done through an identification and analysis of relevant national core labour rights and by making core labour rights a subject during consultations. Core labour rights have been an explicit part of consultations during the concept note phase (see outcomes consultations in part II.H and annex 1 (especially consultations with ILO). At the full proposal phase, potential core labour rights issues relevant to all proposed project activities will also be explicitly part of community and vulnerable groups consultations.

Risk identification at concept note phase: an analysis of relevant core labour rights that are not ratified by the national government are included below, including a description of how the project will address potential risks related to these relevant core labour rights issues:

- ☐ Not ratified:[34]
    a. Fundamental: C087 - Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87)

[34] http://www.ilo.org/dyn/normlex/en/f?p=1000:11210:0::NO:11210:P11210_COUNTRY_ID:103176

b. Governance (Priority): C129 - Labour Inspection (Agriculture) Convention, 1969 (No. 129); C144 - Tripartite Consultation (International Labour Standards) Convention, 1976 (No. 144)

As mentioned during the consultation with ILO representative, potential project activity risks are related to possible construction works: social protection, child labour, safety, no proper contracts. Therefore, reference to – and agreement to comply to - all international core labour right will be made in all contract, especially for local hire of employees. Besides that, on-site training in vocational training centers (5 in Khartoum) of supreme council under ministry of labour + human resources will be conducted and ILO may be involved for establishing activities' maintenance arrangements with communities and the ministry of engineering.

AF principle 7: Indigenous people:

The project will ensure that possible adverse impacts of all project activities on indigenous people (if identified during full proposal phase) are identified and avoided / mitigated. This is done through detailed stakeholder mapping, including identification of specific concerns and needs of indigenous groups, the development of a specific 'gender' approach and baseline, and to propose mitigation measures, when needed, to reduce the risks. Although the basis for this has been set-up during the concept note development phase, detailed assessments will be conducted during the full proposal development phase, including consultations with vulnerable communities and groups focused on identifying and confirming potential risks and impacts of all proposed activities. All potential adverse impacts will then be identified, taking into consideration the specific needs, limitations, constraints and requirements of each group.

Risk identification at concept note phase: the project will ensure all indigenous groups in target areas are identified during the full proposal phase. At the concept note stage indigenous groups (people from Tribes from Darfur, Nubian) have been identified in target areas. Most migrated from other areas in the country. The project will ensure equal representation of this group during consultations, planning processes and for possible job opportunities and to give groups to right to give or withhold its consent to proposed projects that may affect the lands they customarily own (which is often not relevant because of in-migrantion), occupy or otherwise use (in line with UNDRIP, and particularly with regard to Free, Prior, Informed Consent (FPIC)). Also, awareness about the rights of indigenous peoples and how it is a general principle in consultation will be raised if indigenous groups are identified. Analysis so far:

- ☐ Sudan is not mentioned by OHCHR[35]. However, Sudan is not a signatory of C169 (see above). In Sudan there are more than 56 ethnic and almost 600 sub-ethnic groups. The main religions are: Sunni Islam, indigenous beliefs (mainly in the south), Christianity (mainly in the south and Khartoum). Most beneficiaries in target areas are (ex)DPs; they are not regarded as indigenous people.

AF principle 8: Involuntary resettlement

The project will ensure physical or economic displacement is avoided for each project activity.

Risk identification at concept note phase: output 3.1., which entails the construction of dams / water reservoirs in an area where little people live. However, there are some villages and agriculture land close to the area of potential dam construction. If drainage-related interventions

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[35] http://www.ohchr.org/EN/Issues/IPeoples/SRIndigenousPeoples/Pages/SRIPeoplesIndex.aspx

are required, this will only take place in or along existing channels and on public land. More details about (informal) land use, etc. will be provided during the full proposal development phase. Reference to – and agreement to comply to - human right related to avoiding involuntary resettlement will be made in all contract and MoUs and AoCs. No interventions will take place without the consent of inhabitants in the targeted area for dam construction.

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AF principle 9: Protection of natural habitats

The project will ensure no negative impacts on natural habitats will result from project activities.

Risk identification at concept note phase: output 3.1., which entails the construction of dams / water reservoirs in an area where little people live. No major natural habitats have been identified in construction area. However this will be double-checked during the full proposal development phase.

AF principle 10: Conservation of biological diversity

The project will ensure no negative impacts on biological diversity will result from project activities.

Risk identification at concept note phase: According to IUCN red list[36] - Sennar Penduline-tit and Sudan Catfish, may live in Khartoum area. During the full proposal phase, possible impacts of project activities, especially related to output 3.1., which entails the construction of dams / water reservoirs that may have effects on life in streams and surroundings, potential intervention impacts will be assessed. Under the UNESCO Man and the Biosphere Programme reserve[37], there are no 'biospheres' identified in Sudan. In the Environmental and Socio-economic Impact study of Wadi Abu Soueid Water Harvesting and Spreading Project in Khartoum State, Sudan,[38] identified potentially negative effects of dams included the increase in the densities of the noxious Adar (Sorghum sp.) weed and semi-parasitic Buda (Striga hermonthica) plant). The environmental and social impact assessment to be conducted during the full proposal will assess these potential negative impacts and propose mitigation measures if required.

AF principle 11: Climate change

The project will ensure no negative climate change impacts will result from project activities, such as increases in the emissions of greenhouse gasses or in other drivers of climate change.

Risk identification at concept note phase: in line with internationally recognized standards, large interventions in the following sector require a greenhouse gas emissions calculation: energy, transport, heavy industry, building materials, large-scale agriculture, large-scale forest products, and waste management. In line with national standards, an environmental and social impact assessment will be conducted for the proposed activities under output 3.1., which entails the construction of dams / water reservoirs. This assessment will also consider potential greenhouse gas emissions as a result of use of building materials.

AF principle 12: Pollution Prevention and Resource Efficiency
The project will ensure pollution will be prevented and resources will be used efficiently for all project activities.

[36] http://www.iucnredlist.org/search
[37] http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/man-and-biosphere-programme
[38] http://khartoumspace.uofk.edu/handle/123456789/9244

Risk identification at concept note phase: In line with national standards, an environmental and social impact assessment will be conducted for the proposed activities under output 3.1., which entails the construction of dams / water reservoirs. This assessment will also consider pollution prevention and resource efficiency. In principle the intervention promotes resource efficiency as it has a double function of flood prevention and water supply, thus avoiding multiple infrastructure interventions to establish the same.

AF principle 13: Public health

The project will ensure no negative public health impacts will result from project activities.

Risk identification at concept note phase: In line with national standards, an environmental and social impact assessment will be conducted for the proposed activities under output 3.1., which entails the construction of dams / water reservoirs. This assessment will also consider potential health impacts. To avoid potential negative health impacts for this activity, safety signs and equipment will be provided in line with core labour rights.

AF principle 14: Physical and Cultural Heritage

The project will ensure no negative impacts on heritage sites will result from project activities.

Risk identification at concept note phase: UNESCO identified the following Heritage sites in Sudan[39]:

- Gebel Barkal and the Sites of the Napatan Region
- Archaeological Sites of the Island of Meroe
- Sanganeb Marine National Park and Dungonab Bay – Mukkawar Island Marine National Park

These are not located in the target areas. However, identification of for the communities 'important' buildings in target areas will be part of community and vulnerable groups consultations during the full proposal development phase.

AF principle 15: Lands and Soil Conservation.
The project will ensure no negative impacts lands and soil conservation will result from project activities.

Risk identification at concept note phase: In line with national standards, an environmental and social impact assessment will be conducted for the proposed activities under output 3.1., which entails the construction of dams / water reservoirs. This assessment will also consider potential impacts on lands and soils by identifying fragile soils and valuable lands, if any, and to propose measures to reduce negative effects. In the Environmental and Socio-economic Impact study of Wadi Abu Soueid Water Harvesting and Spreading Project in Khartoum State, Sudan,[40] potential negative impacts identified included uncontrolled flooding of potentially productive farmland due to neglect of dam maintenance. The environmental and social impact assessment to be conducted during the full proposal will assess these potential negative impacts and propose mitigation measures, including prove of maintenance plan and budget appropriate to the risk.

[39] https://whc.unesco.org/en/list/
[40] http://khartoumspace.uofk.edu/handle/123456789/9244

3. Environmental and Social Risks and Impacts Management Plan (ESMP)

To be inserted at full proposal development phase. It will include:

- ☐ Risks management arrangements
- ☐ Risks monitoring and evaluation arrangements
- ☐ Grievance mechanism
- ☐ Overview of potential risks and mitigation measures and monitoring arrangements

4. Gender approach and baseline

Purpose

The purpose of developing a specific gender approach and baseline is to provide an overview of what measures have been taken to ensure that women and men and vulnerable groups will have equal opportunity to build resilience, address their differentiated vulnerabilities and increase their capability to adapt to climate change impacts through project implementation (by providing a baseline with targets). Moreover, it also shows how, in this project, women and youth groups are recognized as "agent of change" in building community resilience.

Project preparation process

An UN-Habitat headquarter gender specialist is involved in the project preparation to ensure compliance with the Gender Policy. The project design and approach are 'gender-responsive' because, during the project preparation phase, gender equality and women's empowerment have been considered during initial data collection focused on issues, needs and perceptions, activity prioritization and the identification and verification of specific 'gender' related risks and impacts. This has been done through desk research, surveys, focus group discussions and community decision-making processes.

Specific steps and considerations

1. Determinants for gender-responsive stakeholder consultation

Focus group discussion with women (and groups dependent on water for their livelihoods (agriculture and cattle)) have been conducted during the concept note development phase, especially to identify specific needs regarding proposed interventions. Focus group consultations with youth and DPs / indigenous groups are also planned for the full proposal development phase (besides women and groups dependent on water for their livelihoods) to further identify and assess specific needs regarding proposed interventions and possible and perceived risks and, where needed, mitigation measures. Besides that, the following stakeholders have been or will be consulted during the full proposal phase to understand specific gender issues and needs:

Table 22: Stakeholders (to be) consulted for gender approach

Type of stakeholder	Specific stakeholder
National government	At full proposal development phase
UN agencies	UN women (at concept note proposal development phase)
Community level	Women Unions in El kariab, El Marabie, El Fateh and El Sheikh

See part II.D and annex 1

2. Initial Gender Assessment

The following has been or will be identified / determined:

Data baseline – overview of disaggregated data (beneficiaries) in target areas. Focus will be on women, youth (and children), (ex-)DPs and Indigenous groups (of which the last two groups are often the same).

Table 23: Data baseline – overview of disaggregated data (beneficiaries) in target areas.

Target area	Total	Women	Children (<15)	Youth (15-24)	Elderly (>60)	Dis-abled	In-formal	(Ex-) DPs	In-digenous
Khartoum state	8 million								
Khartoum mentro	6,2 million								
East Nile Locality	1,078,498	575,062	459,440	212,464	301,198	32,354	5%	45%	22%
Soba Sharq Administrative unit	113,433	56,081	57,352	22,346	11,003	3,630	3%	7.5%	17%
Target settlements and population									
El Kariab (down)	28.500* (5.7 / HH)	49%	42%	20%	10%	5 %	Formalized	30%	18%
El Marabie (down)	26.370* (6 / HH)	50%	42%	20%	10%	4 %	Formalized	0%	10%
Al Huda	TBD during full proposal phase								
Elshiekh Alamin (upstream)	7200	50%	43%	20%	10%	2%	0	0	3%
AL Bayada (upstream)	3600	50%	45%	18%	8%	3%	0	0	0
Um Ketra	TBD during full proposal phase								
Um Ushyra	TBD during full proposal phase								
Karari Locality	1,293,195	659,529	55,605	254,759	125,431	49,141	3%	12%	11.7 %
El Fateh Adminstrative Unit	86,332	44,893	37,123	17,180	8,374	3,885	0	95%	29%
Target settlements and population									
El Fateh	53,632	27,889	23,062	10,136	5,202	2,413	0	97%	34%
Al-Thowrat Blok 22-23	TBD during full proposal phase								
Omdurman Locality	698,900	345956	298731	137683	67793	TBD during full proposal phase			

Target settlements and population						
Al Salha	25,000	12,625	11,250	4,950	2,150	TBD during full proposal phase
Al Gea'a	13,810	6,960	6,213	2,679	1,119	TBD during full proposal phase

☐ Differentiated climate change impacts on men and women and their differentiated capacities do adopt to these, gender division of labor and gender-based power structures

According to women unions at community level, impacts of floods and climate change related diseases especially affect women (but also children, elderly and disabled) in a specific way, including:

- Psychologically affected (panicking)
- Closure of schools
- Deterioration of health and medical costs

When conducting activities, it should be considered that women are relatively often unemployed / poor, illiterate and uneducated and customs and norms sometimes prevent them from participation in activities (see below). As for gender division of labour, women relatively often do work around and related to the household – less in public (see below). When employed as laborers, they work e.g. as tea or food sellers, cleaners (e.g. in El Fateh). According to women groups, they have skills that can be build upon, some are well trained, but lack income. Employment opportunities for youth is also considered a problem.

☐ Analysis of legal status of women in the country/region

Sudan is not a signatory on the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW). As reported by OCCHR in 2018[41] there are still issues of violence against women. OHCHR visited Sudan to examine in situ the progress and obstacles to the enjoyment of human rights regarding violence against women, its causes and consequences in 2015[42] and recommended that the donor community focus international assistance programmes on the empowerment of women and girls. OHCHR also visited Sudan to examine in situ the progress and obstacles to the enjoyment of human rights regarding extreme poverty in 2014[43] and recommends improving access to finance and will be achieved by enhancing women's rights and their role in the production sector, as well as their access to all levels of education.

☐ Analysis of cultural/religious status of women in the country/region

- As of 2012, women embodied 24.1% of the National Assembly of Sudan. Sudanese women account for a larger percentage of the national parliament than many Westernized nations. Notwithstanding that, gender inequalities in Sudan, particularly as they pertain to female genital mutilation and the disparity of women to men in the labor market, have received attention in the international community.

[41] http://www.ohchr.org/en/NewsEvents/Pages/DisplayNews.aspx?NewsID=23101&LangID=E
[42] https://documents-dds-ny.un.org/doc/UNDOC/GEN/G16/079/16/PDF/G1607916.pdf?OpenElement
[43] https://documents-dds-ny.un.org/doc/UNDOC/GEN/G04/111/24/PDF/G0411124.pdf?OpenElement

- According to UN Women, women are productive but conservative; consider women prefer to work close to home (because of family) and not walk far (because of safety).
- According to women unions inputs at community level there is a:
  - High level of unemployment especially among women with high dependency on the head of the family
  - High level of poverty (women potentials has not been tapped)
  - High illiteracy rates among women
  - Customs and norms prevent women from effective participation - early marriage and high drop-out rate from school

☐ Opportunities for promoting a 'women' and 'youth' as agents of change

- According to UN Women, 'Change' can be established 'best' at community level (CBO's / popular committees). Therefore, women and youth will be targeted at this level with use of quotas for trainings etc.
- According to UN Women, there are no 'women' focal points in ministries. This will be established during the project.
- According to women unions inputs at community level, women and community solidarity is strong (even despite of different ethnicities) through collective support to individuals during emergency (called Nafeer) or social events (marriage, Funeral etc.) both in cash and kind and women savings groups (called Sanduq) on a rotational manner. Head of women union at local level together with selected teachers can lead activities / be targeted under project.
- According to women unions inputs at community level, the establishment of local development and emergency committee would be required, and women should be represented in it. In Al Fetah, women have a clear role in in risk management, but their intervention is traditional and limited. Therefore gender sensitive risk management knowledge and skills are required
- Youth action groups were active during flood periods to provide support and rescue for the affected people in East Nile Locality and other affected parts of Khartoum state. They are active on Facebook and other social media to communicate with the rest of society to publicize and disseminate information about the disaster. The groups include but are not limited to: Merciful initiative; Luster initiative; Unique Lace initiative; Emergency Road initiative and life makers initiative. Youth groups will be target groups for this project, especially for the establishment of early warning system and ways of communication.

3. <u>Project planning and design</u>

The following will be further identified / determined during the full proposal development phase:

a. Program goals/objectives and target groups
☐ Key gender goals (to improve gender equality)
☐ Entry points to integrate gender considerations (how to empower women and youth)
☐ Suitable interventions to meet specific needs and built on women skills and knowledge

b. Design of intervention activities:
☐ Promoting an enabling environment for gender equality
☐ Specific roles and needs women (and men) and youth

☐ Involvement women (and men) and youth in activities
☐ Additional activities needed to ensure gender perspective, incl. risk mitigation measures

Scale	Disaggregated beneficiaries, gender specific issues and needs (see 2) / baseline	Key goals, entry points and suitable interventions (see 3a)	Specific roles and activities to ensure gender perspective (see 3b), incl. potential risk mitigation measures (see also ESMP)
State / municipal	No clear women focal points in ministries / municipality	Estanlish focal points	
Focus area / community	Women have strong ties and communicate well Women and youth are often not represented in emergency activities	Target especially women, youth and teachers for trainings and set-up and operation of early warning systems	
(Concrete) intervention	Farmers and cattle owners lack access to water	Include these groups in planning and execution	

c. Executing entities:
☐ Commitment to gender equality
☐ Capacity building objective

d. Project outputs
☐ Specific for women and youth
☐ Measuring how the environment will enable gender equity

e. Gender responsive indicators
☐ Indicators towards fulfillment of goals / objectives
☐ Gender disaggregated
☐ Targets toward equality

f. Budget
☐ Allocation for mainstreaming?

Component and outputs	Gender perspective selected executing entity (see 3c)	Specific 'gender' targets (when specific 'gender' output) (see 3d and e)	Specific 'gender' Indicators (see 3e)	Budget required and allocated (see 3f)

4. <u>Implementation</u>
- Adaptive management
- Gender expertise and focal points

- Are partner organizations aware
- Sustainability of gender response/on-going engagement of women
- Strategy for capacity building for local women

5. Performance Monitoring and Evaluation
- Gender responsive management response in place, including participatory monitoring?
- Methods, tools and budgets needed to collect 'gender data'?

6. Knowledge Management, Information Sharing and Reporting
- Gender considerations (inequalities, needs, etc.)
- Lessons learnt and best practices

ANNEX 3: Wadi Soba / East Nile possible dam site selection and flash flood risks

International Journal of Engineering Science Invention
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 5 Issue 12|| December 2016 || PP. 50-61

DAM Site Selection Using GIS Techniques and remote sensing to Minimize Flash Floods in East Nile Locality (Soba Valley)- Khartoum State

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ABSTRACT: *In the last few years devastating flash floods descending downstream through valleys had occurred in East Nile Locality-Sudan. A flash flood can be caused by intense rain, particularly when it takes place in a saturated area where rain has previously fallen. Under these conditions the additional rain runs off over the surface and accumulates in streams and channels at a much accelerated pace. The flooded water had caused a considerable damage in houses, roads and properties. Construction of earth dams is suggested to minimize the destructive effect of these flash floods and make use of stored water in agriculture and grazing. To determine the location of earth dams, multi criterion methods had been used. The best dam location had been achieved applying the selection criterion. The surface areas, volume of reservoirs, had been determined for every selected location Using ArcGIS. Major Landuse, landcover, stream order and location of water body had projected on the watershed area of the Soba valley to extract the residential areas, agricultural areas and grassland effected by suggested dams. Dam location selection model and volume model had been designed to repeat the steps and report the analysis results automatically.*

Keywords: *Flash flood, DAM and Model*

I. INTRODUCTION

Water is one of the main requirements for healthy plant growth. Most arid and semi-arid regions, suffer from insufficient and unreliable rainfall. A high rate of evaporation in the growing season is also common. When it rains in semiarid areas, the rain- storms are usually heavy. The prevailing soils generally cannot absorb the amount of the water which falls in such a short time. [3][4]

Most techniques for water collection make use of large water sources such as rivers and ground water (e.g. wells and irrigation systems), and require large-scale investments. But in many countries in the world small-scale, simple methods have been developed to collect surface runoff for productive purposes. Instead of runoff being left to cause hazards, it is harvested and utilized. Many types of water harvesting techniques with many different applications are available. [1]

Ground investigation is important before planning to construct an earth dam especially site selection and earthworks considerations. Generally, dams in arid regions, particularly, in Sudan, are built to guarantee water supply and reduce the negative impact of flood events. In fact, East Nile Locality is suffering surface water scarcity compensated by flash flooding, which has been affecting East Nile Locality for many years during the autumn season. The catchment experienced major floods during the years 1988, 2007, 2013 and 2014. Unexpected flash floods and strong population growth rates associated with high water needs for agriculture will increase pressure on water resources in Khartoum state especially Blue Nile. Water resources are limited and construction of new dams will be an important part of the solution.

II. METHODOLOGY

2.1. Study Area:

The study area consists of East-Nile and Bahri localities in Khartoum state. The catchments of the natural streams in the study area lay between latitudes (16°40'59"N-14°50'26"N) and Longitudes (34°38'52"E-32°05'23"E) (Figure 1)

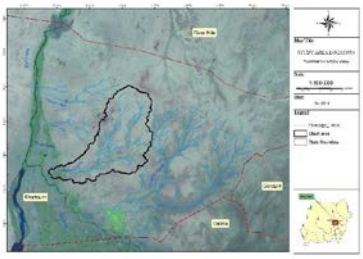

Figure 1 Study area

Several valleys dominate the area. Territory of the national capital is classified under the climatic category of the southern Sahara. Khartoum region is categorized within the zone of semi- arid, which is characterized by the high temperature degree during the day all over the year. The rainfalls fluctuate from year to year and the annual average ranges from 200 mm in the north to 250 mm in the south. Temperatures are highest at the end of the dry season due to cloudless skies. The warmest months are May and June, when the average temperature is 41°C and max temperatures can reach up to 48°c.[4]

2.2. Data Sources:

1- Digital Elevation Model:-

- Date of data: Aug. 2008
- Data Coverage (7490Km2 – 84*92Km) (East-Nile and part of Bahri localities in Khartoum state between latitudes (15°07'38.6"N-16°01'3.6"N) and Longitudes (33°8'48.8"E- 33°03'8.8"E)
- Produced by SRTM-USGS
- Resolution: 30*30 m
- Datum: WGS84
- Projection: UTM, Zone 36N.
- www.opentopography.com

2- Shape file of Soil data:-

- Date of Collected data: 2010 By Ministry of Water Resources and Electricity (DIU)
- Data Coverage (7490Km2 – 84*92Km) (East-Nile locality in Khartoum state latitudes (15°07'38.6"N-16°01'3.6"N) and Longitudes (33°8'48.8"E- 33°03'8.8"E)
- Datum: WGS84
- Projection: UTM, Zone 36N.

3- Shape file of landuse and Land cover data:-

- Date of Collected and prepared of data: 2010 By Ministry of Water Resources and Electricity (DIU)
- Data Coverage: Khartoum state
- Datum: WGS84
- Projection: UTM, Zone 36N.

4- Data from Google earth:-

- Villages in the study area
- All Agriculture projects in the study area
- Roads and their pipe culverts

2.3 Methodology:

2.3.1. Conditions for water harvesting:

- **Climates**

Water harvesting is particularly suitable for semi-arid regions (300-700 mm average annual rainfall). It is also practiced in some arid areas (100-300 mm average annual rainfall). These are mainly subtropical winter rainfall areas. In most tropical regions the main rainfall period occurs in the 'summer' period, when evaporation rates are high. In more arid tropical regions the risk of crop failure is considerably higher. The costs of the water harvesting structures here are also higher because these have to be made larger. [1]

- **Slopes**

Water harvesting is not recommended on slopes exceeding 5% because of the uneven distribution of runoff, soil erosion and high costs of the structure required.

- **Soils and soil fertility management**

Soils in the cultivated area should be deep enough to allow sufficient moisture storage capacity and be fertile. Soils in the catchment area should have a low infiltration rate. For most water harvesting systems soil fertility must be improved, or at least maintained, in order to be productive and sustainable. The improved water availability and higher yields derived from water harvesting lead to a greater exploitation of soil nutrients. Sandy soils do not benefit from extra water unless measures to Improve soil Fertility Are applied at the same time. [1]

- **Crops**

One of the main criteria for the selection of a water harvesting technique is its suitability for the type of plant one wants to grow. However, the Crop can Also be Adapted to the structure. The basic difference between perennial (e.g. trees) and annual crops is that trees require the concentration of water at points, whereas annual crops usually benefit most from an equal distribution of water over the cultivated area.[1]

- **Technical criteria**

When selecting a suitable water harvesting technique, two sets of criteria, of equal importance, should be taken into account [1]:-

- Water harvesting technique should function well from a technical point of view.
- Should 'fit' within the production system of the users. If the risk of production failure of the new technique is too high compared with proven techniques, or the labor requirements of the new technique are too high, your proposed water harvesting system, although designed well, will not be adopted because the priorities of the future users are different.

2.3.2. Selection water harvesting Techniques:

Figure2 provides an overview of preliminary selection of a water harvesting technique. The list of water harvesting techniques in Figure2 is far from complete. You will probably come across different traditional and/or non-traditional techniques. Water harvesting systems can be grouped into two categories: Systems in which the bunds follow the contour line are called contour systems. Systems in which bunds do not follow the contour line, but enclose a part of the slope are called *freestanding systems*. Water harvesting systems for trees usually have an infiltration pit because the harvested water has to be concentrated near the tree. On long slopes systems with an infiltration pit are not advisable, because these systems harvest a large quantity of runoff water, too much to be collected in an infiltration pit. On long slopes the water is collected in a larger, cultivated area and used for either fodder/rangelands or crops. All kinds of variation are possible within water harvesting systems. The bunds can be constructed using a variety of materials: earth, stones and living and/or dead vegetable material (living barriers or trash lines). The bunds may or may not have a provision for draining the excess harvested water. For the free- standing systems variations are also possible in the layout of the bunds. They can be semi-circular, V-shaped or rectangular [2].

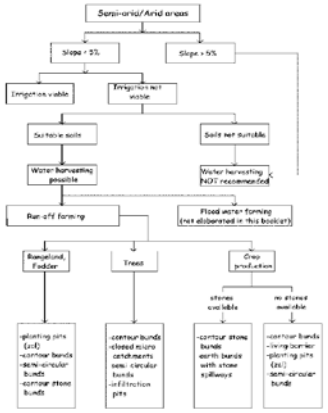

Figure 2 Selection of a water harvesting system [2]

2.3.3. Small Earth Dams

Small earth dams are water harvesting storage structures, constructed across narrow sections of valleys, to impound runoff generated from upstream catchment areas. Construction of the dam wall begins with excavation of a core trench along the length of the dam wall which is filled with clay and compacted to form a 'central core' that anchors the wall and prevents or minimizes seepage. The upstream and downstream embankments are also built using soil with 20-30% clay content. During construction – either by human labor, animal draught or machine (bulldozer, compacter, grader etc.) – it is critical to ensure good compaction for stability of the wall. The dam is fenced with barbed wire to prevent livestock from eroding the wall. Typical length of the embankment is 50-100 m with water depth ranging 4-8 m. An emergency spillway (vegetated or a concrete Shute) is provided on either, or both sides, of the wall for safe disposal of excess water above the full supply level. The dam water has a maximum throwback of 500 m, with a capacity ranging from 50,000 – 100,000 m. The dams are mainly used for domestic consumption, irrigation or for watering livestock. If the dams are located on communal lands, their establishment requires full consultation and involvement of the local community. The government provides technical and financial assistance for design, construction and management of these infrastructures. Community contribution includes land, labor and local resources. The community carries out periodic maintenance of the infrastructure – including vegetation management on embankment, desilting etc. – and of the catchment areas (through soil and water conservation practices). [8]

2.3.4. Selection of Suitable Site for Water Harvesting Projects:

After the boundary of the watershed derived from the DEM by software ARC hydro, the software ArcGIS had been used to derive the layers of different orders of valleys from the DEM According to the results of Slope and hydrology analysis, seven locations had been selected, To determine earth dam's locations multi criterion methods had been used after that the best dam location regarding the selection criterion had been achieved. The surface areas, volume of reservoirs, had been determined for the seven suggested locations Using ArcGIS. The path profiles had been prepared utilizing Global Mapper Software in the seven selected locations. Major Landuse, landcover, stream order and location of water body were projected on the watershed area of the Soba valley to extract the residential areas, agricultural areas and grassland that had been effected by suggested dams.

2.3.5. Calculation of the volume and surface of a reservoir using ArcGIS:

The surface areas, volume of reservoirs, had been determined for every suggested location. Using ArcGIS by converting contour into a Triangulated Irregular Network (TIN), then the contour that marks the reservoir maximum level had been selected and converted into a Polygon to calculate the total volume of the reservoir. The volume model had been designed and run to achieve the area and volume of reservoir.

III. PRIOR APPROACH

On the application of Remote Sensing in flood management noted that DEM model is the main part of flood hazard mapping. In particular, slopes data from DEM are useful for many hydrological studies and can be employed for dam location selection. Furthermore, a limited effort has been devoted in recent years to determine the capability of these techniques in assisting engineering dam design by allowing efficient, quick and economic data collection. However, the application of remote sensing in ephemeral streams is limited compared with permanent rivers.[6]

Used remote sensing and GIS techniques to assign the location of small water harvesting structures across streams/watersheds. Various thematic layers such as Landuse/Landcover, geomorphology and lineaments were used. These layers along with geology and drainage were integrated using GIS techniques to derive suitable water harvesting sites. In addition to the suitable site selection of the dams, they calculated the storage and transmittance of groundwater in the study area.[10]

Furthermore, proposed three dam site locations for Jeddah City in Saudi Arabia based on topographical analysis using different data sets such as topographic maps, remote sensing images, a digital elevation model with 90 m resolution (STRM 2000) and geological map. In addition, these selected locations were in the outlet areas where large tracts of land could be temporarily inundated by water as a result of water being held back by the proposed dam.[11]

IV. OUR APPROACH

Model Builder is very useful for constructing and executing simple workflows, it also provides advanced methods for extending ArcGIS functionality by allowing you to create and share your models as tool. Dam location selection and Volume models has been designed as shown below:-

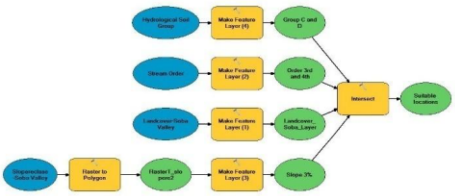

Figure 3 DAM selection Model

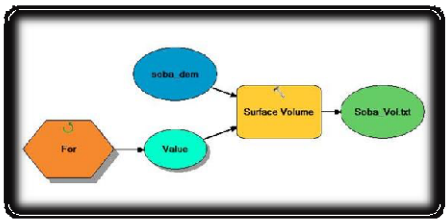

Figure 4 Volume Model

Volume model had been built and using to calculate reservoir volume for selected sites the following had been resulted:

Table 1 Reservoir Surface Area and Volume

Elevation (m)	Reservoir Surface Area(Km2)	Reservoir Volume (10^6 m3)
391	4.467	4.76
392	7.375	10.39
393	11.071	19.25
394	15.339	32.15
395	20.302	49.58
396	26.408	72.41
397	33.994	101.97
398	43.666	139.88
399	55.287	188.40
400	68.791	249.34
401	83.967	324.67
402	99.694	415.56
403	114.612	522.17
404	127.828	643.08
405	140.585	776.82
406	153.434	923.28
407	167.390	1082.83
408	183.062	1257.00
409	200.925	1447.70
410	219.975	1656.95
411	239.212	1885.49
412	257.766	2133.20
413	275.236	2399.06
414	291.542	2681.91
415	306.498	2980.50
416	320.568	3293.58
417	334.862	3620.66
418	350.828	3962.51
419	368.115	4320.90
420	384.397	4696.53

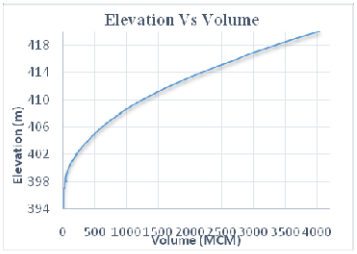

Figure 5 Elevation Vs Volume

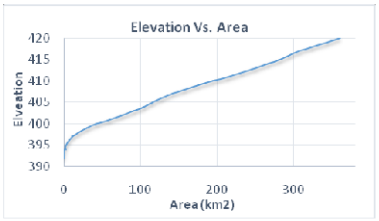

Figure 6 Elevation Vs Area

- Appling conditions of dam site selection in 3.3.1 and Figure 4 the following results had been achieved:

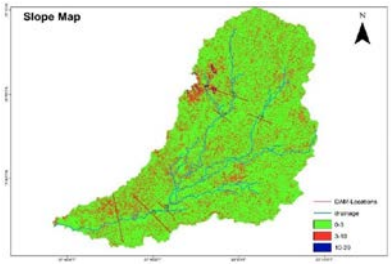

Figure 7 Slop Map

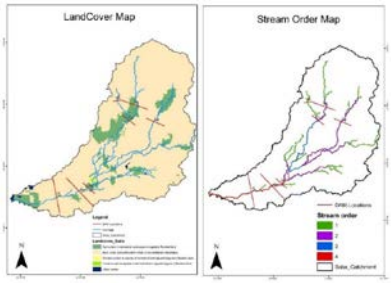

Figure 8 Land Cover and Stream Order Map

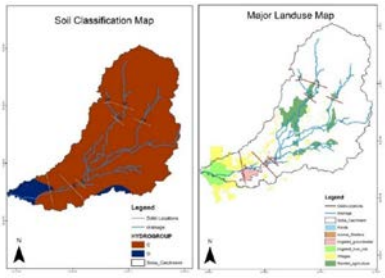

Figure 9 Soil and Landuse Map

- The cross-section had been prepared for each proposed dam site, then the layer of lakes had been exported to Google Earth to extract the affected areas of villages, agricultural lands and grasslands:-

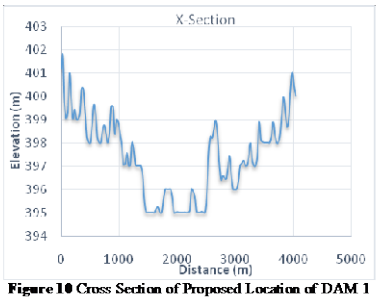

Figure 10 Cross Section of Proposed Location of DAM 1

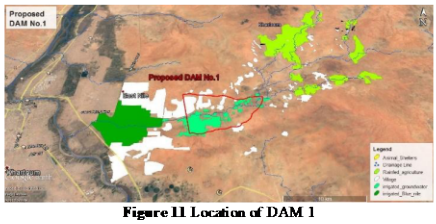

Figure 11 Location of DAM 1

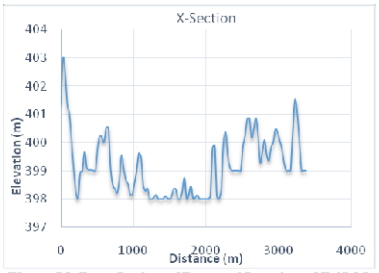

Figure 12 Cross Section of Proposed Location of DAM 2

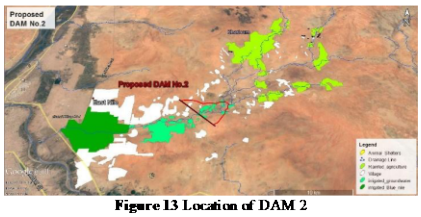

Figure 13 Location of DAM 2

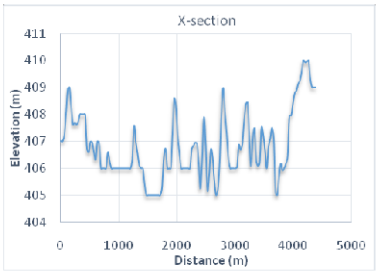

Figure 14 Cross Section of Proposed Location of DAM 3

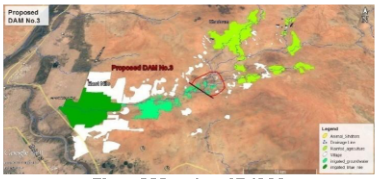

Figure 15 Location of DAM 3

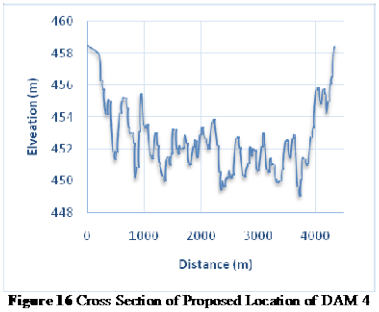

Figure 16 Cross Section of Proposed Location of DAM 4

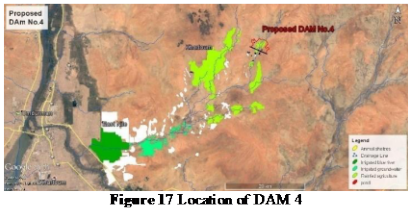

Figure 17 Location of DAM 4

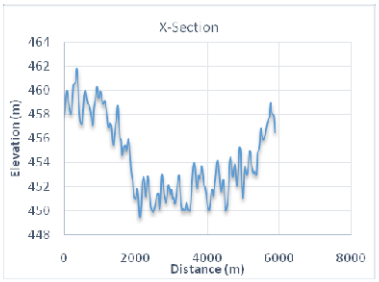

Figure 18 Cross Section of Proposed Location of DAM 5

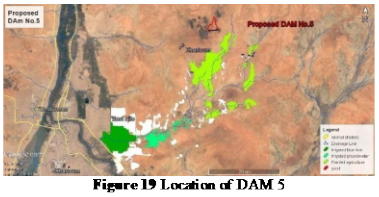

Figure 19 Location of DAM 5

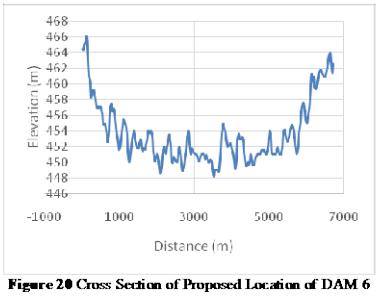

Figure 20 Cross Section of Proposed Location of DAM 6

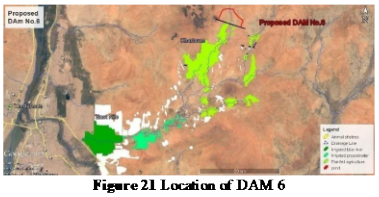

Figure 21 Location of DAM 6

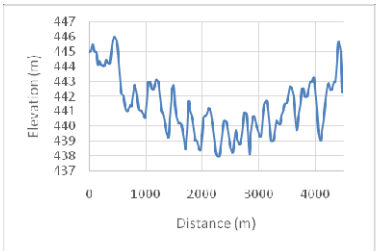

Figure 22 Cross Section of Proposed Location of DAM 7

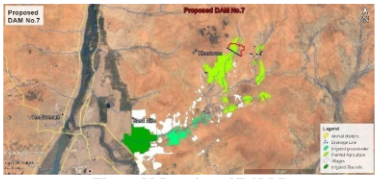

Figure 23 Location of DAM 7

- The following table shows the effects of each proposed dam location in the study area: -

Table 2 Impact of Selected site of DAMs

DAM	potential cultivated area to be covered by lake	potential residential areas to be covered by lake	Area of reservoir
No.	Km2	Km2	Km2
Location 1	11.44	54.479	65.919
Location 2	0.61	18.268	18.878
Location 3	0.79	21.713	22.503
Location 4	0.02	9.875	9.895
Location 5	0	4.783	4.783
Location 6	0	16.538	16.538
Location 7	0	14.071	14.071

- Location of DAM number has the following advantages and disadvantages. The main advantages of this location are: firstly the minimization of the effect of flash flood in Marabe-alshareef town and the agricultural projects near this town, secondly the lake of this dam can be used for irrigation purposes. Its disadvantages are: firstly it will cover large areas of the villages and areas that can be suitable for agriculture or grazing. Secondly the cost of the dam construction is high compared to the cost of settlement of the affected villages and compensation of agricultural lands that could be affected.
- Locations number two and three are the second best options, but they have the same disadvantages of the location of DAM one, with less affected areas, where the dam lake area is less than the first location.
- In location number four the amount of reserved water is not enough compared with the construction cost of the dam as well as the wide areas that will be negatively affected by the construction this dam.
- Location number five had been excluded because it is located in steep surface in the Valley of rank four as well as that the amount of reserved water is not feasible.
- Locations number six and seven can be considered as the third option because they can minimize the effect of flash flood with disadvantages of large area needed for the construction of the dam, which reduces agricultural and grazing lands as well as the high cost of the dam construction compared to the compensation cost of the affected agricultural lands.

- Location of DAM number one had been selected as the best choice regarding reservoir volume which enables the storage of large water quantity. This choice has the credit of minimization of the flash flood effect and the capability of irrigation of wide agricultural and grazing lands

V. CONCLUSION

After the boundary of the watershed had been derived from the DEM, the software ArcGIS had been used to derive the layers of different orders of valleys from the DEM. According to the results of slope and hydrology analysis, seven locations had been selected as suggested water reservoirs, To determine earth dam's locations multi criterion methods had been applied. The best dam locations satisfying the selection criterion had been achieved. The surface areas and volumes of reservoirs had been calculated for seven selected locations. The path profiles were produced in the seven selected locations. Major Landuse, landcover, stream order and location of water body were projected on the watershed area of the Soba valley to extract the residential areas, agricultural areas and grazing lands that had been affected by the dams. Dam location selection model and volume model had been designed to repeat the steps and report the analysis result automatically.

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AI NEELAIN JOURNAL OF GEOSCIENCES (ANJG)
Vol-1, Issue-1, 2017
ISSN: 1858-7801 , http://www.neelain.sd.edu

Original paper

Flash Floods Risk Assessment of Sharg Alneel area, Khartoum State, Sudan Using Remote Sensing, GIS and Geophysical Techniques

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Received: 30 January 2017/ revised: 23 March 2017 / accepted: 20 April 2017

Abstract

This study was carried out to investigate the geological sources that may cause the flash floods of Shareg Alneel area in the eastern part of Khartoum City, Sudan which lead to damage of property and the infrastructures of the residential areas. In this study, remote sensing technique using Landsat-8 images together with Shuttle Radar Topography Mission (SRTM) elevation data and geophysical techniques (resistivity and gravity) have been adopted. Wadi Soba, Green valley and Wadi El Sileit are the main seasonal water courses in the study area that drain into the Blue Nile with a regional parallel pattern. The results show that relatively steep slope from east to west may represent one of the factors contributing to the flood hazard during the rainy season. Also, it can be noted from band ratio technique that high concentration of clay sediment is located close to the River Nile and along these three valleys. This result was confirmed by resistivity technique which shows an existence of considerable amount of clayey sediments that obstruct water infiltration. The residual gravity reveals that the three valleys are characterized by relatively lower gravity anomaly indicating thicker sediments than the surrounding plains. From the obtained results, Flood hazard map has been created which divided the area into low, moderate and high risk areas. Accordingly, it was conducted that that the residential areas were superimposed over high risk zones. This study recommends re-planning of residential areas and construct dykes in the upper stream of the main valleys to decrease the flood hazard effects.

Keywords: Flash flooding; Sharg Alneel; Khartoum; hazard map; Remote Sensing.

1. Introduction

Generally, the knowledge of the earth's natural hazards can lead one to live a safer life, providing guiding principles on where to build homes, where to travel, and what to do during natural hazard emergencies. Although, high distribution of natural geo-hazards around the world, flood is the most common natural hazard in Sudan region which causes more damage than any other geo-hazards that give high significance of interest (Davies and Walsh 1997; Sutcliffe et al. 1989; Sulieman and Elagib 2012). The sequences of severe floods were recorded in 1962-1965, 1978-1979, 1988, 1994, 1998, 1999, 2006 and 2013. The rainy season starts in August when an average of 75.2 mm (30 in) of rainfall occurs. There are two predominant types of floods: widespread floods caused by overflow of the River Nile and its tributaries. It usually originates from heavy rainfall in the catchment areas of the Ethiopian highlands, which causes unpredictable surges in the flow of the Blue Nile. Another type is an exceptionally heavy rain and run-off flooding (flash floods) which is generally short in duration and can cause major damage to villages, urban and agricultural areas located in the catchment and drainage zones. The ground moisture conditions and drainage basin characteristics such as topography, overburden thickness, vegetative cover, and

drainage density control the intensity of flash floods risk. Many researches on this topic have been done to assess and mitigate flash flood hazards (Ryosuke 2003; Vincent 2006; Knocke et al. 2007; Lan Bakeswell 2008; Baldassarre et al. 2010; Kundzewicz 2014).

However, in last years the climatic variability through intensified rainfall regimes together with urban development has made the city of Khartoum, Sudan, increasingly exposed and vulnerable to extreme flash flood events. Sharg Alneel area (Fig.1) is located in the upper eastern part of Khartoum City is frequently affected by heavy flash flooding during the rainy season (Plate 1). Mrabee El-shareef, East Soba, Elfaki Hashim represent the main areas that affected by flash flooding within the study area. The study area extends east of the Blue Nile, cover an area of approximately 5289 km² and is bounded by longitudes 32°,30',28" - 33°,22',58" E and latitudes 15°,54',19" - 15°,22',25" N. Taking into account the socio-economic framework present in this area, this study tries to construct a flash flood scenario that affects Sharg Alneel area in order to develop a basis for further investigations based on the available data resources. In addition, delineate the hazard areas along the wadies and their influence on the distribution of the runoff water.

In this study, the roles of remote sensing and geophysical techniques have been adopted to evaluate the flash flood hazard , construct geological hazard map, and finally, propose possible solutions and recommendation for evaluating the flash flood hazard factors and to assess the risk over time.

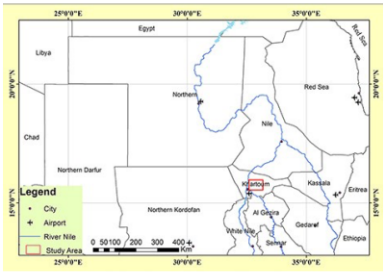

Figure 1. Location map of Shareg Alneel area, east Khartoum City, Sudan

2. Materials and Methods

The flood risk assessment should cover all sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information and to scope the extent of the risk of flooding which may involve preparing indicative flood zone maps. However, to achieve the objectives of the current study remote sensing, GIS and geophysical techniques were adopted. Landsat 8 Operational Land Imager (OLI) image (Path 173, row 49) was used to classify the lithological units and investigate the surface condition of the study area. Different processing manipulations have been applied which include image enhancement and transformation.

Digital Elevation Model (DEM) of the Shuttle Radar Topography Mission (SRTM) with a resolution of 30 meters was used to investigate Physiographic features such as slope and drainage patterns. Lithological well data of Sharg Alneel area were obtained from Archive of the National Water Corporation and the Geological Research Authority of Sudan (GRAS) to determine the depth to basement rocks. In order to study hydrology, hydrogeology and the subsurface condition, geophysical survey including resistivity and gravity techniques was carried out.

Previously, geophysical interpretations from gravity surveys were based on the mutual attraction experienced between two masses, as first expressed by Isaac Newton. Today, the Radar altimeter measurements provided the scientific community with valuable information about the Earth interior (Sandwell and Smith 2009). From this, the sea-surface topography from radar altimeter data was used to calculate the vertical component of the gravity field. This significantly helped in improving the knowledge of the earth tectonic. Consequently, the gravity field measurements were moved from only calculating the marine gravity field from radar Altimeter measurements to measure the global gravity field using new satellite missions. Recent satellite missions were launched like CHAMP in 2000, GRACE in 2002, GOCE in 2009, to measure the global field. The global coverage and the consistent data quality are the most significant advantages of the satellite gravity data.

3. Geology of the Study Area

Many researchers used different techniques to study the geology and hydrogeology of Khartoum area (e.g. Haggaz and Khiralla 1987; Awad 1994; Farah et al. 1997; El Dawi and Farwa 2003; El Dawi et al. 2003; Ahmed et al. 2000; Saad 2001; El khair et al. 2003; Eltayeb 2015). For the purpose of

geological mapping and identification of the main lithological units, remote sensing techniques have been performed in order to enhance the Landsat image for a better geological interpretation via spectral and photographic approaches. Color composites of various band combinations were assembled for lithological discrimination. For instance, the OLI 7, 5, 2 in RGB colour composites (Plate 2a) mapped the main lithologies in the area. In this image, outcrops of the sedimentary rocks appear in dark brown colour. The sandy superficial deposits are displayed in light yellow, the vegetated area in green, water in deep blue, while the shallow basement appears in light violet hue. The decorrelation stretching that utilizes the Principal Component Analysis (PCA) in enhancing the contrast among the different features present in the image was used in the present study to aid in the identification of various lithological units. A colour composite image was assembled from the results of this process (Plate 2b). As it can be observed, the contrast between the various features has increased dramatically. This will have a good impact on the accurate delineation of the geological boundaries when conducting geological mapping through on-screen digitization.

Plate 1. Air plane view showing flash flood damage of Sharg Alneel area, Khartoum City. Sudan (August 2013)

The enhanced images were imported into the GIS environment together with the field data, where on-screen type of digitization was carried out to delineate the geological map of the study area (Fig. 2). Most of the area under investigation is covered by various types of soils. The strong difference in character between soil types is reflected in the morphology of the land forms of the area. So these relationships may be used on the analysis of the soil pattern of the capital region. The geological substrata for these soils are Nubian sandstone, Gezira clays and small isolated rocky outcrops of the basement complex which are preserved in the northern side of the study area. The various geological units weather to produce the parent materials for the formation of soils. In addition, various local alluvial deposits along wadies, the Rive Nile silt and a significant amount of wind-blown materials were added to the soils during the frequent dust storms.

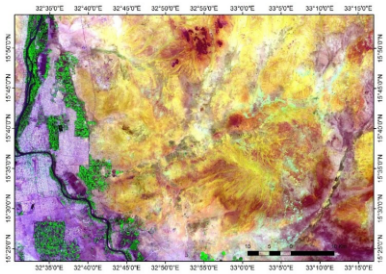

Plate 2a. Landsat 8 colour composites image obtained using the OLI band combination 752 in RGB, respectively, linearly stretched.

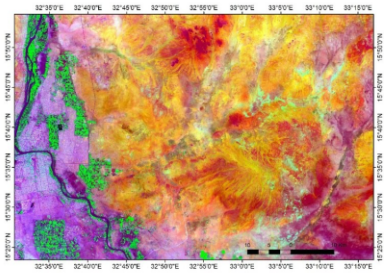

Plate 2b. Landsat 8 colour composites image obtained using the OLI band combination 752 in RGB, respectively, decorrelation stretched.

The Sharg Alneel area represents the foot of the gentle slope of the Butana region (Fig. 3). The digital elevation model derived from the SRTM data shows gently sloping ground surface which is truncated by the occasional Jebeles (isolated hills) or series of hills corresponding to resistant rock outcrops. The Blue Nile is the major drainage feature in the study area. Wadi Soba, Green valley and Wadi El Sileit are the main seasonal water courses which struck by the almost flat nature over much of the study area. They drain into the Blue Nile with a regional parallel pattern and appear to be structurally controlled by east west lineaments (Fig. 3). The slope along wadi El Sileit, Green Valley and wadi Soba is approximately 4°, 2.9° and 10.8°, respectively as measured from the DEM in east-west direction (Fig. 4). Consequently, the relatively steep slope may represent one of the factors contributing to the flood hazard during the rainy season.

4. Flash Flood Risk Assessment

4.1. Topographical Aspects

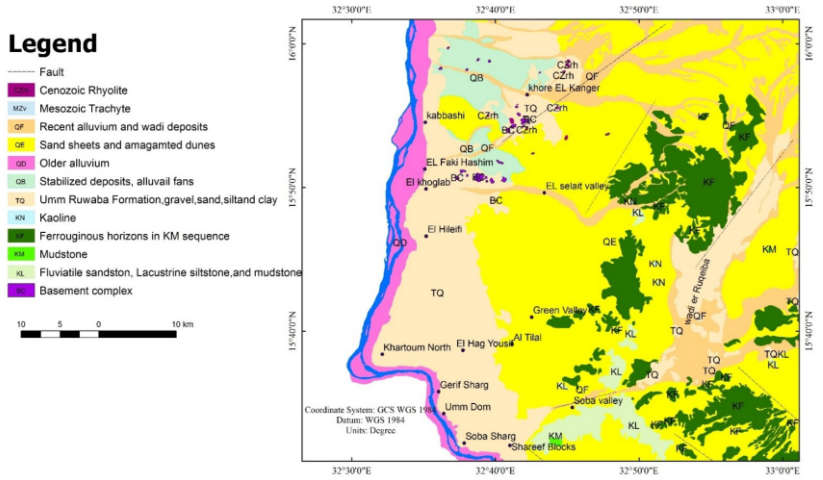

Figure 2. Geological map of the study area

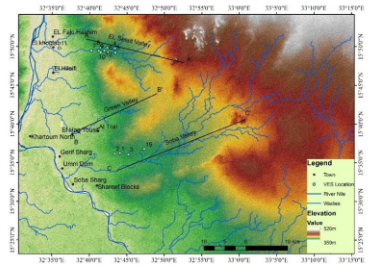

Figure 3. Digital Elevation Model of SRTM image showing the general topographical map of Sharg Al Neel area, Khartoum City, Sudan; A-A, B-B and C-C are the locations of topographical sections.

4.2. Mapping of clayey sediment

Generally, the existence of the thick clayey deposits along wadies on the top strata increase water run-off by obstructing infiltration to underground aquifers. The clay sediments can be easily mapped using the readily available satellite images (Gupta 2003). Clay sediments mapping was conducted in the present study through the utilization of Landsat OLI image and the use of band ratioing technique. In this context, band 7 of the SWIR region of the electromagnetic spectrum was divided by band 6 of the same region (Plate 3). In this image, the light tones represent the clay deposits, while grey tones denote the other land cover types. The light grey tones represent mixtures of clays with other soils.

4.3 Land cover/land use mapping

The intent of this step is to classify the land surface features into land use and land cover classes. The main class of interest to this research is the residential or urban area which will later be used to determine the high, moderate and low risk areas. To this end, routine image classification was applied, nevertheless the results of which were not as accurate as required. As a consequence, the residential and agricultural areas were delineated through visual interpretation via on-screen digitization (Fig. 5).

4.4 Geophysical Survey

4.4.1 Satellite gravity

Satellite gravity data were provided in regular square grid of approximately 1.75km spacing, delivered in the form of Free Air Anomaly together with the elevation for each grid point. Elevation data were used to calculate the Bouguer correction and consequently the Bouguer anomaly. In this way, the study area is covered by 1368 satellite gravity grid points. The Bouguer anomaly values range from -47 to -26 mGal. These values were interpolated in the GIS environment where contour lines were generated (Fig. 6). The intent of this gravity survey is to investigate the major subsurface geological structures that may control the existence and distribution of the drainage systems in the study area.

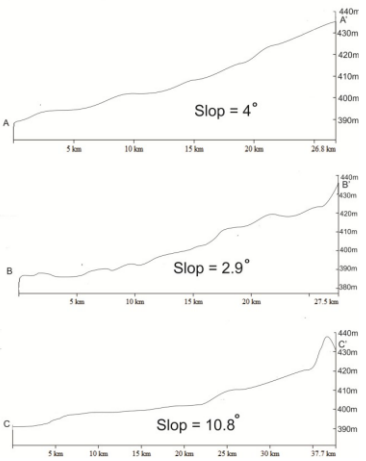

Figure 4. Graphical sections of general slope measured along wadi El Sileit (A-A), Green Valley (B-B) and wadi Soba (C-C)

The obtained Bouguer anomaly map shows two distinct domains: high anomaly igneous intrusion displayed in red hues in the north central part of the map area; and the sedimentary cover portrayed in shades of blue in the eastern and southeastern parts of the area. The intervening colours ranges from orange to cyan represent basement rocks of different depths from relatively shallow near the intrusion to deep far away. Bouguer map manage to reveal the main subsurface structures, i.e. the sedimentary basement boundary or deep structures. At the same time it fails to show the shallow or near surface structural manifestations. Accordingly, the regional and residual gravity components were separated in order to enhance the shallow structures. The computed residual gravity component was superimposed on the Landsat image to facilitate the visual comparison (Fig. 7).

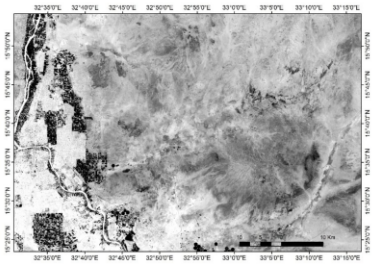

Plate 3. Band ratio image obtained through the division of OLI band7 over band 6.

4.4.2 Resistivity method

The resistivity investigations were carried out using Vertical Electrical Sounding (VES) technique. The measurements were made using ABEM SAS 4000 resistivity meter, adopting Schlumberger configuration. A total of 12 VESs measurements were executed. These VESs were measured in a way to construct electrical profiles close to the main wadies and paleo-structures in order to recognize the vertical and lateral lithological variations (Fig. 3). Accordingly, four psendo sections were constructed using IPI2win software (Fig. 8). The obtained sections reveal that the top most layers contain considerable amounts of clays and silts. Thus, the outcome of this technique supported the results of remote sensing image interpretation and provided additional information about the vertical continuation of the clayey sediments along the three main wadies.

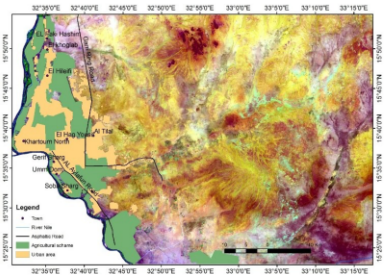

Figure 5. A map showing the residential and agricultural spaces of the study area.

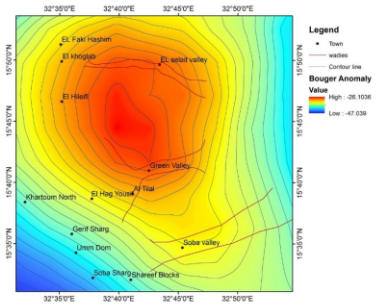

Figure 6. Satellite Bouguer anomaly map of the study area.

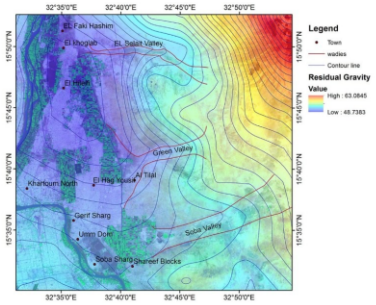

Figure 7. Residual gravity map of the study area superimposed over Landsat colour composite image (RGB=753)

5. Interpretation and Discussion

Generally, short-term, high-intensity rainfall in inland areas with poor drainage often will put urban areas under increased flash flooding impacts. However, the last decades have experienced increase of population growth around Khartoum City that leads to rapid construction development and increase of the residential areas around Khartoum City, especially Sharg Alneel area (Mohammed et al. 2015). Therefore, this study is aimed to evaluate the flash flood hazards in Sharg Alneel area of eastern Khartoum City, Sudan. In order to achieve the above-mentioned objectives, remote sensing and GIS techniques coupled with geophysical methods have been applied in a systematic fashion.

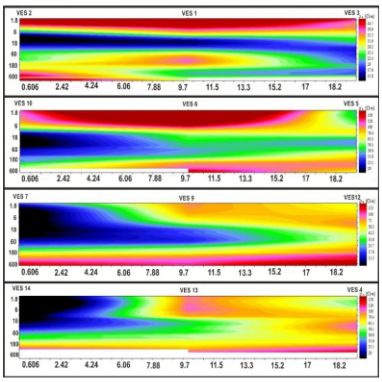

Figure 8. The electrical pseudo sections of the measured VESs in the study area

From band ratio technique of Landsat-8 images it can be noted that the investigated streams appear in light grey tones that indicate the existence of considerable amount of clayey materials. Consequently, the high concentration of clay minerals is located close to the River Nile and along the main three valleys in the study area. The results of DEM interpretation show that the high rate of topographic slope and existence of considerable amount of clayey materials along these three wadies represent the main factors contributing to the flood risk during the rainy season as confirmed by resistivity methods. Furthermore, digital image classification technique shows that bulks of the residential areas are concentrated in these high flood risk areas.

As it can be deduced from Figure (7), the three valleys El Selait, Green and Soba are characterized by relatively lower gravity anomaly. Moreover, the contour lines show V-shape which indicates that the streams erode the underlying rock so deeply. This has the significance that sediments accumulation is thicker in the valleys than the surrounding plains.

According to the results obtained from the different techniques in this study, the study area has been divided into low, moderate and high flood risk areas (Fig. 9). Unfortunately, the study reveals that the residential areas were superimposed over high risk zones. In addition, field observations indicate that the north-south asphaltic road parallel to the River Nile had been constructed with poor road way drainage along the main streams, which leads to widen the area covered by flash floods. These floods threaten even areas that are located away from the wadi channels, mainly to the north and south of the studied wadies such as Mrabee El-shareef, East Soba, Elfaki Hashim.

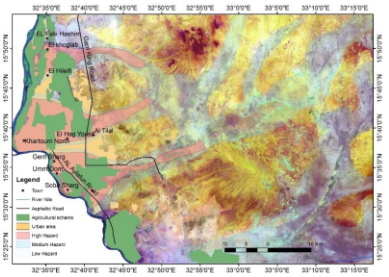

Figure 9. Flash Flood hazard map of Sharg Alneel area, Khartoum City, Sudan

6. Conclusion and Recommendation

The current study has been designed to assess the flash flood hazards that frequently affect Sharg Alneel area, of east Khartoum City. The present flood risk assessment cover sources of flooding that may affect the target site to scope the extent of the risk of flooding which may involve preparing indicative flood hazard map. Surface and sub-surface investigations including remote sensing, GIS and geophysical techniques (gravity and resistivity) have been adopted in the current research which authenticated by field survey. Different digital image processing techniques were applied using Landsat 8 OLI images for the purpose of identification of the main lithological units and delineation of the structural lineaments. The Digital Elevation Model (DEM) reveals that Sharg Alneel area represents the foot of the gently sloping plain of the Butana region. Wadi Soba, El Sileit and Green Valley are the main seasonal water courses in the study area that drain into the Blue Nile with E-W regional parallel pattern. Satellite gravity data showed the role of the major subsurface geological structures in controlling the existence and distribution of the drainage system in the study area. These three valleys are characterized by V-shape which indicates that the streams deeply eroded the underlying rocks. This signifies thicker sediments accumulation in the valleys compared to the surrounding plains. In addition, band ratio technique supported with

geophysical resistivity method proved thick clay deposits in the upper strata in the wadies. As a result, the thick clay deposits along the wadies coupled with slope steepness of the region contribute to the flood risk during the rainy season.

The present study recommends that complete re-planning of land use that can protect communities from the damage caused by flash flooding. Moreover, the urgent absolute solution of flash flood risk of Sharg Alneel area is to build dams/dykes in the up streams of the wadies to control water flow during the rainy season. The risk may be additionally reduced by constructing good drainage channels across the asphaltic road towards the River Nile. Water harvesting by ducking hafirs along the main wadies system that can be directed to economic uses such agriculture or to develop groundwater resources.

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