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Expanding preparedness - integrating emergency response with water sector development in the S(P)EEDWater tool

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During humanitarian crises, emergency response organizations are confronted with a high level of complexity and dynamically changing priorities. Importance of the selection of water methods is amplified when considered that some of the solutions may support local or regional water sectors beyond the period of relief actions. The S(P)EEDWater decision-support tool attempts to reconcile emergency response goals of water delivery with considerations of water sector development. The tool contains peer-reviewed information on more than seventy water supply methods and their multi-disciplinary assessment according to criteria of (i) disaster/conflict, (ii) natural environment, (iii) technological, (iv) economic and (v) socio-cultural issues. This paper identifies key considerations to expand preparedness already in the post-relief phases of emergency interventions. It describes the approach, structure and set-up of the S(P)EEDWater tool and presents an initial assessment of the approach.

Water supply during emergency response and beyond

Information scarcity and core standards in emergency water supply

During humanitarian crises, emergency response organizations focusing on water supply are confronted with a high level of complexity and dynamically changing priorities (MSF, 2011; House and Reed, 1997). Often working in developing regions, the challenges of – disaster-related and local – factors limit their efficiency in achieving self-reliant water supply in the affected areas.

The working approach of humanitarian organisations is rooted in and (partly) defined by the core and minimum standards of SPHERE, an initiative to unify all aspects of emergency relief (SPHERE, 2011). Its standards formulate both the goals and approach to adhere to in different phases of emergency response. These phases are (i) (immediate) relief, (ii) early-recovery, (iii) recovery and (iv) reconstruction. During these periods, response aims at delivering water not only to fulfil SPHERE's minimum requirement of 15 L pppd*, but to allow a gradual reduction of dependence from the aid organisations as well. Ultimately, emergency response seeks to restore the pre-disaster conditions of service, as rapidly as possible.

Water is a basic need (and a human right), hence it is treated as a lifesaving service. As a consequence, water supply is set up within 24-48 hours from the disaster event. Because of the time constraint, there is little opportunity to consider appropriate solutions. Instead, organisations tend to prepare and store standard kits of water supply hardware for an immediate transport when needed. The size and content of such kits differs per organisation, but they are similar in their goal: to safely ensure water delivery in any condition. Most of these kits contain source development and abstraction hardware including numerous converters and adapters to be able to operate worldwide. The deployment of such extensive containers is a necessary part of current emergency relief practice, but it does imply costly delivery.

Improvement of emergency solutions to reduce service dependence

Once an initial (emergency) water supply is achieved, aid organisations can start developing plans for its improvement or adjustment to realise a locally more appropriate system. During the – sometimes simultaneous – phases of relief and early-recovery, the efforts are focused on a timely start for dependency reduction and an improved level of disaster preparedness (SPHERE, 2011; IFRC, 2008). As much as available capacities allow it, water management activities aim at the realisation of people-centred, self-reliant and inclusive solutions to support local capacity and livelihood. This implies solutions that '*benefit of the local economy and promote recovery*' and increase local people's decision-making power and ownership of programmes (SPHERE, 2011). With adjustments, but these efforts continue even between emergencies in the humanitarian framework of preparedness and contingency planning.

A key consequence of this approach is that emergency response organisations should be encouraged to view developing-context methods alongside specific, emergency water solutions as early as possible in emergency situations. By applying development-context technologies, humanitarian organizations may simultaneously achieve increased local disaster preparedness and a more cost-effective delivery without a trade-off in water service quality (IFRC, 2008). Such integration is expected to aid the deployment of solutions that function as efficiently during the interventions as in post-emergency situations.

The S(P)EEKDITS program and the S(P)EEDWater tool

In emergency settings, the installation of or switching to developing-context methods is by no means a straightforward and easy-to-define process. Especially in (peri)-urban areas, numerous unknown factors e.g. ownership of locations and infrastructure or allocated responsibilities can complicate relief efforts.

The S(P)EEDKITS project (www.speedkit.eu) was set up to design & construct innovative technologies and software – in the clusters of water, sanitation, shelter & logistics – in order to aid humanitarian interventions worldwide. Its name refers to the combined objective to develop innovations that are quick to use and deploy (speed aspect) and may function as introduction technologies to disseminate in developing regions (seed aspect). The seed aspect entails that humanitarian and development methods are viewed for their potential to act as seeds for future upscaling to (i) advance local (water) access and (ii) contribute to improved preparedness for the local population (S(P)EEDKITS, 2012).

In the framework of this program, a key objective is the developing of a water management decision-support tool. Conform the objectives of the basic program, the S(P)EEDWater concept is designed to aid emergency WASH workers in identifying and utilizing locally appropriate water methods at the earliest opportunities during emergency response. Its objective is to support a more objective water technology selection in emergency relief campaigns with integrated considerations for post-emergency times.

Methodology

In the framework of the current research, both the humanitarian aid and development context water sectors were analysed. The key factors/aspects in technological selection were identified and an inventory was carried out to identify and categorize relevant technologies in the water management stages of (i) source development, (ii) abstraction, (iii) storage, (iv) conveyance, (v) central treatment and (vi) household-level storage and treatment. Initial assessment and adjustment of the concept quality was based on extensive, open-ended interviews with six senior WASH experts and three shelter experts from six international emergency response organisations (IFRC, NLRC, SRU, OXFAM, MSF and UNHCR). (Shelter experts were included to better understand the working of decision-making mechanisms in emergency response.) Content of the knowledge base methods was developed in 2013 and 2014 using emergency WASH literature (reports and water supply protocols) and resilience studies, project literature and implementation guides of development-context water initiatives. A panel of five (WASH and emergency WASH experts) reviewed and advised both content and functional ranges of the methods. The resulting technology descriptions were subjected to repeated reviewing by emergency response WASH experts from NLRC. Each method underwent a multidisciplinary assessment to define indications on their operating range in the two (emergency and development) environments. These were set in matrices according to criteria grouped as (i) disaster/conflict, (ii) natural environmental, (iii) technological, (iv) economic and (v) socio-cultural.

Results of the tool approach, development and content are explained in the section 'S(P)EEDWater decision-support tool'. Prior to an international testing of the developed digital tool, an initial assessment was carried out. This assessment views the tool approach according its usability in current emergency response practice and it is described in the section 'Initial assessment of the S(P)EEDWater approach'.

The S(P)EEDWater decision-support tool

The approach

The S(P)EEDWater decision-support tool concept had the basic design objective to facilitate a rapid, reliable and objective water technology selection in emergency relief campaigns with integrated considerations for post-emergency times. The tool was to aid both WASH and relief workers to be able to (i) gain relevant information on potential water methods for deployment and (ii) execute a meaningful, multidisciplinary screening of water supply and treatment methods according to user information. The first goal required the development of a knowledge base containing diverse water supply methods; the second goal necessitated the design of a screening procedure on the water method descriptions for eligibility.

The literature review and the expert interviews both confirmed that emergency water solutions consider a combination of (i) standardized water equipment and (ii) purchase and setup of local equipment. The interviews indicated that larger international organisations prefer to use standard equipment in initial emergency response. Such equipment is not only a safe measure to guarantee delivery in any circumstances, but it also limits the needs (and costs) of training, worldwide. All interviewees agreed that WASH decision-makers in emergencies have a significant degree of freedom in designing water delivery and that their local decisions were often formed after negotiating with experts of other participating relief organisations. This meant that an adaptive decision-support approach was needed to mitigate the problem of an almost infinite number of emergency scenarios. It was decided that a combination of tool information and user intelligence would offer the highest flexibility for a reliable selection. As a result, the tool now contains multidisciplinary descriptions and an embedded multicriteria assessment matrix on each of the included methods.

Another consequence of reliable handling was that the decision-tree of the tool needed to be as simple and transparent as possible. This was necessary so that tool users would understand the reason of selection or omission of any given water method. The development process showed that this is possibly best approached by including a single, simultaneous multicriteria-screening of the eligibility criteria. This design implies that a screening can be automated after the feeding of user preferences (e.g. the preferred water source), and that the tool only needs to offer (i) the pool of selection and (ii) the specific reasons of mismatch between user definition (e.g. preferred water source is groundwater) and method function (reason of mismatch: method uses surface water). This is a crucial design element, as it leaves the final selection with an informed tool user, who can then critically view the available information and weigh them based on the local experience.

The knowledge base

S(P)EEDWater's knowledge base consists of relevant emergency and development-context technologies presented alongside each other, in a non-discriminative format. The knowledge base offers both factual information on the water methods and experiences with functioning in emergencies (where applicable).

An important feature of the high complexity in defining what is truly resilient in an emergency-recovery context is that many of the selections' considerations are non-technological. Water source selection alone has to deal with a great diversity of criteria in the form of, e.g., proximity, quality, quantity, treatment requirements, landownership and/or availability. Therefore the method descriptions in the S(P)EEDWater knowledge base are grouped according to information in the areas of

- Description: general description of a method and its working
- Emergency use: key boundaries of application & optimal deployment in the humanitarian context
- Financial: installation and operational costs and the most significant reoccurring expenses
- Institutional: institutional requirements and management activities to ensure sustainable operations
- Environmental: local conditions suitable for use, ecological sustainability and contamination facts
- Technical: construction and O&M (operation & maintenance) information
- Social: social & human health, including necessity for awareness raising or similar campaigns
- Requirements: Information on packaging and deployment in a relief/recovery-context.
- Additional: literature sources and references (linked, where possible)

The categories listed (Table 1) make up the entire water supply chain in any situation. In an ideal scenario, local water sources would be equipped with abstraction, storage and conveyance systems to foresee the affected population with safe water. In disasters, these conventional water solutions are often damaged to some extent, necessitating at least a partial new system. In a few cases, relocation or poverty may imply that safe water is not even a common service; requiring a complete albeit temporary water management chain.

During emergency response, preference is given to water supply arrangements with no treatments (except for chlorination as a safety measure). Application of treatments is discouraged either because of hardware requirements or because of the cost implications. However, direct water delivery may not always be an option. In such cases, treatments are unavoidable. Although humanitarian water delivery would then place a priority for central treatments, even that may not always prove feasible (IFRC, 2008). For this reason the stage HWTS is also added to include point-of-use, safe storage and treatment methods.

Table 1. Inventory of categories and methods in the S(P)EEDWater tool

Category	Methods	Description
Source development	Rooftop rainwater harvesting; unlined hand-dug wells; lined hand-dug wells; manually drilled wells (hand-auger, jetting, sludging, percussion); mechanized drilled wells; subsurface dams; infiltration galleries and drains; spring protection; direct surface intake (bottom, side & floating); sump surface intake	Ground- and rainwater methods, and even some of the surface water solutions may require development of the source to directly connect to the desired water source.
Abstraction	Rope and bucket; household-level, suction handpumps; household-level, lift handpumps (Tara, Bucket, Canzee, Rope); community-level, lift handpumps (Afridev, India Mark II, deep-well); community-level, suction, motorized pumps (centrifugal); community-level, lift, motorized pumps (hydraulic ram, submersible pump); gravitational, roof catchment gutters and pipes; traditional designs	This stage contains emergency and developmental methods for the extraction of water from surface or groundwater sources.
Storage	Elevated (steel & concrete) storage tanks; surface-level storage tanks; underground storage tanks; sand storage dams; natural catchment and storage (open, natural ponds, lakes, wetlands); bladder tank; onion tank; metal frame reservoir; Oxfam tank; mesh reservoirs	This stage contains methods/devices of water storage, including general method groups based on elevation and specific emergency tank types.
Conveyance	Pressurized (pipeline) distribution; gravitational distribution; motorized transport; public standpost; water vendor/kiosk; manual transport (jerry cans, rollers)	The stage 'Conveyance' contains water transportation and distribution options.
Central treatment	Screening and straining; pre-settling; aeration; coagulation & flocculation; sedimentation; roughing filter; rapid sand filtration; slow sand filtration; micro filtration; activated carbon; desalination; UV treatment; chlorine disinfection (piped water included); combined, commercial units	This stage includes all (semi)-centralized water purification methods that may be expected in an emergency setting.
Household Water Treatment and (Safe) Storage	Settling; straining; aeration; natural coagulation; chemical coagulation; iron removal filter; biosand filter; ceramic filter (pot, candle, siphon, CSP, silver pot and Kisii-filter); charcoal filter; adsorptive arsenic removal; precipitative arsenic removal; pasteurization; boiling; chlorination; UV treatment; desalination through heating; commercial disinfection options; commercial multi-treatment units	A specific category within water technologies. It covers all technologies and methods that aim at water purification and – often combined – storage within the household.

Categories of assessment – the multi-criteria matrices for screening

Next to the multidisciplinary descriptions, each method in the knowledge base received an assessment of functioning. This assessment considered each option in Table 2, for each method. A method's functioning or eligibility was established as 'eligible, 'partially eligible', 'not eligible' and 'not relevant'. In case of the options 'partially eligible' and 'not eligible', 1-2 sentence explanations were given on the specific limitation.

All decision aspects were viewed in a combined, emergency response-development focus. This is not only true for the disaster -related criteria that are primarily important for emergency response. As an example, The O&M criterion is conventionally associated with technology. However, a necessity to deploy a WASH expert – with the related costs and logistics – implies that O&M expertise is more a disaster-related criterion in this initiative. In case of the screening factor 'key consideration', eligibility was determined by the panel of experts reviewing the content. In all cases, emergency WASH experts were given the final decision on determining the eligibility of e.g. 'fast construction/deployment' for the assessed methods.

Not all factors would have a direct relevance for every method. 'Water lifting' can applied to define only the optimal abstraction methods and criterion 'ground formation' to determine eligibility of borehole construction options. Treatments were already described as non-preference methods. Still, where necessary, the tool differentiates between the conventional option of chlorination, and the treatment of one or several contamination types to be mitigated on the short-term or only after a long period of operation. More than one contamination will be possible to mark in this screening factor. Explanatory texts are provided in pop-up windows of the digital tool to offer information on the expected source and effect of each contamination.

Table 2. Evaluation categories, related criteria and options in the S(P)EEDWater tool

Category	Criteria	Options
Disaster/conflict	Location	Urban, rural/remote
	Humanitarian phase	Relief, early recovery, recovery, both relief & recovery
	Key consideration	Sabotage/theft-proof, economic construction, economic maintenance, local maintenance, fast construction/deployment, technical resilience, water quality, land availability
	Intended period of use	A few weeks, six months, up to one year, more than a year
	Construction time	Not important, < 24 h, < a week, 1-2 weeks, a month or more
	O&M expertise	Not required, limited training, medium training, WASH expert
Natural environment	Water source	Surface water, groundwater, brackish water
	Treatment (contamination)	No treatment, Chlorination, additional treatment (immediate), additional treatment (on long-term)**
	Ground formation	Soft (sand, clayey, consolidated), hard (weathered & bedrock)
	Water lifting	Not relevant, 0-8 m, 8-15 m, 15-40 m, >40 m, unknown
Technological	Method sophistication	Not important, labour-intensive, intermediate, technology-intensive
	Water transport	Manual, animal, pick-up trucks, no transport, unknown
Economic	Construction costs	Not significant, low (<USD500 per unit), medium (USD500-1,000), high (>USD1,000)
	Maintenance costs	Not significant, low (<USD500 per unit), medium (USD500-1,000), high (>USD1,000)
	Packaging needs	Bag, pellet, container
Socio-cultural	User training	Not required, low-level, medium level, high-level
	Preferred level of service delivery	Household/tent, shared (2-5 households), small-community (street, ward level), large-community (camp, town)
	Water transport	Manual, animal, trucks, no transport, unknown

Initial assessment of the S(P)EEDWater concept

Applicability in emergency phases and situations

The approach allows flexible viewing of the number and type of methods and the offering of alternatives. This is expected to be a useful feature as the field objective is often to ‘redesign’ a partially non-functional system. Another positive response from the interviewed experts regards the notion that the tool is not a decision-making, but a ‘support only’ instrument. This appears to better fit the high complexity experienced in emergency response. In a software form (under development by D’Appolonia), the screening and pre-selection process is perceived as rapid and objective (SPEED element). The non-discriminative selection process from both emergency and development technologies (SEED function) is accepted as a robust solution. The offering of eligible alternatives supports a critical reviewing of existing preferences of tool users. The offering of general information on method eligibility may limit its use for senior WASH experts. However, this approach is likely to offer optimal utilization in educational and training settings. Based on the humanitarian practice, the application of non-emergency solutions is possibly limited in the initial emergency response. Also, relocated populations will enjoy limited benefits of the deployed conventional methods beyond the humanitarian phase. Finally, a limitation is expected from the omission of packages (hose or adapter sets) and commercial units for rent. Although latter solutions are unlikely to contribute to local preparedness, they may be useful options in specific settings.

Ease of (reliable) use

The level of transparency in the tool is expected to be a positive feature. When faced with limited eligibility, a user can learn the reason of limitation and opt for the method with the least significant shortcoming. This approach supports humanitarian experts as their decisions often consider trade-offs between imperfect solutions. Still, the level of WASH expertise to reliably use the tool requires thorough testing (just as the quality of the content). Optimally, the identified solutions should be discussed amongst experts or even in a multistakeholder setting. In former, the information in the knowledge base is likely to offer a good common platform to compare views; latter setting would provide an opportunity to view options with the participation of beneficiaries. Such meetings should also incorporate a post-assessment step where e.g. local availability of skilled personnel or availability of parts is assessed. Integration of the obtained experiences from the tool use (and new information on the included methods) is to be systematically organised. As monitoring and reporting is an integrated part of emergency relief, this may not be a limiting factor.

Conclusions

A tool was built to facilitate objective water method selection in emergency response campaigns. It offers (i) an extensive, multidisciplinary knowledge base of over 70 methods and (ii) a multi-criteria screening. The assessed information revealed that emergency response organisations utilise transported (stored) equipment and local materials in varying combinations. To reflect this diversity in approach, the tool is designed to offer an initial screening of methods, but it leaves the ultimate selection with the user(s). The initial assessment indicates the approach to be a useful addition both in the field and especially in an educational environment. Future testing will concentrate on evaluating whether a strict protocol is required for a reliable use by emergency response workers. By integrating ‘speed’ and ‘seed’ functions, the S(P)EEDWater tool is expected to reduce the gap between humanitarian and development efforts in local water sectors.

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Notes

* per person per day; ** Removal of the following contaminants is included: arsenic, fluoride, iron, manganese, heavy metals, sulphate, salts, pesticides, nitrate, phosphate, odour & taste and turbidity.

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