

SPATE IRRIGATION PROJECT IN SUDAN

A BRIEF REPORT

The spate irrigation project started in June, 2011 and the first phase is planned to end by June, 2015. This project, which is funded by IFAD and UNESCO-IHE operates in four countries: Sudan, Ethiopia, Yemen and Pakistan. Its overall objective is to contribute to the improvement of the livelihoods of the spate irrigation communities through solutions-oriented research and capacity building programmes that address tangible practical problems and feed into policy formulation.

In Sudan, the spate project is being implemented by HRS. In 2011, Sudan made by far the best progress in conducting practical solutions oriented research and capacity building activities. This was rewarded by selecting Sudan to host the first annual project meeting and some additional budget to purchase important field research equipment.

In this brief note, the major project achievements so far and the planned activities for the remaining project period are outlined.

Main accomplishments in 2011:

In June, 5 to 6, 2011, a meeting was held in Kassala with key stakeholders including farmers and WUA leaders, local government representatives (ARC, GRTU, GAS, and University of Kassala) as well the Ministers and selected staff of the Ministries of Agriculture and the then Ministry of Irrigation and Water Resources. This stakeholder meeting identified the major problems in GAS and the necessary research topics:

- 1) River protection work and irrigation diversion: What is the optimal flood protection scenario?, How to maximize irrigation diversions and sediment problems?
- 2) Irrigation Water distribution: What is the optimal irrigation distribution network?. What is the best on-farm water management
- 3) Institutional setups: How can the WUA be viable and credible water management partners? What are the O&M roles and responsibilities of different institutions at different levels?
- 4) Assess impact of Mesquite, and what are the solutions: Mapping, effect on canal capacity, impact on animal feed, how to remove/reduce the impact.
- 5) aquifer artificial (induced) recharge systems: Determine types of aquifer in north Delta, identification of recharge capacity and the suitable recharge techniques in north Delta,

Details of 2011 accomplished activities is shown in Table (1)

Solutions oriented research projects in 2011

Immediately following the stakeholder meeting, practical oriented research programmes were developed in collaboration on improving water diversion and distribution, on farm water management and sediment control and management. To link the research with capacity building, two young Sudanese MSc students were

involved under the joint supervision of Hydraulic Research Station and UNESCO-IHE Institute for Water Education.

The Research focused on Fota Main Canal systems, one the of the 7 main canal systems with the most severe water supply problems

Main results of the solutions-oriented research

Existing situation

1. Intake and canal network

- Almost zero slope of the first reach of the main canal and the wide river near the intake causes:
 - A maximum of 1.8 m sediment deposition at intake and main canal
 - Reduction of design abstraction capacity ($9.4 \text{ m}^3/\text{s}$) by 78%
 - High operation and maintenance cost (canal de-silting)
- Even if sediment problem is solved, due to lack of flow guiding bunds, the maximum diversion will be $8.1 \text{ m}^3/\text{s}$ - less than the required $9.4 \text{ m}^3/\text{s}$
- 50% of the 3,300 ha remains dry annually

2. Field level - Kasir Rabakasan

- 294 ha irrigated as one field unit
 - Poor distribution: over irrigation at upstream (1700 mm depth), restricted supply at mid stream (900 mm), completely dry 80 ha at downstream (Figure 4)
 - Low average yield - 1 to 2 ton/ha

Preliminary recommendations communicated to GAS authorities:

Sediment management and water delivery

- Fota intake: construct 3 spurs on the right side of the river, raise intake sill level by 1.2 m, and remove the right side wall of the intake. This could avoid sediment deposition at the intake and realize $9.4 \text{ m}^3/\text{s}$ at medium flood.
- Fota main canal: modify the slope of the first two reaches by 0.05% and introduce settling basin with annual/bi-annual de-silting - settling basin dimensions: 200 m x 30 m and 200 m x 25 m. This could improve the water delivery capacity by 89%.
- Rabakasa secondary canal 2: localized cross regulator to raise water level by 0.5 m. This could increase the discharge through off-take from nearly zero to $1.2 \text{ m}^3/\text{s}$
- Overall output: sufficient spate flow to irrigate at least 80% of the whole 3300 ha

On-farm water management

- Divide the irrigated field longitudinally into two equal units of 150 ha
- Elongate Kasir Rabakasa misga (tertiary) canal by 400 m
 - Ensures full irrigation of the entire misga field.
 - Reduces the irrigation application time from 25 to 20 days.
 - Better distribution uniformity: 950, 820 and 520 mm irrigation depth at upstream, midstream and downstream.
- Narrow the 1st and 2nd reaches of Kasir Rabakasa misga canal by 2 m and 1 m at upstream and downstream respectively: ensures additional 30 ha of irrigable area at the upstream of Rabakasa 1 misga.

- Move from sorghum only and introduce a cropping pattern - first harvest: sorghum, millet, sunflower and cotton; second harvest: Sorghum, millet and water melon.

These recommendations are being seriously taken. The GAS authorities have already implemented the first 2 recommendations with regard to sediment control and management at Fota canal and are considering the implementation of the recommendation with respect to longitudinally dividing the mesga fields.

Apart from the practically oriented Research:

- Three Young staff, one from HRS, one from ARC and one from Dam unit completed their short course training in spate irrigation in the Netherlands and have returned back.
- One modern slide projector, two high accuracy GPS and 6 USB internet sticks have been purchased

Achievements and plans in 2012

As a result of the successes in 2011, Sudan was selected to host the annual project meeting from 28 April to 4 May. The meeting was attended by all core project team from Ethiopia, Yemen, Pakistan, Sudan, MetaMeta and UNESCO-IHE. Two stakeholder workshops were undertaken - one in Kassala, where the Gash Agricultural Scheme (focal project site) is located and the other in Khartoum, the seat for Ministry of Water Resources, a key implementing partner. In Kassala, the research findings were presented that covered on-farm water management, optimizing water diversion and sediment control, farming practices and cost benefit analyses. These presentations have been recorded and are available at www.thewaterchannel.tv. The meeting was officially opened by the State Minister for Agriculture. In Khartoum, the former minister of Water Resources, in his opening remarks, expressed his strong support for the project and promised that spate irrigation will have a good representation in the UNESCO Category II Water Harvesting Centre that is expected to soon be established under the umbrella of the former Ministry of Water Resources (now: Ministry of Water Resources and Energy). Thereafter, project achievements and challenges in 2011 as well as the plans for 2012 and beyond were presented (www.spate-irrigation.org) and discussed. Finally, the core project team convened to strategize on how best to implement and enhance impact of the Project activities.

Following this successful annual project meeting and with the mission to build upon its success on practical oriented research and capacity building in 2011, the HRS project team embarked on a field research campaign in GAS. Three young HRS engineers are currently in GAS engaged in flow measurement and sediment concentration data collection and analyses. This field campaign is beneficial for all stakeholders involved:

- The young engineers: Gain field experiences in flow measurements as well as knowledge on computer programmes such as the CROPWAT and SWAM relevant for assessing the efficiency of irrigation systems
- GAS: The field research will provide them with accurate assessment of how much water they have applied and how much of this has been efficiency used and what they need to do to improve their water use efficiency
- GRTU: Improved accuracy in the flow measurement and data analyses - this is essential for their flood control interventions
- HRS: their young engineers get the opportunity for field training and together with the senior engineers improve the hydrological data base in GAS as well as contribute to improving the water use efficiency of the system

Another field research being implemented with ARC is the assessment of the actual soil moisture retained in the soil under different water applications to the field that range from 25 days to 10 days under the two dominant soil

types, Lebed and badob. This field research is essential as it will indicate how much water is sufficient under which soil type for what type of cropping pattern.

To make the field campaign a success, GRTU have made their best staff available, GAS has contributed 20,000 SDG to pay for the 16 assistants for flow measurement, HRS through the spate project is fully covering the field research costs of the three young engineers. The HRS has also ordered two field research equipments: 1, Turbidity meter for quick and accurate sediment concentration - this will replace the bottle method which is very cumbersome and time consuming as well as prone to practical errors. 2. Soil moisture meter, this gives instant soil moisture measurement in the field and is to replace the time consuming gravimetric method.

Apart from this field campaign, which runs until end of October, 2012, four other major activities were implemented:

- Knowledge and experiences sharing workshop among the WUAs in GAS, Khor Abuhabil, Toker, Yemen and Ethiopian farmers (15-18 December, 2012). The WUAs in GAS that are in the process of strengthening themselves gained a lot with regard to farmer organization and mobilizing resources, operation and maintenance activities as well as water distribution arrangements.
- A draft spate irrigation curriculum for Khartoum University, Gezira University and Kassala University was developed (November to December, 2012) - this process has started and an introductory lecture on spate irrigation has been given to MSc students in Water Resources Management - currently spate irrigation is not taught at any university in Sudan.
- Two engineers and water professionals, one from each GRTU and HRS awarded scholarship and attend the short course training on spate irrigation in Delft the Netherlands in the period 10 to 21 September, 2012.
- Country database of new 34 spate network members including 23 farmers, 12 specialists. The spate network database including 2011 database sum up to 72 members of relevant participants, have become registered members of the Sudan Spate Irrigation Network (Sudan-SpN) and will be updated regularly of ongoing activities.

Details of 2012 activities and progress is shown in Table (2)

In 2013 and 2014, The project will further undertake the remaining practical oriented research activities with the involvement of young engineers so that to strongly link research to capacity building; it will train 8 young engineers in spate irrigation, establish a website-based spate irrigation network with the sole objective of prompting exchange of latest knowledge and developments in spate irrigation within and outside the country, purchase important research and office equipment.

Table 1: Work plan 2011 and achievements

Item	Description/Activity	Key deliverables (planned)	Key deliverables (achieved)
1	Strengthening the Spate Irrigation Network	Key deliverables (planned)	Key deliverables (achieved)
1.1	Develop country Network plan 2011-2014	Country network plan stating vision, mission, mandates and major activities (2011-2014)	Completed
1.2	Develop country Database of spate specialists	A spread sheet of names, titles, specialization of 5-10 SPN members	A spread sheet of names, titles, specialization of 31 SPN members
1.3	Identification key Implementing Organization	Preliminary list of relevant key implementing organizations identified	Completed
2	Innovative Action Research Projects	Key deliverables (planned)	Key deliverables (achieved)
2.1	Selection of field assistant(s) for the research activities	A field assistant (F.A.) is selected	Completed; Eng. Mugahid Fuoad
2.2	Collection of existing relevant Information	Documentation of existing data	In progress
2.3	Field assistant management	Supervision and progress reporting	
2.4	Prepare preliminary criteria & identify a menu of action research topics	Criteria and a menu of action research topics listing	Completed
2.5	Stakeholder meetings to identify relevant action research topics	Meetings with stakeholders	Completed; 9 Meetings
2.6	Field visits to identify two action Research topics & pilot area	Two research action topics identified	Completed
2.7	Preparing concept notes & sharing with fellow country project leaders	Two concept note for the action research prepared & shared	Completed
2.8	Develop full action research proposals	Two full action research proposals developed	Seven research proposals completed
2.9	Preliminary data gathering for the research	Preliminary data prepared for the implementation of action research	Completed
2.10	Support to two small research / documentation activities	One small research holder proposed and if possible two	Proposed but not completed
2.10.1	Competitive grant for two applied research projects on two topics	Key deliverables (planned)	Key deliverables (achieved)
2.10.2	Discussion with stakeholders	Two topics identified	Completed : 4 meetings conducted in Khartoum, Medani and Kassala
2.10.3	Preparing detailed notes on (Open Call for proposals)	Document prepared and distributed	Completed; Research proposals announced, and applications received from research organizations
2.10.4	Forming a committee to evaluate proposals	Committee formed and best proposals selected	in progress
3	Capacity Building, Continuous Knowledge Development & Dissemination	Key deliverables (planned)	Key deliverables (achieved)
3.1	Two participants for spate short course attendance at UNESCO-IHE	Two participant will complete short course in spate irrigation at IHE	Completed
3.2	Preparation of one practical note	One practical notes published	Translation completed for one practical note , dissemination on progress, preparation of another practical note on progress.
3.3	Purchasing one laptop, one video camera, one digital camera	laptop, digital camera, video camera purchased	Not Completed, A beamer is purchased

	Sharefair in IFAD, Rome, Spate Irrigation Good for People, Livestock and for the Environment		
4	Project management	Key deliverables (planned)	Key deliverables (achieved)
4.1	Project supervisory committee:	Access to institutions database & a bank account open for the project	
4.1.1	Facilitating access to higher level relevant government institutions	Funded by Ministry of Water Resources	Completed
4.1.2	In kind support: provision of offices, telephones, equipment, guest house, transport	Funded by Ministry of Water Resources	Completed
4.2	Project country team leader activities		
4.2.1	Detailed work plan for 2011	A draft work plan with budget and time of delivery	Completed
4.2.2	organize meetings & workshops	Meetings and \ or workshop conducted	Completed; 4 meetings and one workshop conducted
4.2.3	Financial statement preparation and facilitating auditing	Annual financial statement report	Completed
4.2.4	Develop draft\detailed work plan for 2012	A draft work plan with budget and time of delivery	Completed
4.2.5	Progress and final report writing	A progress or final report describing the progress of project activities	Completed: A progress and final (2011) report completed
4.3	Running Secretariat office	Archiving project documents, dissemination of project output	Just started
4.4	Local Travel And Accommodation	Visit project sites	Completed

Table 2: Work plan 2012 and achievements

Item	Description/Activity	Key deliverables (planned)	Key deliverables (achieved)
1	Strengthening the Spate Irrigation Network		
1.1	Make the SSpN visible at national level. Assign a part time secretariat	Bi-annual newsletter on spate activities in Sudan, Maintain HRS WEBSITE, particularly the Spate ,Regularly update the spate chapter with relevant articles, technical documents, with spate news , prepare relevant spate brochures	Spate chapter is included within HRS-WEBSITE with project information and activities. Spate brochure prepared One bi-annual newsletter on spate activities
1.2	Strengthen the SSpN membership	Increase the number of members from 36 to 50 members, enlist at least five farmers, and regularly update the spate irrigation members, solicit contribution of members to spate network chapters(documents, photos, videos,...)	A spread sheet of names, titles, specialization of 50 SSpN members
1.3	Tailor-made support to Agricultural Research Corporation(ARC), Kassala, Khartoum and Sudan University, WUA Organizations	A spate irrigation seminars: 1. ARC: familiarize with agricultural research issues addressed in other countries and the research approaches used, priority agricultural research areas in spate systems in Sudan,2. WUA: Experiences and success stories from other countries concerning organizational, operation and maintenance activities conducted by WUA, 3. Universities: a lecture highlighting the importance of mainstreaming spate irrigation in higher education.	Completed Seminars have been conducted at ARC-Kassala, WUA Higher Appex-Aroma. A WUA-to-WUA regional workshop on Knowledge and Experience sharing during 15-18 Dec. conducted in Kassala. Lectures and meetings at Khartoum University, Kassala University were done.
2	Innovative Action Research Projects	Key deliverables (planned)	Key deliverables (achieved)
2.1	Implementation of solutions oriented research activities within two research programs developed in 2011: 1. Towards productive and profitable spate irrigated agriculture in Sudan,2. Gash river training and protection works to mitigate flood damages. Research is to be implemented through MSc studies. Implementation budget includes MSc research fund, scientific supervision and guidance, write up of synthesis report	1. Draft 3-4 MSc proposals, 2. one to two draft journal articles	Two draft Journal articles prepared 3 technical reports on: Hydrological data analysis in Gash river: on progress Flow measurement and water efficiency and productivity in Fota and Degain main canals in GAS scheme: Completed Flow measurement, Water efficiency and productivity in Salamo alikom main canal in GAS: Completed 3-4 MSc proposals: Incomplete
2.1.1	Preparing concept notes & presenting in a seminar at IHE for MSc students and staff	Nine concept notes for the action research prepared & presented	Completed

2.2	Field supervision and guidance by project field assistant	Progress report of field work & facilitation of practical matters	Completed
2.3	Support to two small research / documentation activities	One small research holder proposed and if possible two	Not completed
2.4	Competitive grant for two applied research projects on one of the two topics: 1. Spate flow for artificial aquifer recharge for both domestic and agricultural water use, 2. WUA in GASH; if and how they can be viable and credible contributors to better spate irrigation water management	One progress research report	
2.4.1	Forming a committee to evaluate competitive research proposals	Committee evaluates and selects the best proposal	Best proposal selected with topic on: Strengthening Water Users Associations institutionally for sustainable participatory management of spate irrigated agriculture scheme, Sudan
2.4.2	Preparing ToR and approval of the final proposal	Complete proposal document prepared and accepted	Completed
2.4.3	In depth explanation of the research methodologies and approaches and the progress made thus far. (a sample of the questionnaire should be agreed on)	An inception report	Completed
2.4.4	Detailed report on the preliminary research outputs, practical and scientific problems encounters and solutions found or suggested	Interim report	Working is in progress to produce the interim report
3	Capacity Building, Continuous Knowledge Development & Dissemination	Key deliverables (planned)	Key deliverables (achieved)
3.1	Two participants for spate short course attendance at UNESCO-IHE	Two participant participated in the short course in spate irrigation at IHE	Completed; One participant from HRS, one from Gash River training unit
3.2	Preparation and dissemination of two practical notes	Two practical notes published in English and Arabic	1.One draft note 2.Video documentation
3.3	Contribution to preparation of spate program development charter as annex to the Country policy on land and water management and development	A draft policy document on spate irrigation development in Sudan	Work in progress,
	Equipment for Hydraulic Research Station (HRS)	1. Equipments for the research; soil moisture, flow measurement and sediment measurement, 2. Equipments for office;	Soil moisture meter and turbidity meter have been purchased
	Introduction of Spate Irrigation in curricula of Institutes of Higher Learning (national workshop)	National workshop conducted with participants from education, research institutes, Engineers, field practitioners, draft spate irrigation curriculum prepared	Lectures and visits to selected universities were done Two universities already approved to include the spate irrigation on their curriculum namely Gezira and Kassala Universities
4	Project management	Key deliverables (planned)	Key deliverables (achieved)
4.1.1	Facilitating access to higher level relevant government institutions, seminar venues, transportation	Funded by Ministry of Water Resources	Un limited Support provided

4.1.2	In kind support: provision of offices, telephones, equipment, cars , guest house	Funded by Ministry of Water Resources	Completed
4.2	Project country team leader activities		
4.2.1	Detailed work plan for 2012	A draft work plan with budget and time of delivery	Completed
4.2.2	organize meetings & workshops	Meetings and \ or workshop conducted	Completed
4.2.3	Financial statement preparation and facilitating auditing	Annual financial statement report	Completed
4.2.4	Develop draft\detailed work plan for 2013	A draft work plan with budget and time of delivery	Completed
4.2.5	Progress and final report writing	A progress or final report describing the progress of project activities	Completed
4.3	Running Secretariat office	Archiving project documents, dissemination of project output	Completed
4.4	Local Travel And Accommodation	Attend and present project activities in world water forum	Completed