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Research alternatives for the knowledge gap

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LOCAL ACTION WITH INTERNATIONAL COOPERATION TO IMPROVE AND SUSTAIN WATER, SANITATION AND HYGIENE SERVICES

Research alternatives for the knowledge gap

C. Print & I. Smout (UK)

PAPER 2765

The world may be headed for a perfect storm in the coming years that will stretch human ability to manage the combined pressures of population, climate change and unsustainable economic growth. Despite global progress in WASH significant poverty traps are likely to remain and may worsen in the mega-cities and rural remote areas. Least income Fragile and Conflict Affected States in Africa currently remain the areas of most concern. They exhibit the weakest service delivery pathways but are typically highly complex and challenging operational environments. Lack of hard data inhibits research in this area, which can result in major challenges for WASH programming. This paper presents analysis, reviews probabilistic methods for engineering, and presents a paradigmatic framework for research and knowledge generation, demonstrating that methods and tools exist to underpin judgments and decisions under uncertainty.

Context

It is said that we live in an increasingly dynamic, complex, interconnected and intrinsically smaller world, and that the prospects for human development will strain the resources of the planet and human ability to manage. Major challenges in the coming years revolve around population growth and migration, conflict and security, and growing inequalities between the poorest and wealthiest on the planet. Climate change and environmental stress compound the pressures on access to sustainable water, food, land and energy resources. (Beddington 2010, HMG Foresight 2011). Assuming that population will stabilise, two possible solutions are to reduce economic inequality to ensure fairer distribution of resources, and/or to dramatically reduce consumption through more effective and efficient use of renewable resources.

Many projections don't foresee real progress for the world's poorest partly because security and economic interests are protected by the powerful and as such will remain in tension with many aspirations of equitable and sustainable human development, operationalized through the Sustainable Development Goals (SDGs). There are likely to remain sinks/traps of real poverty where progress is most needed, with many of the world's poorest concentrated into growing mega-cities or the rural and remote areas of Sub-Saharan Africa (SSA) and in Fragile and Conflict Affected States (FCAS) (Collier 2004). In these areas major gaps in coverage of water and sanitation point to need for research and knowledge generation, in order to underpin means and methods of improving service delivery (Weinthal 2012, De Waal 2014).

Method

The authors draw on meta-analysis from published research, particularly from evidence and outcomes of recent studies in FCAS from both WSP and WEDC.

Analysis

Drawing on the more recent development of values in the western tradition, and when approached through philosophical dualism, any simplified succession (fig. 1) looks problematic when applied to global, human development as a whole. Where tensions between internationally driven and traditional ideas and values typified by a pre-modern mind-set typically exist, they are likely to remain in many least developed

countries, where local action and international cooperation do not always work optimally to improve and sustain WASH services. We thus infer that where different mind-sets see things differently, and will drive their agenda, a complex of values will continue to co-exist and/or conflict to some degree. In much of Africa at least the debate remains highly contested (Moyo 2009, Gates 2013).

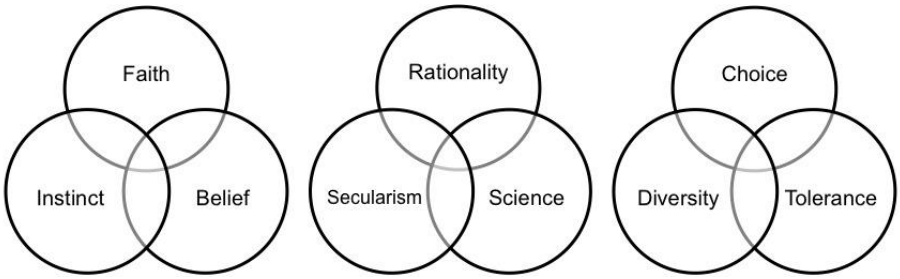


Figure 1. Pre-Modern, modern and post-modern value paradigms

Source: WEDC – Print 2015

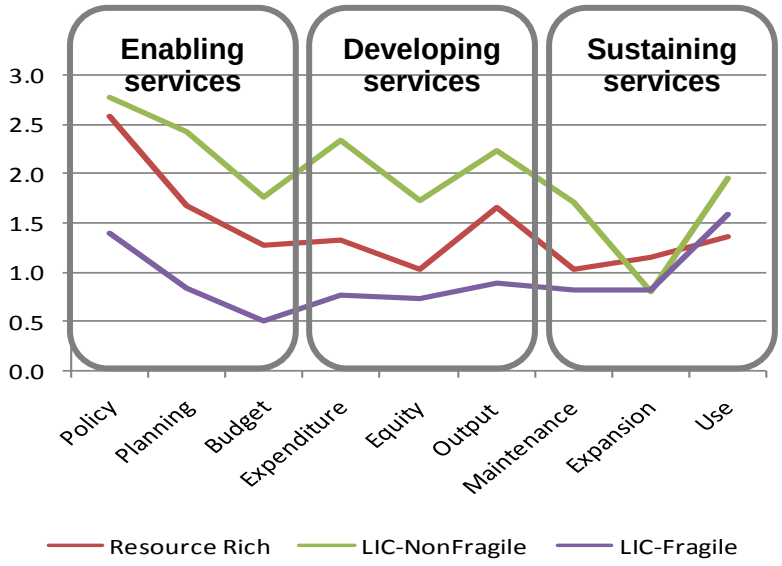


Figure 2. Low-income conflicted fragile African states have weak service delivery pathways

Source: WSP – De Waal 2014

A colleague who had a propensity for working in difficult places and attained a senior position in global WASH for Oxfam was known to exercise a maxim in the execution of his professional duties, advising others "it's not what we don't know that gets us into trouble, it's what we know for sure that just ain't so". He was well aware that a complex of external and internal forces influence program outcomes for the WASH practitioner and for the sector per se. Development is complex and development problems have been described as 'wicked problems' (Conklin 2001, Spratt 2011). Wicked problems involve a high degree of uncertainty where each problem is linked to another, and is unique and novel even if at first they appear alike. With wicked problems just diagnosing the problem can be a challenging and extremely difficult task,

and an essential component of a wicked problem is that there is no stopping rule, because there is always something more that can be done to improve the situation.

Achieving universal coverage in WASH without doubt requires a complex of interdependent influencing factors; available water, operation and maintenance, a sustainable economic model and capital reinvestment, monitoring of public health risks, on-going public communications of benefits to society, etc.. Progress reporting for the DGs showed that coverage in some Africa countries has not kept pace with population growth. A comparison in Africa between resource rich countries, stable low-income countries (LIC) and fragile low-income countries suggests that LIC-fragiles have the weakest service delivery pathways (Figure 2). Countries such as Liberia, Sierra Leone, Somalia, Congo, DRC, CAR and South Sudan present particular problems because either they are generally not represented on global indicator reporting or have clear institutional and capacity deficits in their core country systems. Localised research evidence provides some illustration of typical problems, for example WSP (2014) found in Monrovia (Liberia) that municipal utility coverage is as low as 10,000 connections in a population of 1.2 million and informal services are highly contaminated. In Mogadishu, Somalia there is no functional water utility at all as there has emerged an un-centralised network of wells, small scale reticulated systems and vendors with limited water treatment options (Print 2013). In many ASALs pastoralism is intrinsically linked to co-operation and conflict over water supply and the challenges of nomadic development under non-equilibrium conditions are well documented (Scoones 1996, Sullivan 2003). The case of Somalia also suggests that externally driven state building, countering violent extremism and humanitarian policies, has worked at crossed purposes (Menkhaus 2010). Focus on core systems for delivery of services opens up the argument that institutional legitimacy is incompletely developed in the collective action model of new institutional economics, and that a set of normative incentives is needed to build trust and successful institutional reform (Wang 2013).

Studies of the MDG indicator highlighted the lack of a water quality indicator (Dar 2011). The indicator; a typology of ‘improved water sources’, clearly does little to reflect temporal and spatial variations in access to coverage, let alone reflect accurately on the contribution of WASH to environmental sustainability. While the post MDG agenda points to improved indicators of performance, the SDGs retain a focus of interpretation of progress through the geographic rather than scientific lens, but which recognise WASH as cross cutting and fragmented (UN 2013, 2016). The evidence base for WASH may thus be ‘improving’ but it remains problematic in areas of limited rigorous evidence regarding the specific delivery models and where the existing evidence is generally inadequate to determine whether investments are more or less cost-effective than other interventions, given uncertainty and the variability in benefits across social and physical settings (Cairncross 2011). Models of service delivery appear extremely variable between FCAS and are unique to the context and problems addressed. However, while it remains difficult to capture factual evidence of the full transformational benefits of adequate WASH, there is an emerging agenda to more precisely enumerate the evidence for aid effectiveness in the poorest states (WSP 2014).

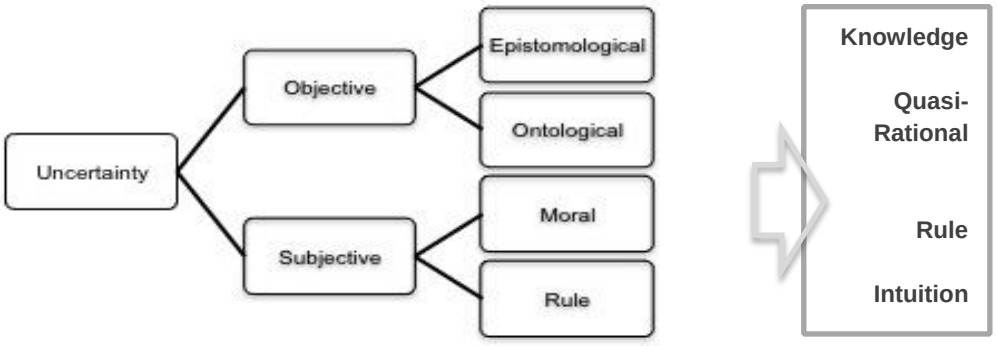


Figure 3. Uncertainty domains and their relation to the basis of decisions

Source: Tanneart et al – 2006

Working with uncertainty

Water is fundamental to life, so even in the most challenging conditions access to water remains purpose driven. Under these conditions, it is natural that the priority remains a focus on implementation rather than research. The specific method of research in any case needs to be defined. Figure 3 describes a framework that may be used in focussing research adapted to context, on the understanding that local attitudes and values shape the possibilities for effective research. In an FCAS like Somalia, an epistemological (knowledge-based) research approach to uncertainty has proved possible and produced useful knowledge for riverine water resources planning and management (Houghton-Carr 2011), starting from a no-data condition but leading to modelling. Somalia provides a unique case where knowledge generation in water resources and supply has been on-going since 2001 despite lack of central government until recently (www.faoswalim.org). In contrast, where host values are heavily influenced by faith and the role of science in society is less well appreciated an appropriate approach may well be through addressing subjective uncertainty and the rules and moral codes that govern conduct. Given the ethical approach to research in LICs necessary, figure 3 is adapted from a study into the ethics of uncertainty in medicine, for which in the light of possible dangers, research becomes a moral duty (Tannaert 2007). The use of knowledge in society continues to hold meaning for human development globally, and can be considered the hallmark of effective research (Hayek 1947).

A generic approach for the WASH practitioner is to integrate knowledge of both physical and social sciences when developing services; the programme is one of both 'hardware' and 'software'. The results chain proceeds from identification to outcomes that are derived from a knowledge continuum linking hydrological sciences, water resources development, water supply and wastewater technology, and public health sciences to underpin social, economic and environmental development. Constrained by data environmental engineers that are trained to reduce risk and enhance reliability may be tasked or pressured to support decisions with an insufficient evidence base for desired outcomes. Although the discipline of engineering uncertainty is well developed (Jordaan 2005) one adaptive strategy is found in approaches and methods held broadly in common with economists that are derived from Bernoulli and Bayes.

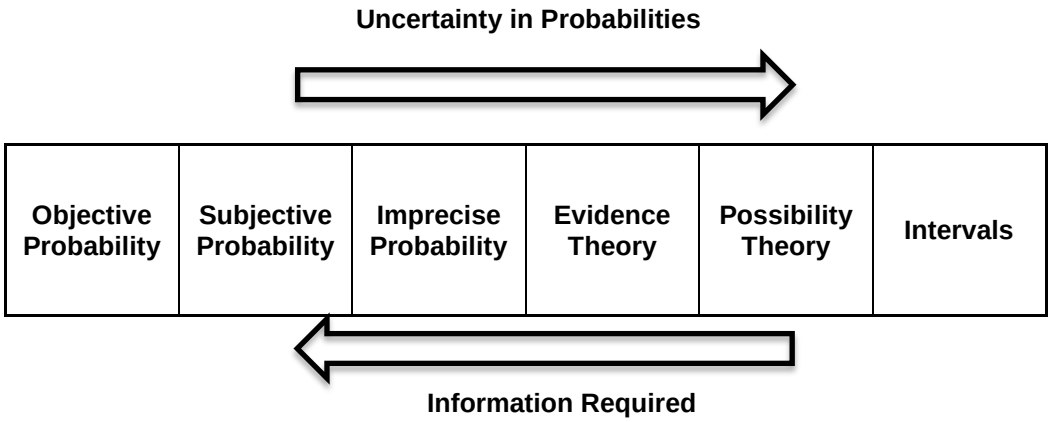


Figure 4. Alternative ways to represent uncertainty

Source: Nikolaidis – 2011

Many decisions are based on beliefs concerning the probability of uncertain events. Figure 4 shows a choice of probabilistic modelling tools ranging from the application of objective, subjective and imprecise probabilities through the use of evidence and prospect theories and intervals. The choice of model is framed from the amount of information required, broadly inverse to the degree of uncertainty in the probabilities (Nikolaidis 2013). Tables are available for probabilistic models according to the amount of data available, relating the distribution to recommended uses; for example the Beta distribution is useful where there are small amounts of data or no-data, with good quantification of bounds and the most likely values. Upper and lower bounds of belief functions underscore evidence theory (Shaffer 1976). The adoption of intervals

(triangular distribution) for flood risk analysis have been suggested following research of uncertainty starting with neural networks as the academic, theoretical basis (Gorantiwar 2007).

Ultimately this understanding builds on the premise that decisions and uncertainty, like probability and utility, are dually related. However in engineering, probability and utility are subjective and attach to the person, not to the event (Jordaan 2005). The crucial thing then in applying probabilistic methods is in understanding the heuristics (informal methods) and biases associated with judgement under uncertainty. Understanding heuristics is required to interpret what is happening on the ground, and how that can affect the outcomes of research. Representativeness, availability, adjustment and anchoring are identifiable biases in quantitative research of perceptions, and choices, values and frames influence validity of results (Tversky 1974, Kahneman 1984).

Concluding remarks

International aid is the western response to poverty and chronic underdevelopment and where there remain significant deficits in coverage of WASH services there is a need for effective research. Future projections indicate that SSA and FCAS will remain amongst the most challenging environments in which to sustain improved service delivery. If so we will be able to understand within a matter of years if and how WASH has become a wicked problem. For now sufficient valid data is likely to remain hard to come by in many areas of SSA and FCAS and there is a need to address critical gaps in knowledge. Uncertainty analysis based on probabilistic methods holds some promise from which to match modelling with limited observations.

While the basic requirements for local data in support of planning and implementation by practitioners on the ground is not disputed, the links between data and improved service delivery pathways need to be more closely analysed. What is suggested here is a paradigmatic approach, a mind-set to match readily available survey and assessment tools. Given that we learn naturally from trial and error it seems reasonable to think that the way to find out about the world is to test hypotheses against observations. This is the basis of the scientific method whereby our conclusions have to be grounded in experience. On the other hand where disorder enters into information or method, the learning curve suggests that engineers can eschew standard methods such as hypothesis testing and focus more deeply on the nature of the problem at hand.

Probabilistic reasoning invariably requires the use of unsupported assumptions. This is warranted where judgements and/or decision support is required for programming where either data and information is limited, or the links between data, information and effective decisions are constrained by a capacity gap. In theory assumptions may be guided by understanding the kind of decisions that will likely be attached to the domain of uncertainties that are being explored - either objective or subjective - and also to the degree of uncertainty attached to data and information available for probabilistic modelling. Table 1 describes the nexus of paradigms available to the researcher exploring explicit and implicit knowledge generation through ‘hard’ or ‘soft’ research options, and our template is offered for further deliberation by the research student facing the challenges of the need to know. In the final analysis, both the researcher and practitioner may benefit from learning to embrace a full set of research alternatives underpinning knowledge generation, while recognizing that it remains our duty to deal with messy, real world problems in guiding the delivery and development of WASH services in the world’s poorest countries.

Table 1. Knowledge Generation (1,2) and Research Alternatives (3,4) (Print, C. 2014)

1. Explicit	2. Implicit	3. Hard	4. Soft
Know What	Know How	Evidence	Assumption
Theory	Practice	Practise	Theory
Epistemic	Experience	Objective	Subjective
Propositional	Heuristic	Certainty	Uncertainty
Inductive	Deductive	Statistics	Probability
Complexity - Stability		**Science - Belief**	

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Contact details

Chris Print - Researcher
WEDC, Loughborough University,
Loughborough, Leicestershire, LE11 3TU, UK.
Tel: + 254 724 500765
Email: c.r.print@lboro.ac.uk

Ian Smout – Principal Programme Manager
WEDC, Loughborough University,
Loughborough, Leicestershire, LE11 3TU, UK.
Tel: + 44 1509 222642
Email: i.k.smout@lboro.ac.uk