



SMART WATER SYSTEMS PHASE II



INCEPTION REPORT

December 2011

Project R5737

1 INTRODUCTION

Oxford University was awarded a New and Emerging Technologies research grant from the UK Department for International Development (DFID) to undertake Phase II of the Smart Water Systems Project over the period September 2011 – August 2013. Phase I of the project aimed to establish a generic case for smart water systems with the objective of developing pilot strategies for Phase 2. Smart Water Systems harness mobile communication innovations to capture, transmit and process data to enhance water security and to reduce poverty¹. The rapid expansion of mobile communications, particularly in developing regions over the last few years, present new opportunities for Smart Water Systems to promote water security for those with the greatest need and to those most difficult to reach². Kenya has been at the heart of mobile technology innovations which offer new pathways to tackle Africa's enduring challenge of achieving water security that can then provide a platform for economic growth and poverty reduction.

The Phase II programme of work incorporates two work packages in rural Kenya on a) Smart Rivers and b) Smart Handpumps. Rural Focus Ltd (RFL), a Kenyan engineering consultancy, is the implementing partner. This inception report details undertaken during field visits in October and December 2011 to a) inform and embed project activities with Government of Kenya initiatives, b) finalise project sites, and c) finalise agreed activities over the project cycle.

2 Project aim and objectives

The aim of the overall research will be to design, implement and evaluate Smart Water Systems in rural Kenya to promote water security and to reduce poverty. Project outputs will include:

- a) To pilot and empirically evaluate Smart River Systems and Smart Handpumps.
- b) Increase awareness and new knowledge of poverty impacts of smart water systems for gravity-fed, piped systems and groundwater-fed, handpumps.
- c) Develop new rural water management and regulatory models.

The aims of inception activities were to:

- a) Link project activities to government policies and programmes.
- b) Generate awareness amongst project stakeholders.
- c) Agree a shared pathway forward with stakeholders and project partners.
- d) Undertake feasibility assessment of study sites.
- e) Finalise project activities within agreed objectives.

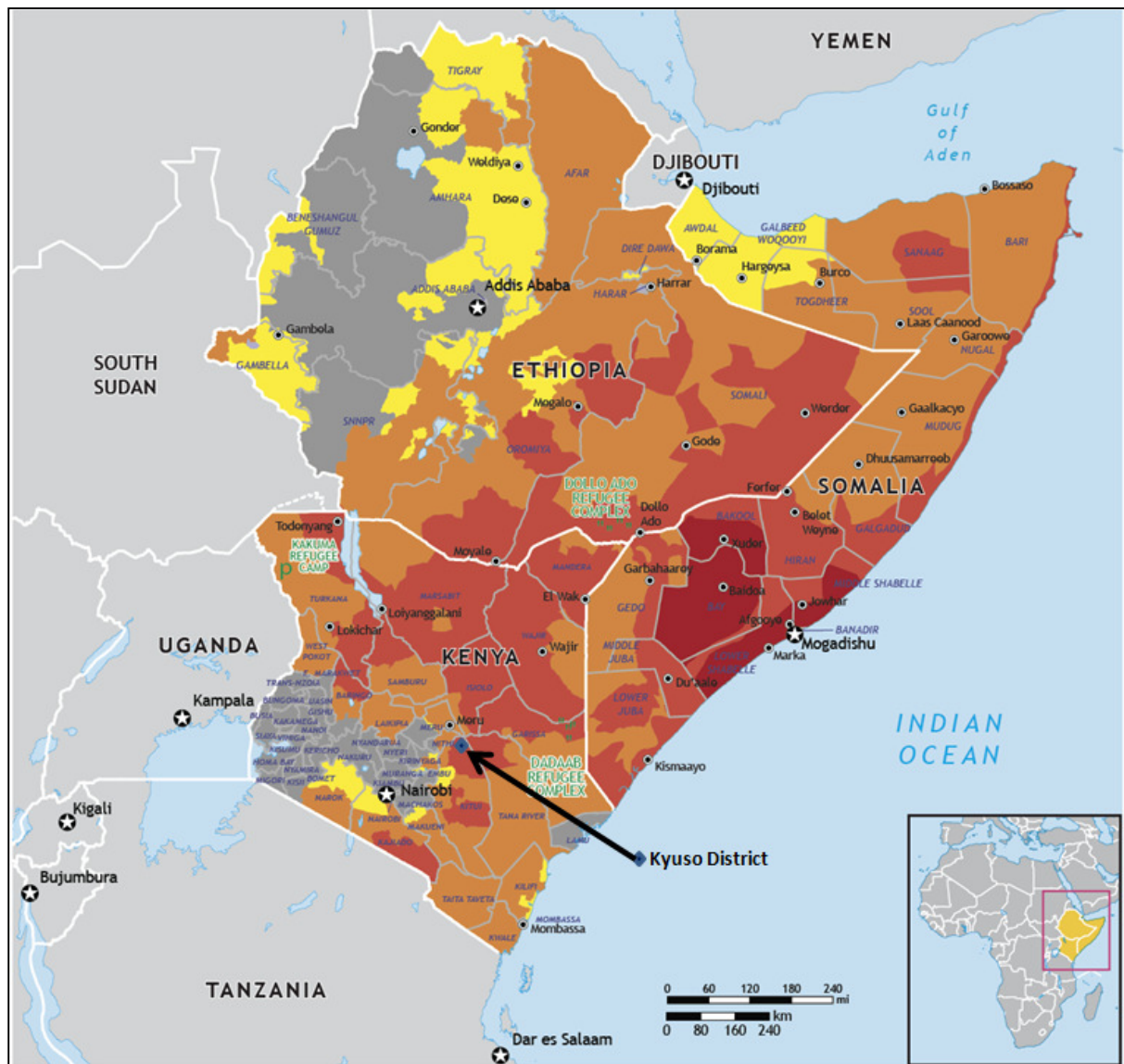
3 Study sites

The Smart River project will be located in Burguret River sub-catchment within the Ewaso Ngiro River Basin which flows west from Mount Kenya to the Laikipia plateau. Total river abstractions doubled due to increasing community water project and agricultural demand over the last 10 years. There is increasing tensions between all water users and significant water shortages in dry periods that result in many communities without basic water supplies for extended periods. Such challenges are being experienced across Kenya compounded by increased frequency of climate extremes that make resource management increasingly difficult leading to wider poverty impacts (Fig. 1).

¹ For Phase I activities and outputs see: <http://oxwater.co.uk>

² Hope, R.A., Foster, T., Money, A. and Rouse, M. (2012) Harnessing Mobile Communications Innovations for Water Security. *Global Policy (early view)*

FIGURE 1. LOCATION OF KYUSO DISTRICT SITUATED IN AN EXTREME AREA OF HYDRO-CLIMATIC RISK AND FOOD INSECURITY ACROSS SUB-SAHARAN AFRICA (SOURCE: USAID)



A Smart River System will be designed to automatically measure abstraction on daily time-steps to determine current water use patterns, to explore new allocation systems and to protect environmental flow allocations. The project aligns with Government of Kenya policy (2002 Water Act) on resource conservation, poverty reduction and community investment. Improved water resource management will lower water risk and enhance water security to benefit the poor who are more vulnerable to water supply failure.

Kyuso District is the proposed study site for the Smart Handpump pilot. Kyuso District is located in Eastern Province falling in the lower arc of the Horn of Africa. The intensity and severity of droughts have increased over the last 10 years with the District recovering from the recent Horn of Africa drought event. 95% of the District population live in rural areas with 60% of the population falling below the US dollar day poverty threshold. Over one in six handpumps do not function with repair times often high (months vs. weeks). Most households rely on unimproved water often greater than

30 minutes away with associated economic and health implications. A sample of handpumps will be fitted with Waterpoint Data Transmitters which will measure and transmit handpump use in real-time over the mobile network to trigger maintenance alerts.

4 ACTIVITIES

4.1 Smart Rivers

On October 5th 2011 a meeting was held in Nairobi to introduce the Smart Rivers project to the Water Resources Management Authority (WRMA) which is the competent authority in the Ministry of Water and Irrigation for water resource management, development and conservation. The concept received the endorsement of WRMA representatives in attendance, including the CEO and senior technical managers. There was a consensus amongst attendees that the Burguret River pilot represented an innovative approach that could pilot effective water allocation and efficiency measures across Kenya.

FIGURE 2. LOCATION OF BULK WATER ABSTRACTION AND MANUAL METERS ON THE BURGURET RIVER



A subsequent meeting was held in Nanyuki on 10th October attended by local stakeholders, including representatives from the regional and sub-regional offices of WRMA and the Burguret River Water Resource User's Association (BWRUA). A presentation provided participants with an overview of the initiative, and the ensuing discussion culminated in widespread agreement to undertake the pilot project (see Appendix). Following this meeting a site visit was undertaken of the Burguret River alongside local WRMA officials and WRUA members. Several intakes that supply nearby community schemes, river gauging stations and master meters sites were inspected. Specifications for the procurement and installation of smart master meter installation have since been collected by RFL.

On 7th December a follow-on meeting was conducted with both local WRMA officials and representatives from the Community Water Projects and the BWRUA. In addition to providing a detailed outline of the project, a participatory exercise built support for the project and generated a shared vision for the Burguret River which then produced a set of scenarios and strategies to achieve the vision by 2020.

FIGURE 3. SMART RIVERS WORKSHOP WITH MEMBERS OF THE BURGURET WATER RESOURCES USERS ASSOCIATIONS (BWRUA)



4.2 Smart Handpumps

An introductory meeting was held in Nairobi at the Ministry of Water and Irrigation on 6th October. Attendees represented the Ministry of Water and Irrigation; Kyuso District Water Office; Tanathi Water Services Board; Water Services Trust Fund; SNV; and the Water Services Regulatory Board. Following a presentation by Oxford University, a constructive discussion took place in which all parties expressed their support for the pilot initiative.

On 6th-7th October a field visit was undertaken in Kyuso District, Mwingi Constituency, as the proposed study site for the Smart Handpump study. Following discussions with the District Water Officers and local pump mechanics, several waterpoints in the district were visited. Testing and validation of the Waterpoint Data Transmitter was also conducted at one of the waterpoints. With ongoing drought conditions and low socio-economic metrics Kyuso offers a relevant location to test the Waterpoint Data Transmitter in a remote, semi-arid and low-income area recently affected by the Horn of Africa drought.

FIGURE 4. SITE VISIT TO WATERPOINTS IN KYUSO DISTRICT



Due to variable mobile coverage in Kyuso District, Busia District in Western Province was visited on 4-5th December. Visits to several of the district's handpumps were accompanied by the district manager of the UNICEF-sponsored WASH programme, and a GIS specialist from Lake Victoria North Water Services Board (LVNWSB). The following day a meeting was held in Kakamega with representatives of the LVNWSB to gauge their interest in hosting the smart handpump pilot. As in Kyuso, the LVNWSB officials expressed their strong desire to host the pilot initiative. A meeting was held with the new Chief of WASH in Kenya, Dr Thowai Zai, who expressed interest in piloting this

initiative within UNICEF's national programme of work. This opportunity will be followed up in due course.

The equipment used to monitor handpump usage consists of one WDT (Waterpoint Data Transmitter) per pump plus a bespoke database that aggregates, processes and presents the data from all the pumps included in the study. The Oxford-designed prototype was tested in Zambia in July 2011 (Thomson et al., 2012). Over the intervening 12 months the WDT concept has been further developed into a unit that is suitable for long-term use in an operational environment. This uses both off-the-shelf electronic components and bespoke parts.

The operational WDT will record pump usage in hourly time steps and transmit the data over the mobile phone network as a SMS message. The WDT fits within the handle of the Afridev pump and is designed to be physically robust, with no moving parts. It is low-profile and, as much as possible, tamper-proof. Battery life has been calculated as between 12 and 13 months (to fit the length of the trial).

A bespoke database and user interface have been developed by the team in Oxford. The SMS messages are routed through a modem into FrontlineSMS, a free open-source software package, into a SQL/PHP database. The user interface takes this information and processes an individual pump's usage data so it can be displayed in a graphical format alongside a map indicating the location of the pump in question. This allows for an immediate and intuitive representation of the status of each pump in the trial. In the trial period, the data are being monitored and used by the research team, including the maintenance provider, and the District Water Office, which is part of the Ministry of Water and Irrigation. The aim is to release the data for wider consultation and review once the trial is effectively under way.

5 NEXT STEPS

5.1 Smart River

Activities planned for the first half of 2012, include:

- Baseline data collection on permits and abstractions
- Baseline data collection for poverty and water service/use indicators
- Procurement and installation of smart meters and instrumentation
- Launch and operate smart river system

5.2 Smart Handpumps

Activities planned for the first half of 2012, include:

- Finalise design and production of WDTs and performance monitoring software
- Baseline data collection for poverty and water service/use indicators
- Train and equip handpump mechanic and establish maintenance model
- Engage communities to gain consent and install WDTs
- Launch and operate Waterpoint Sustainability System

APPENDIX I – TABLE OF IN-COUNTRY ACTIVITIES

Date	Location	Activity	Organisations*	Attendees
5/10/2011	Nairobi	Smart River introductory meeting	Water Resources Management Authority (WRMA)	- CEO - Technical Manager - Water Rights Officer - Ground Water Officer - Database Officer - Research Coordinator
6/10/2011	Nairobi	Smart Handpump introductory meeting	Ministry of Water and Irrigation	- Engineer - Supt. Engineer
			Water Services Trust Fund (WSTF)	- Business Analyst - Technical Advisor
			Water Services Regulatory Board (WASREB)	- CEO
			SNV	- Water Advisor
			Tanathi Water Services Board (WSB)	- District Water Officer (Kyuso) - Asst. Water Services Mgr
6/10/2011	Nairobi	Meeting	Safaricom	- Head of social inclusion
7/10/2011	Kyuso District	Kyuso waterpoint site visit	Tanathi WSB	- District Water Officer (Kyuso) - Asst. Water Services Mgr
			Private sector	- Local pump mechanics
10/10/2011	Nanyuki	Smart River introductory meeting	WRMA	- CMO x 2 - Regional Surface Water Officer - Regional Ground Water Officer - Regional Water Rights Officer - Sub-Regional Manager
			Burguret Water Resources User Association (BWRUA)	- Chairman - Vice Chairman - Treasurer - Secretary - Executive Officer
10/10/2011	Burguret River	Burguret River site visit	BWRUA	- As above
			WRMA	- As above
4/12/2011	Busia District	Busia waterpoint site visit	Lake Victoria North WSB	- Busia UNICEF WASH Programme Manager - GIS Specialist
5/12/2011	Kakamega	Smart Handpump introductory meeting	Lake Victoria North WSB	- Finance and Administration Manager - Community Development Manager - GIS Specialist - IT Officer - Asset Development Officer
7/12/2011	Nanyuki	Smart Rivers visioning workshop	WRMA	- Sub-regional Manager
			Kamangura Water Project	- Chairman - Treasurer
			Mureru Water Project	- Representatives x 2
			Buguret Water Project	- Chairman - Treasurer
			Gatune Water Project	- Chairman

			Kapati Water Project	- Chairman
			Njoguini Water Project	- Chairman - Secretary
			Tambuzai	- Representative
			BWRUA	- Executive Officer - Vice Chairman - Secretary
12/12/2011- 15/12/2011	Kyuso District	Kyuso site visit	Tanathi WSB	- Kyuso DWO
			Private sector	- Local pump mechanics

* In addition to teams from Oxford and RFL

APPENDIX II – Presentations (available on request)

- A1. Ministry of Water and Irrigation, WRMA, Nairobi, 5 October 2011
- A2. Ministry of Water and Irrigation, Water Services, Nairobi, 6 October 2011
- A3. Water Resources Management Authority, Nanyuki, 10 October 2011
- A4. Burguret Water Resource Users Association, Nanyuki, 7 December 2011

Project Contact Information

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To follow updates on **mobile/water for development** research: <http://oxwater.co.uk>

The image shows a screenshot of the 'mw4d' website. On the left is a navigation menu with the following links: HOME, ABOUT, PROJECTS, RESOURCES, and CONTACT. The main content area features a large header image of a woman at a water pump with the text 'mobile/water for development'. Below this are three smaller images: 'smart handpumps' showing a hand pump, 'smart rivers' showing a river with a dam, and 'mobile payments' showing a Safaricom mobile phone. On the right side of the page, there is a vertical image of a woman carrying a bucket on her head.