Institution: University of Oxford

Unit of Assessment: 14 – Geography and Environmental Studies

Title of case study: Smart Handpumps: Improving Drinking Water Services in Rural Africa

Period when the underpinning research was undertaken: 2010 – Dec 2020

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Rob Hope	PI	Oct 2006-present
Patrick Thomson	Researcher/Co-I	Oct 2011-present
Johanna Koehler	Researcher	Sept 2013-Sept 2020

Period when the claimed impact occurred: 2012- Dec 2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact (indicative maximum 100 words)

Research by Hope and team investigated the inadequate servicing of local water pumps in sub-Saharan Africa which has led to changes to practice, technology and policy in the provision of water services in rural Kenya. Research findings initiated a social enterprise, FundiFix, which deploys 'smart' water handpumps (developed as part of the research) and generates real-time data on their use and performance. FundiFix relies on an innovative combination of community and donor funding to service the pumps, and currently offers secure drinking water to over 82,000 rural Kenyans. The Fundifix model has now been recognised by national-scale legislation in Kenya.

2. Underpinning research (indicative maximum 500 words)

Following the UN's designation of the 1980s as the 'International Drinking Water Supply and Sanitation Decade', many rural communities in Sub-Saharan Africa were provided with new boreholes and handpumps to access groundwater for their daily water needs. Communities were given responsibility for their new water system, but little support to maintain them. Hundreds of millions of people rely on these pumps but up to a third are out of action at any one time. Communities then face the choice of using water from an unsafe source or spending long hours walking to the nearest functioning handpump. Partly because of this, 54% of the rural population across Sub-Saharan Africa has to make do with water that is likely to be unreliable or unsafe to drink.

Given the uncertainty of external funding for pump maintenance, the research in rural Kenya led by Hope began by investigating communities' preferences and willingness-to-pay for water services. Data was collected through water point mapping, a survey of 3,500 households, examination of community and government records, social choice experiments and focus group discussions at local level, and key informant interviews at policy level, as well as the application of insurance thinking and risk modelling [**R1-R3**]. The research clarified how much rural communities are willing and able to pay for water services [**R1**]. It showed that these communities value a rapid maintenance service but not if repairs take more than five days [**R2**]. It also demonstrated that they do not prefer current institutional arrangements – community management with (theoretical) government support – and are open to private sector engagement [**R3**].

These findings were used to design a new service delivery model: the social enterprise FundiFix, originally set up in 2013 as part of an ESRC grant. Fundifix initially provided free repairs to 200 water pumps (underwritten by the research grant). Further research has led to the development of new financial models, blending user payments with government and donor financing (known as PPP, or Private Public Partnerships) [**R4**].

Subsequent work by the team has situated the development of PPP funding models for rural water services within the wider landscape of institutional theory by adapting the cultural theory of risk

originally developed by anthropologist Mary Douglas [**R5**]. This led to the insight that formal institutional and legislative arrangements may restrict pluralistic arrangements such as PPP, and must be addressed if such approaches are to thrive [**R5**].

A final element underpinning the team's impact was the development of the Water-point Data Transmitter device [**R6**]. Installed in a handpump – which is then 'smart' – this device generates, processes, and transmits hourly information on real-time abstraction volumes and breakdown incidents over the mobile phone network. This data underpins FundiFix's service provision, allowing the identification of broken pumps in near real-time [**R6**]. The team's research shows that these smart pumps reduced the average downtime of the 200 pumps from one month to three days, with 45% of repairs completed within a day [**R6**].

3. References to the research (indicative maximum of six references)

R1: Foster, T., Hope, R. (2016) A multi-decadal and social-ecological systems analysis of community waterpoint payment behaviours in rural Kenya. *Journal of Rural Studies*, 47(A): 85-96. http://doi.org/10.1016/j.jrurstud.2016.07.026 [output type: D]

R2: Koehler, J., Thomson, P., Hope, R. (2015) Pump-priming payments for sustainable water services in rural Africa. *World Development* 74: 397-411. http://doi.org/10.1016/j.worlddev.2015.05.020 [output type: D]

R3: Hope, R. (2015) Is community water management the community's choice? Implications for water and development policy in Africa. *Water Policy* 17(4): 664-678. http://doi.org/10.2166/wp.2014.170 [output type: D]

R4: Thomson, P. and Koehler, J. (2016) Performance-oriented monitoring for the water SDG – challenges, tensions and opportunities. *Aquatic Procedia* 6: 87-95. http://doi.org/10.1016/j.aqpro.2016.06.010 [output type: D]

R5: Koehler, J., Rayner, D., Katuva, J., Thomson, P., Hope, R. (2018) A cultural theory of drinking water risks, values and institutional change. *Global Environmental Change* 50: 268-277. http://doi.org/10.1016/j.gloenvcha.2018.03.006 [output type: D]

R6: Thomson, P., Hope, R., Foster, T. (2012) GSM-enabled remote monitoring of rural handpumps: a proof-of-concept study. *Journal of Hydroinformatics* 14(4): 829-839. http://doi.org/10.2166/hydro.2012.183 [output type: D]

Funding: PI for all grants: Hope. Smart Water Systems, DFID, GBP273,000, 2011-2012; New Mobile Citizens and Waterpoint Sustainability in Africa, ESRC, GBP420,278, 2012 – 2015, Groundwater Risks and Institutional Responses for Poverty Reduction in Rural Africa, NERC/ESRC/DFID, GBP133,005, 2013-2014, Insuring against Rural Water Risks in Africa, ESRC, GBP93,130, 2013-2016, Rural Water Sustainability in Unicef, GBP257,638, 2014-2016, Development Frontier Part 2, ESRC, GBP199,931, 2015-2017

4. Details of the impact (indicative maximum 750 words)

Research including **R1**-**R3** informed the design and founding of FundiFix in 2013. The evidence-based approach of this social enterprise (initially elaborated in the underpinning research **R6** and **R1**-**R3**, and later developing to incorporate learning from **R4**-**R5**) has enabled the company to evolve from a small social enterprise in 2013 into an independent organisation offering reliable and safe drinking water to 82,000 people in Kenya's rural counties of Kitui and Kwale. Repair times for handpumps have been reduced substantially, and up to 20,000 users have benefitted from improvements to water infrastructure. The research has also influenced the development of the funding structure and legislative basis of the FundiFix model.

The growth of Fundifix as an independent company, enabling improved water provision in rural Kenya

Since 2013, FundiFix has evolved into a Kenyan-owned and registered social enterprise. Servicing 200 water pumps in that year, the company held 130 maintenance contracts with communities and schools, which serve a population of 82,000 people in Kitui and Kwale counties including 25,000 pupils in 74 local schools in December 2020 [**E1**]. FundiFix therefore ensures the reliable delivery of around 73,000,000l of drinking water annually [**E1**].

FundiFix also provides local employment and training for 17 full- and part-time in-house technicians, engineers and plumbers, and offers opportunities in accounting, business management and marketing [**E1**]. As the Director of FundiFix explains, "we operate local offices to facilitate relationships with rural communities and provide quick response to breakdowns. We have employed professional technicians, own various assets including electrical and plumbing equipment/tools, and maintain stocks of spares at each of local offices to support delivery." [**E2**].

FundiFix has improved water service provision in two ways. First, use of the Water-point Data Transmitter device [**R6**] has enabled the company to drastically accelerate the repair of existing 'smart handpumps'. The 2014 Performance Review of Kenya's Water Services Sector by the Water Services Regulatory Board (WASREB) states that "with this system [FundiFix] the average downtime for handpumps in the study area fell from 27 days pre-trial to under three days, representing a great improvement in performance" [**E3**]. The rapid repairs translate into many hours saved collecting water. Across all the pumps in FundiFix's care, an estimated 100 person-days are saved per pump per year, or 12,500 person-days per year in total.

Second, in recent years FundiFix has rehabilitated and upgraded existing water infrastructure and offered new water services for up to 20,000 users in Kitui County. These benefits have been achieved through partnerships with local initiatives and international donors. Specifically:

- In Mwingi, a town in Kitui County, existing water infrastructure – the Tharaka Women's Water Project – was upgraded in 2019. This entailed the repair of storage tanks and more than 50 km pipeline and valves, as well as the installation of production metering and a 'water ATM' (an unmanned smart handpump where people use a pre-paid fob to buy water). The costs amounted to KES1,400,000 (GBP9,258) and up to 15,000 users benefitted from improved drinking water [**E1**].
- The Ikathima Community Piped Scheme in Kitui County was upgraded and improved in partnership with the Sharewater Foundation in 2018, at a cost of KES620,000 (GBP4,090). The works entailed expansion of solar water pumping, installation of a water ATM, rehabilitation of a 'water kiosk' (a smart handpump where people can buy water to take home by paying an attendant), and six months of repair and maintenance service for the scheme, leading to reliable water access for over 3,000 people [**E1**].
- The Ivonangya Community Piped Scheme in Mwingi North was rehabilitated and improved for KES450,000 (GBP2,974) in collaboration with the Hardcore Foundation in 2019. FundiFix has helped to repair a community water kiosk and install a water ATM. This has enabled 24/7 access to water for up to 2,000 people [**E1**].

To date eight rural piped schemes have been rehabilitated since FundiFix has taken over their management as part of an ongoing partnership with UNICEF Kenya [**E4**].

Developing the FundiFix PPP funding model

The underpinning research [**R4**] has also resulted in an innovative funding model for water services. This has been described by UNICEF Kenya as the FundiFix model [**E4**]. The 2017 Impact Report of UNICEF Kenya demonstrates how the organisation has adopted and promoted the model: "UNICEF continued to build on the innovative Public-Private Partnerships (PPP) model, FundiFix, to improve maintenance services for rural water supplies" [**E4**].

The challenge of financially sustainable water provision in rural areas is well known because the costs of infrastructure expansion, maintenance and repair are difficult to cover if water use is to be priced at levels that are affordable to all sectors of the population. Local communities play an important role in contributing to the financial sustainability of FundiFix: its community customers contributed over KES4,002,993 (GBP26,165), towards maintenance costs in 2019 [**E5**], indicating they value its rapid and reliable service.

Nonetheless, other sources of funding are indispensable, and FundiFix has managed to secure these. This is primarily due to the creation of two Water Services Maintenance Trust Funds which subsidise the cost of the service through donor funding of "an estimated GBP165,000 from charities and non-traditional private companies [**E6**]:

- The Hardcore Foundation – a-not-for-profit organisation that works with locally established organizations on various community based projects: EUR5,000;
- Base Titanium Ltd., a mineral sands project in Kenya: GBP50,000;
- doTerra Ltd. from Kenya: GBP15,000; and
- Share GmbH, a social enterprise from Germany: EUR150,000.

One of Share GmbH's founders learned of the research on water infrastructure in Kenya from an article by Koehler in the *Economist*. Share works on a 1+1 principle, meaning that for each product sold an equivalent product is given to a person in need. Share's founder explains that:

> "this concept [i.e. FundiFix] was a suitable candidate for Share's 1+1 principle, offering exact data on water output and reliable impact for the community. Therefore in 2019, Share contracted the Water Services Maintenance Trust to fund FundiFix in Kitui and Kwale counties to provide this 1+1 match through its rural water maintenance services … The match is equivalent to over 100 million litres of water provided by FundiFix to more than 80,000 rural water users." [**E7**]

Changing the legislative framework

Local and national government in Kenya has recognised and promoted FundiFix's combination of improved service provision and innovative funding methods. A 2019 Research Report from the Sustainable WASH (Water and Sanitation Hygiene) Systems Learning Partnership states that "FundiFix has gained the support of both national and local government", and confirms that WASREB have highlighted "FundiFix as a good example of the professionalization of rural water services" [**E8**].

The Kenyan Ministry for Agriculture, Water and Livestock Development has convened a quarterly forum for WASH stakeholders in Kitui County since 2016. A County Executive Committee Member confirms that the research has informed the sustainability debate at these fora and has been instrumental in revealing policy gaps and influencing the design of the first County Water Bill. He writes that:

> "the work that has been done by Oxford University research and by FundiFix has been important to improving our knowledge of rural water service issues affecting the County and subsequently helped us address access ... Demonstration of the FundiFix model since 2014, including the monitoring and funding approaches, has helped us give more reliable water to more than 58,000 people in Mwingi North and show a new way of providing these services" [**E9**].

At national level, team member Koehler has influenced the Government of Kenya in the development of the Kenyan Water Act by the Government of Kenya. The Act passed in 2016, and Article 94(3) of the Act now recognises novel approaches to rural water provision, including private sector with investment and financial plans for rural water services. This marks an important shift from the previous emphasis on community management of water supply. On the basis of the team's research findings (published as **R1-R4**), Koehler engaged extensively with the Acting Director for Water Services in Kenya's Ministry of Environment, Water and Natural Resources, who says:

> "I am therefore happy to confirm Johanna Koehler's consultation role and enrichment of the amended Article 94 of the Water Act 2016, which is likely to have consequences for the 58 percent of the total Kenyan population outside formal, piped water service provision areas and the 78 percent that are not actively regulated" [**E10**].

The FundiFix model is now enabled by national-scale legislation, which institutionally embeds its capability to provide access to clean, safe, locally available water in Kenya [**R5**]. A case study on the use of smart pumps written by SDSN Trends – an initiative of the UN Sustainable Development Solutions Network that brings together data experts from across the globe – concludes that:

> "access to safe and reliable drinking water is a systemic challenge in sub-saharan Africa and throughout the world. This challenge is magnified by the technical and financial issues that reduce the reliability of handpumps and leave communities struggling to afford basic maintenance. The Smart Handpump Project in Kenya demonstrates an innovative way of

remotely collecting data about handpump operation. Combining data with an alternative business model has reduced the pump downtime tenfold in participating communities and improved the reliability of water access" [**E11**].

5. Sources to corroborate the impact (indicative maximum of 10 references)

E1: FundiFix website and company information.

E2: Letter of support from Director of FundiFix.

E3: Report, WASREB (2014) Impact: A Performance Review of Kenya's Water Services Sector 2012-2013.

E4: Report, UNICEF Kenya (2018) Looking Back, Moving Forward: Impact Report 2014-18.

E5: Fundifix payment records.

E6: Letter, Finnish Consulting Group, Kenya (2020) Grants to Water Services Trust Funds.

E7: Letter of support from Co-Founder and Chief International Officer, Share.

E8: Report, Sustainable WASH Systems Learning Partnership (2019) Sustaining Rural Water as a Comparative Study.

E9: Letter of support from the Ministry of Agriculture, Water and Livestock Development, County Government of Kitui.

E10: Letter of support Irrigation Secretary, Kenya (2019) Letter about Water Act 2016.

E11: Case Study, SDSN TReNDS (2018) Handpump Data Improves Water Access: Case Study by SDSN TReNDS.