A FRAMEWORK OF ACTION FOR HOUSEHOLD WATER TREATMENT AND SAFE STORAGE INTERVENTIONS RUN BY RED CROSS AND RED CRESCENT EMERGENCY RESPONSE UNIT (ERU) IN EMERGENCIES

by

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In Colombia, 30^{3h} June 2019

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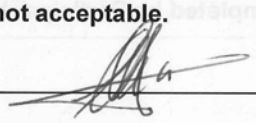
Signed: 

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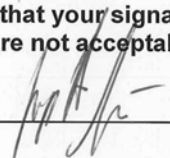
Signed: 

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ABSTRACT

The International Disaster Database EM-DAT (2017)[1] reported that the number of recorded natural disaster events have been progressively rising from the beginning of the century till the 21st centrury. Whatever the emergency situation may be, the provision of water is considered a 'fundamental human need, basic human right'[2] (Un.org, 2019). There is a limited body of evidence investigating the effectiveness of HWTSS interventions in emergencies. Nevertheless, organisations working in emergencies can adopt different preparedness strategies to boost the effectiveness of their actions and properly incorporate factors of success to in the design of their programs. The research aims to review of the existing knowledge on 'household water treatment and safe storage interventions' in emergencies through the opinion of WASH practitioners and emergency managers in order to identify which are those factors of success and propose a clear FoA adapted to the Red Cross and Red Crescent Emergency Response Units (RC/RC ERU).

Key words: household water treatment, emergency response units, household water supply., water supply in emergencies.

[1] Emdat.be. (2019). *EM-DAT | The international disasters database*. [online] Available at: https://www.emdat.be [Accessed 8 May 2019].

[2] Un.org. (2019). ACCESS TO SAFE WATER FUNDAMENTAL HUMAN NEED, BASIC HUMAN RIGHT, SAYS SECRETARY-GENERAL IN MESSAGE ON WORLD WATER DAY | Meetings Coverage and Press Releases. [online] Available at: https://www.un.org/press/en/2001/sgsm7738.doc.htm [Accessed 8 January 2019].

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EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

The International Disaster Database EM-DAT (2017) [3] reported that the number of recorded natural disaster events have been progressively rising from the beginning of the century till the 21st century. In addition to natural disasters, last years have seen how new categories emerged such as 'complex emergencies', to be understood as a major humanitarian crisis caused by a combination of social inequities, political violence or political instability which may seriously affect livelihoods and provoke large movements of people. In addition to this, an increasing number of displaced population can be expected due to climate change anomalies such as 'water scarcity' [4] (Rigaud et al., 2019) that will add, in the near future, another layer of complexity to the wide range of potential emergency situations that Governments and the humanitarian community will have to face.

Whatever the emergency situation, the provision of water is considered a 'fundamental human need, basic human right'[5] (Un.org, 2019). Research studies on water supply in emergencies claim that an inadequate provision of clean water can lead to serious risk for public health in terms of transmission of infectious diseases such as 'hepatitis E, cholera and other diarrheal diseases' [6] (Bastable and Russell, 2013, p.10-12). The increasing shortage of clean water resources and the increasing risks associated to the spreading of water borne diseases resulted in the humanitarian community to pay more and more attention not only to treating water at the source or the point of production, but also to all those elements associated to the production and management of safe water in households (water storage, household water treatment and management (HWTSS)) in order to prevent the spreading of water borne related diseases.

The question whether HWTSS can play an important role to supply clean water in emergencies has been of interest for experts for some time. The reasons explaining which the potential gains are of using bulk water supply systems versus Point of Use (PoU) continue to be discussed and in cases are considered by practitioners as a real issue on the ground needing further research (Bastable and Russell, 2013, p. 2-15).

[3] Emdat.be. (2019). *EM-DAT | the international disasters database*. [online] Available at: https://www.emdat.be [Accessed 8 May 2019].

[4] Rigaud, K., de Sherbinin, A., Jones, B., Bergmann, J., Clement, V., Ober, K., Schewe, J., Adamo, S., McCusker, B., Heuser, S. and Midgley, A. (2019). *Groundswell*. [online] Openknowledge.worldbank.org. Available at: https://openknowledge.worldbank.org/handle/10986/29461 [Accessed 13 April 2019].

[5] Un.org. (2019). ACCESS TO SAFE WATER FUNDAMENTAL HUMAN NEED, BASIC HUMAN RIGHT, SAYS SECRETARY-GENERAL IN MESSAGE ON WORLD WATER DAY | Meetings Coverage and Press Releases. [online] Available at: https://www.un.org/press/en/2001/sgsm7738.doc.htm [Accessed 8 January 2019].

[6] Bastable, A. and Russell, L. (2013). Gap Analysis in Emergency Water, Sanitation and Hygiene Promotion,10-12. Humanitarian Innoation Fund, Elrha.

A first glance into HWTSS practices in emergencies indicates that most of the relief organizations have developed a comprehensive offer to guarantee clean water supply through the delivery of water treatment equipment able to supply clean water during emergencies. Furthermore, most of the relief organizations have signed collaboration agreements with service providers for pre-positioning and/or quickly carrying out the delivering of household water related technologies to the populations affected by disasters. Even when data collected from people interviewed shows that 49% of the emergency and wash managers mentioned that their organizations did not considered HWTSS methods as a priority and one of the main strategies to be implemented in order to supply clean water in emergencies. Research numbers show that organizations continue to put the biggest focus on water treatment at the point of production and delivery to the final beneficiaries 44,83% compare to 20.69% of the responders who highlighted that their relief organization gave priority to water supply interventions at the point of consumption. This is contradicted by the fact that in a recent survey carried out by the Emergency Department of the Spanish Red Cross (2017) 86% of the members of the Emergency Respons Units mentioned that 'HWTS interventions can be especially useful as part of the exit strategy', and 74% of the total people interviewed expressed that they were deployed in humanitarian contexts where HWTSS interventions could have been useful (SPRC 2017, pp. 7-9).

Moreover global standards and rules have been elaborated, and then approved, providing basic guidelines to ensure an efficient implementation of the programs household water treatment programs by relief organizations and UN Agencies. Despite this fact, research data shows that a significant 25.64% of the people interviewed did not have access to specific tools or a detailed framework of action when planning household water interventions on the ground. In addition to this, 16% of the people interviewed requested more guidance on how to plan, design and finally operationalize this type of interventions in order to gain more impact on their interventions. Last, but not least, research and sharing knowledge networks have grown in the last years and specialized agencies and INGOs have dedicated more resources to train their staff aiming to ensure an adequate delivery of humanitarian services. However, survey data reflect the urgent need to systematize the existing knowledge on HWTSS, especially in prone disaster areas and better-trained WASH and emergency practitioners and prone disaster communities. Research highlights gaps and suggests the importance to invest more and better in HWTSS preparedness related activities. Some of these activities are directly linked to increasing HWTSS knowledge on the field, developing lessons learned and having a better understanding of what it works or not in prone disaster areas. Other areas of improvement suggested consist in boosting research to make

household water technologies affordable for communities affected by disasters and strenghtening monitoring mechanisms and tools.

Furthermore, despite all the efforts done to harmonize household water treatment principles among stakeholders, a persistent theme in the specialized literature is the serious doubts regarding the real impact of household water treatment interventions implemented in emergencies[7] [8] [9]. Indeed, recent studies have pointed out coordination, household water selection criteria, monitoring, community participation, adherence and acceptance by the communities as some of the main causes leading to lose efficiency and efficacy. Results of the literature review are consistent with the research findings and the results of the survey.

It is nonetheless true that some of the problems previously identified could be easily solved if relief organizations adopted a more systematic approach and clear 'framework of action (FoA) allowing WASH practitioners and emergency managers to better capture relevant information at grasp level and thus identify what can be the elements of success which could influence positively an adequate implementation of HWTSS programs. Then, once these principles may be identified how they could be successfully operationalize on the ground to reach their ultimate operational goals.

To achieve these objectives, the research focuses on the expertise cumulated by the Red Cross & Red Crescent Movement through its Emergency Response Units (ERU) set up model in emergencies. Although, HWTSS methods have not been yet fully been integrated as part of the Emergency Response Units (ERU) disaster response tools available, it is considered that this approach has been useful in responding to a wide range of emergencies since the mid-90s and its advantages can be used for the successful delivery of water in hard to reach areas, where populations are dispersed or in those areas affected by a disaster where it is not possible to install a centralized water distribution system.

The research suggests that some of the characteristics of the ERU approach such as standardized equipment; rapid deployment, self-sufficiency and well-trained technical specialists can be of interest to develop a clear framework of action on HWTSS in order to increase effectiveness. It is thought that the Red Cross & Red Crescent Emergency

[7] Ali, S.I. and Kadir, K., 2016. Water Treatment. WASH in Emergencies | HIF Problem Exploration. Report. Cardiff: ELRHA, pp. 2-28 Available from: http://www.elrha.org/wp-content/uploads/2016/01/Water-Treatment-WASH-Problem-Exploration-Report.pdf [Accessed 15 February. 2018].

[8] Guerrero-Latorre L., Gonfa, A.h, Girones, R., 2013. Environmental investigation in Maban, South Sudan (April 2013): preliminary results. Barcelona: University of Barcelona WADHE Project.

[9] Daniele S. Lantagne and Thomas F. Clasen, *2012.* Use of Household Water Treatment and Safe Storage Methods in Acute Emergency Response: Case Study Results from Nepal, Indonesia, Kenya, and Haiti Environmental Science & Technology *2012* 46 *(20), 11352-11360.*

Response Units are not only a reflection of the main challenges and constraints that relief organisations can face when deploying human resources and equipment in the aftermath of a disaster, but also this approach can contribute to show the limits and the potential benefits of providing standardized humanitarian services (clean water supply) by means of pre-selecting materials & equipment, harmonizing monitoring systems (water quality, vector control and health impact), train specialised staff and finally, set up well structured and reliable hygiene promotion strategies.

It is believed that developing a more strategic approach on HWTSS interventions, as part of the existing range of WASH strategies by relief organisations, could decisively contribute to fill growing number of people at risk and in urgent need of water supply services, thus increasing efficiency and impact of household water supply solutions.

This research will lead us to the conclusion that the likelihood of success increase when Emergency Response Units (ERU) deployments are in compliance with the enabling and technical factors of success as well as the principles identified and described into the 'framework of action' (FoA) proposed which can be summarized as follows:

a) No implementation without being in compliance with national regulations on HWTSS (if exists) or with Ministry of Health guidelines and recommendations.
b) No distribution of HWTSS items/treatment methods or equipment without training;
c) No implementation of HWTSS activities without adequate PDM protocols established;
d) No implementation without adequate assessment of the existing previous experiences on HWTSS when identifying technical options and/or building the bridge with local practices;
e) No implementation without adequate protocols to ensure community participation during the whole Project cycle.
f) No HWTSS without including a solid 'theory of change', 'behavioural change' coupled with hygiene education activities;
g) No HWTSS without adequate water management safety plans to avoid recontamination of water at household level;
h) No communication without harmonization of key messages with other relief organisations through the coordination of mechanisms established for the emergency response at global/local level.

Last but not least, the research serves to provide further details about how to operationalize household water interventions principles previously described into the 'framework of action' defining clear implementing activities at each stage of the emergency cycle.

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List of acronyms

CAWST	Centre for Affordable Water and Sanitation Technology
CERF	Central Emergency Response Fund
CSO	Civil Society Organizations
DREF	Disaster Relief Emergency Response Fund
DMIS	Disaster Management Information System
ERU	Emergency Response Unit
EW/EA	Early Warning / Early Action
FACT	Field Assessment Coordination Team
HA	HA
HWT	HWT
HWTSS	HWT and Safe Storage
IFRC	International Federation of Red Cross
INGOs	International Non Gouvernmental Organization
M&E	Monitoring and Evaluation
MEAL	Monitoring, Evaluation, Accountability and Learning
M&E	Monitoring and Evaluation
MSF	Doctors Without Borders
NS	NS
NGO	Non-Governmental Organization
NFIs	Non-Food Items
PoA	Plan of Action
PoU	Point of Use
PoUWT	Point of Use Water Treatment
PDM	Post Monitoring Distribution
RC/RC	Red Cross and Red Crescent Movement
RDRT	Regional Disaster Response Teams
UNHCR	The Office of the United Nations High Commissioner for Refugees
WASH	Water, Sanitation and Hygiene
WHO	World Health Organisation
WSP	Water Safety Plans

1. INTRODUCTION AND BACKGROUND.

This research will take you on an exciting journey where you will explore the possibilities offered by the Emergency Response Units of the Red Cross and Red Crescent Movement (hereinafter referred to as RC/RC ERU) in delivering household water treatment and safe storage (HWTSS) in emergencies. This journey will allow you to have not only a better understanding of the key factors allowing their effectiveness in 'emergencies' but also to identify which are those enabling factors and operational elements that should be considered for an effective deployment and setting up of HWTSS iterventions on the ground using the RC/RC ERU approach. The elements identified through this research will contribute to suggest a RC/RC ERU fremewok of action (FoA) for future HWTSS interventions.

1.1. GETTING ACCESS TO CLEAN CLEAN WATER IN EMERGENCIES.

In order to get an overall view of HWTSS [10], it is particularly important to emphasize which are the characteristics associated to this type of water supply intervention. On the one hand, the nature of HWTSS inerventions demands the development of special skills, procedures and guidance that have not been always fully integrated at operational level by all relief organisations acting in the 'humanitarian arena'. Despite the fact that most of the practitioners consulted referred to the existing humanitarian World Health Organisation (WHO) standard guidelines for water quality purposes and Sphere Handbook for general advice as the most relevant tools to be applied in case of emergency, it is also true that an urgent need is perceived amongst practitioners (see Chapter 4) to go beyond common resources available at the humanitarian community and think more strategically about how to promote the role that HWTSS can play in emergencies. And then, what could be the most suitable deployment modalities to increase cost-effectiveness of HWTSS interventions.

As mentioned above access to safe water is one of the main priorities in emergencies. Solidarités International asserted that 2.6 million people die every year due to water related diseases and insalubrious living conditions according.[11] Furhermore, 2.1 billion people still do not have access to a domestic drinking water supply service and 844 million do not even have access to basic water supply (Solidarités International, 2018). Ali and Kadir (2016, p.9) claimed that:

> 'The provision of adequate quantities of safe water is a basic necessity in emergencies. Inadequate provision of clean water is linked to the

[10] For the purposes of this research, the term Household Water Treatment and Safe Storage (HWTSS) will be taken to mean *"a set of technologies, equipment & material and knowledge used by the beneficiaries at household level or at the point of use (POU) to improve the quality of their water by treating it in the home in the aim to improve public health and reduced risks associated to drinking unsafe water"*.

[11] Solidarités Internationale, 2018. 2018 Water, sanitation and hygiene barometer. Inventory of access to a vital resource. 4th Issue.

> transmission of infectious diseases including hepatitis E, cholera, and other diarrheal diseases.'

Based on common humanitarian values and principles, the UN System[12], International Organizations, INGOs specialized on humanitarian issues (e.g. Action Against Hunger (AAH), OXFAM, Medicins Sans Frontieres (MSF), and the International Federation of Red Cross and Red Crescent Societeies (IFRC) amongst others) and civil society organizations (CSO) have developed, emergency after emergency, a package of 'disaster response tools'[13] to provide lifesaving services when local infrastructures are damaged, temporarily out of use or insufficient to cope with clean water needs. The rational behind is always to mitigate, 'the spread of waterborne pathogens is of particular concern during population displacements (due to war, famine, or natural disaster), major floods, and faecal-oral disease outbreaks.' (Ali and Kadir, 2016, p.10). As WHO (2012, p. 4) stated 'household water treatment and safe storage inteventions (HWTS) is a proven intervention to improve drinking-water quality and reduce diarrhoeal disease'. This is confirmed by J.Rayner et al., (2016, p.7) who indicates the effectiveness of HWT to remove bacteorological contamination, which is confirmed also by the ELRHA (2019, pp. 26-42) report, which indcates that there is a common agreement that without adequate access to safe water, infectious diseases including hepatitis E, cholera and other diarrhoeal diseases can easely cause the loss of life. In addition, a huge number of HWT technologies, whether physical (e.g. boiling, solar disinfection, UV irradiation, plain sedimentation, filtration and aeration) or through the use of chemicals (e.g. coagulation-flocculation, chemical precipitation, ion exchange, chlorination, ozonation, iodination, or silver/cooper contact treatment), equipment and humanitarian standards (e.g. WHO Drinking Water Guidelines and Sphere Standards) have been developed to ensure adequate access to clean water for the populations affected by disasters or man-made hazards.

In addition to this, investments on innovative equipment (ELRHA, 2019) have been done by private-public sector and new theoretical approaches have been developed by relief organisations as minimum basic standards required to cope with the lack of clean water supply in emergencies. Nevetherless, the question of, whether it is more effective to supply bulk clean water at the point of production or invest humanitarian efforts to ensure clean water supply at the Point of Use (PoU) continue to preoccupy the practitioners and is perceived as an issue which needs further research.

[12] Definition of UN System: the *"The United Nations System consists of the United Nations, its subsidiary organs (including the separately-administered funds and programs), the specialized agencies, and affiliated organizations."* Available at: https://en.wikipedia.org/wiki/United_Nations_System.

[13] For the purpose of the research the term "disaster response tools" make reference to the set of guidelines, technical notes, coordination mechanisms, tools and strategies developed by the humanitarian community and the private sector to alleviate the suffering of populations affected by natural or man-made hazards.

1.2. STATING OF THE PROBLEM

TOPIC.

HWTSS technical tools, guidelines and norms are available for humanitarian practitioners and organisations to be used in emergencies. Darcy et al. (2013 cited in Yates, T., 2017) and Parkinson (2009 cited in yates, T., 2017) argued for their limited impact and the lack of effectiveness of WASH interventions, specially HWTSS related ones, in large and medium scale disasters around the globe. However, there is also evidence that these interventions contributed with a certain degree of success to prevent and mitigate the spreading of water borne diseases by promoting good water management at household level (Clasen, T. And Lantagne, D. , 2012, pp. 11358-11359) In emergency context, the humanitarian community has to take quick decisions, and adopt what they consider the most efficient HWTSS, eventhough often possible practitioners lack of an adequate understanding of the local context barriers, including previous solutions that have been successfully implemented in the targeted area, the availability of the products in local markets or the acceptance by the community of the HWTSS solutions proposed.

PROBLEM RESEARCH.

Despite the fact that HWTSS interventions are well known as one of the possible options to reduce water borne diseases burden during a given disaster,

> 'This systematic literature review found a dearth of high quality evidence for the effectiveness of WASH interventions to address public health outcomes in humanitarian crises. While evidence exists on the effectiveness of WASH interventions in relation to water quality or other WASH indicators, there remain significant gaps in knowledge with regards to the impact of WASH in interventions in relation to health outcomes in humanitarian crises.' [14]

Some of the reasons found in the literature review are that organisations put essentially the focus on ensuring the delivery of adequate water treatment at the source and/or at the point of distribution and less attention is usually paid to what occurs at the point of consumption (PoU). Then, monitoring tools and approaches to collect and analyse reliable information about water supply related impact on population's health are not always integrated as part of the emergency response. Even the nature of the data collected is mostly related to the number of litres produced and/or distributed respectful of water quality international standards during a given emergency. It is indeed difficult, for example, to find valuable data on healths' impact or establishing causal relationships amongst factors influencing water supply interventions. There are less evidence for HWTSS treatment approaches as these interventions are not usually privileged by the humanitarian organisations or they are

[14] Ramesh, A. et al., 2015.

implemented combine with other water supply interventions, then their effectiveness is more complex to measure. In addition, it seems that the humanitarian commnity have to face regularly the same problems when implementing HWT programs on the ground (Ali et al. 2016, pp. 22-24).[15]

JUSTIFICATION.

Characteristics of HWTSS interventions are strongly related to behaviour change. Effectivity is highly influenced by previous knowledge on HWTSS of the populations affected by a given disaster and the existing hygiene promotion practices at houshold level. Most of the time the scope of the disaster does not allow for an holistic and deepen analysis of the whole supply water chain. In addition, financial ressources required to address emergency needs are limited. Then, relief organisations have to prioritize interventions based on cost-effectiveness criteria. Furthermore, it is usual that relief organisations repoduce the same apporaches that were useful in other emergencies, independently of the context, or without considering important local drivers. This is specially dramatic for HWTSS interventions which are usually higlhy influenced by external factors, often quite difficult to control by relief organisations, if preparedness activities has not been done and adequate information has not been previously collected in order to adopt the right decisions.

Some of the problems identified might be difficult to solve by the organisations themselves and demand huge investments, nevertheless there are other elements that might be clarified through a more systematic and clear FoA allowing WASH practitioners, emergency managers and organisations to identify which are the key factors to successfully implement HWTSS operations in emergencies. HWTSS activities implemented could be easely improved if relief organizations build on local cumulated experiencies in disaster areas. To achieve these goals it becomes relevant to respond some questions such as when, why and how could be more effective to use water supply interventions at the PoU; or what would be the factors of success to be integrated by relief organisations, specially RC/RC ERU as part of the decisión making process when deciding to deliver HA through HWTSS interventions.

[15] Emergency WASH gap analysis conducted by Ali, S.I and Kadir, K. raised issues on community participation and empowerment of vulnerable groups (M&E) from the beginning of the interventions (2nd position) and HWTSS cost, sustainability and water quality (11th position)

PURPOSE OF THE STUDY.

The purpose of the research is to question whether the use of a RC/RC ERU [16] approach could be appropriate to implement HWTSS interventions in emergencies. If the findings are positive, we will assert what would be the more suitable 'FoA' for an effective deployment of RC/RC HWTSS ERU. We will briefly explore which modules can be included as part of the 'pre-packaged' appoach and later, based on the information and lessons learned gathered from ERU's teams, which could be an hypothetical sequence of activities to be implemented during a given disaster. To achieve this objective, this research collects and analyses not only the existing HWTSS information related to the cumulated RC/RC experiences when deploying their ERU but also draw from opinions, articles, good practices, lessons learned from emergency and water and sanitation practitioners on the field.

This research will consider that the RC/RC ERU approach in emergencies is not only a reflection of the main challenges and constraints that relief organisations face when deploying human resources and equipment, but also RC/RC ERU approach can contribute to show the limits and great advantages existing when implementing an homogeneous package of activities to provide basic water services to the population affected by disasters.

The RC/RC internal reports [17] indicate that HWTSS methods have not been yet fully integrated as part of the ERU disaster response tools available. This means that one of the main challenges of the HWTSS is to define how to set up an effective design and operational process that maintains the 'hallmarks of ERU identity' (e.g. standardized equipment, rapid deployment, self-sufficiency and well-trained technical specialists). In addition to this, the design of a FoA is required, defining the adequacy and the pertinence of developing a HWTSS module as a new tool to the existing RC/RC ERU disaster response tools already available at the IFRC. In order to feed the debate and contribute to future HWTSS interventions under the RC/RC ERU deployment approach, the researcher contacted ERU members and confirmed some of the opportunities that offer the research for the development of a future HWTSS Module. These opportunities have been summarized as follows:

(a) Show more evidence about the added value of developing a HWTSS ERU as part of the response mechanisms of the RC/RC;

[16] These units consist in *'[…] a team of trained technical specialists, ready to be deployed at short notice, which uses pre-packed sets of standardized equipment. RC/RC ERU are designed to be self-sufficient for one month and can operate for up to four months. RC/RC ERU were created in 1994 to give immediate support to NSin disaster-affected countries. They provide specific support or direct services when local facilities are either destroyed, overwhelmed by need, or do not exist.'* [16] Ifrc.org. (2019). *Emergency Response Units (RC/RC ERU) - IFRC*. [online] Available at: https://www.ifrc.org/es/introduccion/disaster-management/-respondiendo-a-desastres-/disaster-response-system/dr-tools-and-systems/eru/ [Accessed 08 January 2019].

[17] HWTSS in Emergencies 22032019_sma oscar.docx IFRC, 2016; WASH Working Group. Spanish Red Cross, Madrid, 2017)

(b) Contribute through the collection and anaylisis of valuable information, in developing a clear 'FoA' indicating the main principle and guidelines under which a future RC/RC HWTSS ERU could be deployed, for the delivery of adequate clean water at household level in man-made and natural disasters;

(c) Identify which are the key elements to be considered into the decision-making process for an effective deployment of the future RC/RC HWTSS ERU (e.g. scale of the disaster, level of damage, access to treated or untreated water sources, previous HWTSS knowledge in the affected area, access to population, risk of epidemies);

(d*)* Map out HWTSS technologies, items/devices from different perspectives: availability, performance characteristics, simplicity of use, costs, recognized effectiveness in the field, availability of the products at household level and at community level;

(e) Suggest monitoring and evaluation indicators associated to the activities, outputs, outcomes proposed and the impact of the HWTSS activities on the ground when deployed.

Points **(d); (b)** and **(e)** were specially highlighted by the RC/RC members interviewed as being critical. Due to time constraints, the research focuses on the points **(a), (b)** and **(c)** while points **(d)** and **(e)** are only partially covered and would require further research. Bearing in mind the information mentioned above and the fact that HWTSS interventions can lead to significant improvements to supply clean water in emergency contexts (Clasen et al., 2007, pp. 599-600; Fewtrell et al., 2005, pp. 42-52), apparent that there is a need to explore the potential gains of improving the capacities of the ERU to assist populations that couldn't be assisted through the traditional operational deployments which consists essentially in installing a centralized water supply system and the production of massive water.

The research has essentially focused on the development of a 'FoA' [18] for the effective deployment of a future HWTSS module in case of natural disaster as well as the analysis of different HWT options available on the market that could be potentially included as part of the future emergency 'pre-packaged tool kit'.

Initially the research was limited to the emergency interventions implemented by humanitarian actors up to the first month of a given emergency. Nevertheless, after reviewing the existing literature, it has been realised that most of the documents made reference to the whole cycle of the emergency response, the researcher judged pertinent to extent the period

[18] Framework for action: It means the development of a set of ideas, rules, good practices or proceedings providing adequate guidance to successfully implement a program, project or activity on a given matter.

of analysis up to three months[19]. This is particularly interesting when it comes to water supply interventions in emergencies, as sustainability factors must seriously be considered by implementing adequate exit strategies. Mostly, the research focus has been put on large-scale natural disasters, which demands the intervention of international organisations, prior to the authoritation of local authorities. The research use examples of humanitarian programs in which HWTSS emergency programs or activities have been partially implemented or played an important role as part of the emergency response (tsunami: Indian ocean (2004), earthquake: Haiti (2010); Earthquake Nepal (2015); population movement: Bangladesh (2017)). It is important to mention that, in most of the case studies used, HWTSS activities were implemented in parallel to other water supply interventions. Cumulated experiences on small-scale disasters have been likewise considered only if there are evidences of good practices that allow scaling up future interventions such as floods in Pakistan (2010). Emergency situations caused by man-made hazards has been as well considered only when there was relevant information to better inform the final research results, as it was the case for the Cox's Bazar emergency in Bangladesh (2017)[20] or the response to the mixed migration flows for Venezuelan refugees and migrants (2019).

1.3. OBJECTIVES AND RESEARCH QUESTIONS.

The researcher considered the following questions as central to know more about the driving factors leading to a successful implementation of HWTSS operations in emergency settings. Research questions have been formulated to better identify which are the enabling conditions under which it could be more effective to invest on implementing HWTSS interventions. The research questions proposed have been designed as well to collect information on the type of items/devices which might be included as part of the HWTSS pre-packaged' tools [21].

Research Question 1: Which are the enabling factors allowing the effectiveness of HWT and Safe Storage in "emergencies" for the humanitarian organisations? To have a more comprenhensive understanding of the enabling factors the research made other enquiries such as **(a)** Which are relevant differences between HWTSS in emergencies and development approach; **(b)** Why it is necessary to promote HWTSS in emergencies (e.g. provide clean water at the point of source versus clean water at the point of use)? **(c)** Which are the factors prompting a successful HWTSS humanitarian

[19] RC/RC RC/RC ERU are usually deployed three months into the area affected by the disaster.
[20] REACH (2018)
[21] Definition of prepackaged tools: It is a set of technical solutions consist of human resources, equipment & supplies and knowledge ready to be deployed on the field to alleviate the suffering of the populations affected by disasters and provide humanitarian solutions aiming to increase the access to basic needs such as clean water, sanitation, shelter. (Oscar LLorente, 2018)

intervention (e.g. local markets, previous knowledge and practices, training activities, awareness practices); **(d)** Which are the challenges/lessons learned faced by humanitarian actors to implement HWTSS programs in emergencies? (i.e. type of disaster, scale of the natural disaster, risk of epidemy, infrastructures, access to population); **(e)** Which are the approach privileged by humanitarian organisations to set up and run HWTSS programs in emergencies (e.g. prepositioning stocks at high risk prone areas, direct purchase and transport of HWTSS equipment's; local supply; deployment of technical specialists, direct intervention within the communities affected; externalization to other community based organisations existing in the affected area)?

Research Question 2: What are key elements to be considered for the effective deployment of the HWTSS RC/RC ERU system? Emergency water and sanitation practitioners and organisations participating into the research will be as well asked about **(a)** What should be the composition of RC/RC ERU teams to fulfil its mission?; **(b)** What should be used to monitor the effectiveness of HWTSS interventions in the field?; **(c)** What are the existing standards and guidelines to run HWTSS interventions? Which are the water treatment solutions deemed by humanitarian organisations to provide clean water at household level that might be included as part of the IFRCs HWTSS module?; **(d)** What are the HWTSS pre-packaged technologies available on the market?; **(e)** What are the most cost-effective HWTSS methods in terms of availability, easy to use, recognized effectiveness on the field (water quality), cost and acceptability of the beneficiaries? **(f)** Are there other 'items/devices' required to run the RC/RC HWTSS ERU activities in the field?

TARGET AUDIENCE

This research suggests a range of operational tools and recommendations for humanitarian workers and organizations to help them into the decision-making process in order to better assess when and how HWTSS interventions have an added value. Moreover, research findings on HWTSS interventions in emergencies will hopefully contribute to feed the discussion on how to improve future RC/RC operations on HWTSS using the ERU's deployment modality.

2. LITERATURE AND SITUATIONAL REVIEW.

Chapter 2 explores the available information on the literature review with regard to the role and impact of HWTSS programs in emergencies. Chapter 2 offer an overall overview of the lessons learned gathered by the relief organisations. This is particularly important as it offers a global understanding of the main topics such as relevance, effectiveness and the limits of HWTSS interventions through the analysis of different field experiences, research reports and documents. In addition to this, the literature review takes a closer look to water treatment technologies and define the advantages, disadvantages, strengths and opportunities for the setting up of HWTSS interventions in emergencies. Finally, Chapter 2 will provide a brief description of the operational modalities, guidelines and existing technologies available on the markets aiming to supply clean water at household level in emergencies.

2.1. ROLE OF HWTSS IN EMERGENCIES.

Based on the literature review, most of the water supply interventions implemented by humanitarian organisations, whatever the scale of the disaster, integrates a water treatment component at the source, at the point of delivery to the beneficiaries or at the final point of consumption. Despite the fact that there is an important number of HWT related documents available at specialized networks (CAWST[22], Elrha, HWT Network), little evidence has been generated by relief organizations with regard to the impact generated and the lessons learned of this type of operations on the ground.

Furthermore, there are many technical documents, guidelines and academical articles about how to treat and supply clean water at the point of delivery. HWT technologies and equipments are, in general, well described but there is less relevant documents about how INGOs operate HWTSS equipment delivered at the PoU. The evidence from the studies suggests that water contamination risks linked to a bad use and safe storage of clean water supplied lead to lose potential gains on public health and render useless the efforts deployed by relief organisations to supply clean water. A recent report from Elrha (2019, pp. 28-30) stood out that practitioners facing the implementation of HWTSS 'often lack the technical, contextual or experience-based information to help them select and implement these products or technologies. Current or historical knowledge of the implementation of solutions in specific regions prior to an emergency is also limited.' The literature review higlights all these factors as some of the bottlenecks to gain efficiency in achieving the ultimate goal of saving lives and reducing water borned diseases at household level in disasters.

[22] CAWST refers to an interactive online knowledge database that gives water practitioners access to information on contextually appropriate point-of-use water treatment technologies and their effectiveness. This platform is practitioners focused and solve problems oriented. This platform has a global reach across 107 countries, with over 500 users accessing it monthly (Elrha, 2019). Available at: https://www.elrha.org/wp-content/uploads/2019/01/HIF-WASH-innovation-catalogue-WEB_9.5MB.pdf [Accessed 9 May 2019].

It is also an evidence that 'the availability, quality and condition of water source and surrounding region will differ immensely from event to event making it impracticable to provide a one for all solution' (Steele, A. and Clarke B., 2008, p. 483). Thus, relief organisations with an unequivocal vocation to deliver water services in emergency context are in need to work on developing effective preparedness strategies that allows them to offer the broadest possible range of water supply solutions, including HWTSS strategies. This has been confirmed by Ali and Kadir (2016) who suggest that there is no a 'one-size-fits-all solution' due to the scope and the humanitarian consequences of the disasters. As a result, the range of water supply interventions, including HWTSS options should be adapted to the different levels of acuity. Bearing this in mind, some solutions implemented during the acute phase of a given emergency could not be considered as acceptable by the same users in the stabilization phase some weeks later.

The primary role of HWTSS inerventions in emergencies, has been directly associated to mitigating water health risks related issues and public health outcomes. Nevertheless, HWTSS is only one of the multiple options available when planning water supply interventions in emergencies. Reports consulted mention that most of the time HWTSS interventions are implemented jointly with other water supply activities and rarely they are implemented in an isolated manner. In general, water treatment technologies, included under the umbrela of HWTSS interventions, are not advantageous enough to supply massive quantity of water in medium to large scale disasters[23] while there is little evidence about HWTSS programs implemented in small scale disasters. Besides the fact that 'the tresholds between these different forms of hardship and disasters have been poorly defined' [24], HWTSS methods and practices deserve to be considered to provide an interim measure for removing bacterias, viruses and protozoos under circumstances in which it is not possible to deliver water supply by other means (water tracking, centralized water supply systems, bottled water).

However, despite the difficulties to compare HWTSS interventions under different contexts, the literature review suggests that HWTSS can be more effective when beneficiaries populations **a)** are concentrated in a small area; **b)** the scale of the disaster is moderate or low; **c)** relief, organisations have an easy access to populations and equipment and materials

[23] UNDRR defines small-scale disaster as a type of disaster only affecting local communities which require assistance beyond the affected community and large-scale disaster as a type of disaster affecting a society which requires national or international assistance. According to CRED definition large scale disasters means 10 or more people reported killed and/or 100 people reported affected and/or a call for international assistance. Thresholds for small scalle disasters is not fixed but we can mentioned some characteristics such as smaller figures in terms of deachts and costs, do not create attention at international or national level to donors,numerically less impact and associated with mal-development (Shrestha and Gaillard, 2019).

[24] Shrestha, S. and Gaillard, J., 2013.

are available at local markets; **d)** markets are not totally disrupted and **e)** there is not major security and logistics problems.

In addition to this, the literature review suggests that HWTSS can play an important role in providing clean water whether populations affected by the disaster are scattered, relief organisations have difficulties to transport heavy equipment because of logistics or security issues and other alternatives to provide clean water are not viable (e.g. centralized water supply system, water tracking, treatment at the point of source through water treatment plants, or others). Bearing in mind this, the literature review indicates that HWTSS interventions can be included amongst the alternatives to supply clean water at household level. This alternative can be particularly useful for vulnerable households having access to water of poor quality that cannot be easily accessed through water tankering, the deployment of water treatment plants or the quick rehabilitation of infrastructures.

Engler et al. (2013 cited in Bastable and Russell, 2013, p.15) have supported that HWTSS have high levels of efficacy in laboratory trials while their field effectiveness levels have generally been reported much lower due to challenges with incomplete compliance or more simple because of the fact that HWTSS interventions were not sufficient familiar for the people affected by the disaster (Travis Yates et al, 2017, p.17). It is significant that the quality of evidence was low and limited to only a small portion of interventions, primarily focused on HWTSS.

With regard to the nature of emergency HWTSS interventions, they are typically short-term and often unsustainable without significant external funding support and enabling external conditions (i.e. supply chain, previous knowledge, acceptability). Moreover, most of the reports consulted indicated that HWTSS interventions has been implemented in contexts where affected populations had sufficient access to water but water quality did not meet mínimum standards. The literature review also highlighted how HWTSS interventions are highly dependent on beneficiary understanding and use of distributed water treatment equipment.

2.2. ADVANTAGES AND DISADVANTAGES OF USING HWTSS APPROACHES.

Water supply is considered as one of the main priorities of assistance when a disaster strikes. The literature review suggested that HWTSS interventions implemented are among the most efficacious WASH interventions (Yates, T et al. 2017, pp 18-23) and challenging Bastable and Russell (2013, pp.16-17)

> 'Evidence that WASH interventions reduce the disease burden in an emergency is limited, but is seen through disease risk and reduced transmission risk.'

However, there is not enough evidence to state the effectiveness of HWTSS interventions compare to other water supply intervention because of the wide range of variables influencing these interventions at each disaster as found by Schmidt and Cairncross (2009, cited in Bastable and Russell, 2013, p.15) in their meta-analysis. This position is not completly shared among researches such as Yates (2017, p.23), Wilner (2017, pp-63-64) or more recently Clasen (2015) who suggests a 'positive impact' in developing context or during the acute phase in emergencies (Lantagne, D et Clasen, T, 2012, pag 11352). According to the Guidelines for Drinking Water published by WHO providing safe water to drink is a key element to increase well being and improve public health in emergencies. Evidence suggests that HWTSS can improve household the quality of household water consumed and reduce diarrheal diseases in emergency and development context [25]. A general review of the literature indicates that HWTSS must be seriously considered as a priority to supply clean water, specially when the population affected is scattered and living in isolated areas that might be difficult to reach by relief organisations. Second, when damages to water infrastructures are serious and conditions are not met to implement other WASH interventions (water tracking, water treatment at the source, bottle water supply, repair pipelines) to re-establish normal supply of water to the populations affected. Indeed, the population affected by the disaster has to get access to water sources in the aftermath of the disaster even if water sources are potentially polluted. Moreover, HWTSS should be prioritized if there is a serious risk of spreading water borne diseases, as is often the case in people displaced by conflict, which are usually concentrated in high numbers in small area to seek protection and have limited access to minimum water sources or adequate sanitation. In addtion, HWTSS interventions were reported in the literature review as an effective water emergency response to tackle:

- Flooding events or natural disasters (cyclone, typhone, earthquacke) that lead to displacement;
- Complex emergency settings (such as Haiti) when relief did not always progress to development programs;
- Outbreaks caused by untreated drinking water, especially cholera outbreaks;
- Literature review indicated as well that HWTSS might also be especially effective during the 'acute phase' of an emergency when responders couldn't yet reach the affected population with longer-term solutions.

[25] Lantagne, D. and Clasen, T., 2013.

Other advantages and disadvantages are summarized below:

Box 1. Potential advantages and disadvantages of HWTSS interventions in emergencies.

ADVANTAGES	DISADVANTAGES
(A) HWTSS interventions are flexible, modular and adapted to the humanitarian needs detected on the ground.	(A) HWTSS can be costly depending on the needs, the enabling conditions and the modality of deployment retained by the relief organization for the intervention.
(B) Are relatively easy to operationalize whether the relief organization has specialized, experienced and well trained staff to supply clean water.	(B) HWTSS demands important investments on preparedness activities, meaning rapid assessment of the previous knowledge in the prone disaster areas, training specialized staff, knowing market capacities, availability of the water technology selected on the market and trials to assess acceptance.
(C) Effective if there is a clear framework of action and a set of pre-packaged activities ready to be implemented on the ground.	(C) Activities require an intensive investment on labour force for training and monitoring activities if we want to ensure adequate impact and avoid recontamination of water at household level.
(D) HWTSS interventions have the capacity to complete other water supply interventions and measure water quality at the point of consumption (PoUW).	(D) Lack of adherence and acceptance is a high risk in this type of interventions.
(E) Covering water supply when there is no possibility to make functional a centralized supply system and population affected have access to unsafe water supply sources for the population.	(E) Lack of coordination on key messages disseminated to the affected population as well as lack of homogeneous water treatment technologies selected can lead to lose potential gains on public health.
(F) Adequate to cover scattered/dispersed populations and households with special needs.	(F) It can increase dependency of the beneficiaries from the technology proposed.
(G) The use of cash on HWTSS interventions can contribute to boost local markets and improving adherence to the solution proposed.	(G) HWTSS relief distributions might be an issue.
(H) HWTSS allows to work on water safety plans and reduce potential recontamination of water supplied at household level.	(H) HWTSS interventions demands a comprehensive monitoring and evaluation (M&E) strategy.
(I) Improving water quality undertaken at the household level and keeping people healthy by removing organisms like germs and parasites that usually cause diseases, and suspended particles like dirt which make the water look and taste bad.	(I) Use of HWTSS products distributed may be an issue if beneficiaries are not adequately trained.
(J) HWTSS also deserve to be considered highly cost-effective and it might be rapidly deployed and taken up by vulnerable populations if enabling conditions (logistics, access to water sources) are met.	(J) Control of chemicals used to treat water.
(K) HWTSS is among the most effective interventions to mitigate the risk of spread of water borne diseases and must be considered by relief practitioners as a powerful tool to complete other WASH interventions (bulk water distribution, water bottle distribution, etc…), provided that the setting up of HWTSS might be adequately monitored by the relief organisation.	

Source: Author-based on responses from WASH practitioners and emergency managers.

Despite the apparent benefits of implementing HWTSS methods in such circumstances, the question that reamined to be answered was to what extent relief organisations, particularly RC/RC ERU system, were prepared to invest in it. Writtings consulted, dealing with this particular subject, did not provide a definitive answer to this question. From an operational persepective, HWTSS interventions are reflected into the literatura as only another option available amongst many that can be performed by relief organisations to supply clean water. HWTSS interventions might be useful to fill water supply intervention gaps and/or provide immediate access to safe clean water while more sustainable solutions are carried out. In fact, HWTSS were the best suited option to non-acute emergencies in which population was dispersed, did not have access to safe water sources and there was a high diarrhoea prevalence among the population affected by the disaster.

Operationally speaking, HWTSS interventions brought water treatment closer to the end user, limiting the opportunities for recontamination but, also placed the burden of water treatment on vulnerable individuals (Bastable and Russell, 2013, p. 19). Logistically speaking HWTSS demanded more investment on software activities, specially through awareness, sensitization and monitoring related activities to ensure a high impact of the activity. This will compel the organisation to recruit skillful labor force ressources in order to set up these activities on the ground. These ressources might be difficult to find or do not necessarily have the skills required to pass messages adequately. If this is the case, the organisation will have to develop strong training materials and invest on training specialized people to replicate the trainings on the ground. However, impact of awareness activities was not as evident as it can be easily jeopardize because of the lack of adequate coordination mechanisms between the organizations working on the ground, the lack of clearness due to contradictory messages disseminated to the affected population and the disorder generated by the distribution of non identical techonologies among the affected population.

2.3. OPERATIONAL STANDARDS, GUIDELINES AND PRINCIPLES.

First responders in any emergency are community-based and local organizations, Government agencies and last but not least relief organisations. Central Governments may also request external support from regional partners and/or the international humanitarian system. While national legal systems are the main regulatory frameworks for protecting disaster-affected people, provision of international HA is guided by the UN General Assembly resolution 46/182 (1991) ‘Strengthening of the coordination of humanitarian emergency assistance of the United Nations’. The resolution provides the framework for emergency relief oganisations and informs the work of the humanitarian system today. It lays out 12 guiding principles for humanitarian action. Subsequent UN General Assembly resolutions on

strengthening the coordination of emergency HA have reinforced General Assembly resolution 46/182 and expanded the core humanitarian principles to also include operational independence.

Binding and non-binding international humanitarian and human rights law also regulates humanitarian action. The 1949 Geneva Conventions and the Additional Protocols adopted in 1977 and 2005 establish the principles of international humanitarian law, which regulates the conduct of armed conflict and seeks to limit its effects. The Geneva Conventions have been ratified by 196 States and are universally applicable.
With regard to the agency responsible for the surveillance of drinking water supply services is different at each country. In some countries, it is the Ministry of Health (or public health) and their regional or departmental offices. In others, it is the environmental protection agency or the environmental health departments who has this responsibility. These agencies usually provide a framework with targets, standards and legislation to enable and require suppliers to meet their obligations.

In case of disaster, Governmet priorities will be rapidely shifted to cover the most immediate needs, and control mechanisms applying for normal situations can be less strict. However, first responders have to be in compliance with the minimum national requirements and proceedings compulsory of each country. Agencies who are involved in providing water for consumption by any means should be required to ensure and verify that the HWTSS approach or water supply systems proposed are capable of delivering safe water and that they routinely achieve their goal. The World Health Organisation (WHO) has developed a comprehnensive methodology and guideline packgage to test and certify a perfomant HWTSS (WHO, 2016). In other countries, such as the Colombia, Government has approved a specific regulatory framework for the use of HWTSS devices.

Regarding the existing guidance frameworks on HWTSS we can mention that the information available mainly refers to the setting up of HWTSS in developing contexts. Most of the information found refers to guidance, manuals and frameworks, which focus primarily on long-term development operations and settings. Some of these concepts and indicators may also apply to emergency situations such as acceptability, water quality, affordability and sustainability of the interventions. Nevertheless, others such as the selection of most appropriate technologies, or the setting up of hygiene promotion and monitoring tools might be slightly different because of the quantity of water for the population affected by the disaster, the availability of supplies at local markets, their acceptability, the efforts requested to promote the technology or logistics difficulties inherent to the emergency situation (Clasen

et al, 2006, p.195-198). Below, we will mention some of the documents, which contain elements that can be consulted to better inform an action framework when implementing HWTSS in emergencies. Most of them are reported as well by people surveyed.

- Existing and emergencing global humanitarian standards, which includes the Humanitarian Charter and Minimum Standards in Disaster Response (Sphere Standards, 2018), and the WHO A toolkit for monitoring and evaluating HWT and safe storage programmes, and the Water Safety Plans (WSP) or UNHCR manuals, which set up minimum standards to provide water supply to people affected by disasters;
- Existing norms and policies approved by local authorities with regard to the provision of HWTSS services existing local regulations with regard to the selection and setting up of HWT technologies;
- Guidelines provided through academic, research or specialised networks on the matters such as WEDC, or existing HWTS Networks;
- Internal guidelines available at each emergency organisation;
- International humanitarian principles derived from international humanitarian law and described in General Assembly resolutions, meant to be applied in all humanitarian action. And the ‘do not harm approach’ principle.

In addition to what was aforementionned before, the following principles has been considered particularly relevant for increasing the efficiency of HWTSS at grasp level:

- No distribution of HWTSS items/treatment methods or equipment without training;
- No implementation of HWTSS activities without adequate monitoring protocols established;
- Including the existing previous experiences on HWTSS when identifying technical options and/or building the bridge with local practices;
- Boosting community engagement;
- No HWTSS without including a solid ‘theory of change’ coupled with hygiene education activities;
- No HWTSS without adequate water management safety plans to avoid recontamination of water at household level;
- No communication without harmonization of key messages with other relief organisations through the coordination of mechanisms established for the emergency response at global/local level.

2.4. HOUSEHOLD WATER SUPPLY AND WATER QUALITY TECHNOLOGIES.

Disruption of reliable water supplies in an emergency means that there is a need for supply from other alternative sources, which might potentially be contaminated. Therefore water from these sources have to be tested in order to identify the most appropriate water treatment solution. Information gathered on PoUWT options frequently includes reduction in turbidity, disinfection, and sterilization which often requires chemicals and other Non –Food Item (NFIs) to ensure that beneficiaries can get access to safe water. In general, HWT methods has to be supplied at the PoU and be accompanied, in most cases, by a strong training programme and awareness campaign to ensure their correct implementation. In addition, the selection of appropriate PoUWT options relies on the results obtained from rapid needs assessments that evaluate, amongst others, local context, the scope of the emergency, health risks, previous knowledge and behaviour practices and the technical principles applying for HWT.

Literature consulted makes reference to the WHO Guidelines for Drinking Water Quality, as the principal text providing a comprehensive framework to address drinking water quality and efficiency for HWTSS methods. Nevetheless there are other documents of reference for humanitarian practitioners that establish mínimum quality standards required to supply clean water [26].

The literature review strongly evidences that water management and safe practices activities should be included as part of the operational approach to mitigate health risks and avoid a deterioration of the water quality at the PoU (Bastable and Russell, 2013, p.12) whatever the water treatment method selected. Most of the water supply documents reviewed through the research indicates that most of the intervention strategies in emergencies included some type of sensitization or awareness activities at household level, even when those activities did not fall under the specific category of HWTSS specific programs.

The literature review identifies three areas in which innovative technologies and approaches have been developed and put at the service of HWTSS interventions. Three areas are: **a)** HWT equipment; **b)** Safe storage items; **c)** Monitoring tools to measure adequately water quality. While HWT and water quality related technologies have been well developed into the literature review, the research found more difficulties to get access to reliable information on technologies applied to improve safe storage at household level.

[26] Sphere Handbook 2018, Chapter Water supply, Sanitation and hygiene promotion, pp. 90-112.
WEDC. Loughborough University. Dissertation Research: MSc Infrastructures in Emergencies (2019)

7 essentials methods has been identified to treat water at the point of consumption. One or a combination of these methods are generally included as part of the response mechanisms deployed by the INGOS for ensuring a safe access to clean water. Main options identified are: **a)** Sedimentation; **b)** Coagulants and disinfectants; **c)** Ceramic candle style water filters; **d)** Ceramic pot style filters; **e)** Biosand filters; **f)** Boiling; **g)** Solar disinfection (SODIS).

Research identified as well a wide range of products specially manufactured to supply clean water in emergencies or able to be rapidely installed at the point of use by the populations affected. Nevetheless, the research found that the existing offer for water safe storage products on the markets was more reduced. Regarding this last point, there has not been substantial innovations in the last years. Stakeholders and markets put their efforts in determining the most appropriate method in supplying clean water while forgetting develop products able to minimise post delivery water contamination at the point of use or the final consumption. Lessons learned pointed out the importance of maintaining the integrity of the water chain by ensuring adequate safe collection and storage of the water previously distributed.

The third element focuses on the technologies available to measure water quality parameters at household level. Control of water quality parameters and monitoring strategies are critical when planning a water supply intervention. The literature review indicates that one of the main challenges faced by relief organisations implementing HWTSS interventions consisted in how to ensure adequate collection and analysis of water quality parameters. As mentioned previously, the possible gain in avoiding the spreading of water borne diseases thanks to HWTSS interventions, can be rapidely be jeopardized because of bad water treatment or management-practices at the point of use or a poor design of water quality testing activities. Early detection of risks to the quality of the water is therefore critical to take quick decisions and make investments on activities more efficient. Consequently, having a realiable method to control and check regularly water quality at household level can be essential not only to ensure access to safe water by the affected populations but also to better plan and make more cost effectiveness water supply interventions.

Literature review recommended that the relief oranisations establish before a comprehensive plan of water quality monitoring in order to ensuring safe access to drinking water at household level. Through the attentive reading of the documents, some of them adapted to the humanitarian contexts, several tools were identified to monitor water quality parameters

(i.e. Aquagenx Compartment Bag Test (CBT); Portable Water Testing Kit OXFAM-DELAGUA, VIRWA[27])

2.5. GENERAL APPROACH & DEPLOYMENT MODALITIES.

Regarding HWTSS interventions, the research did not intend to offer a detailed analysis of the underlying causes that motivated a humanitarian organisation to intervene in emergency context, but it will briefly explain what were the common interests, expectations and deployment modalities co-existing in the 'humanitarian arena'. Even when these intervention modalities are well known by humanitarian practitioners, it is considered important to describe them in order to better inform the development of a useful FoA for the RC/RC ERU. The literature review consulted identified four principal actors participating into the 'humanitarian areana' in the aftermath of a disaster. In a humanitarian context, these actors usually provides assistance to a country when governments make appeals to both official and unofficial cooperation actors, who, upon request, finances and delegates functions according to their proposed action plan to implement, in this case WASH activities, in an articulated and coordinated manner. These actors can be categorized as: **a)** Governmental authorities; **b)** Organisations of the civil society (CSO); **c)** INGO's*;* **d)** Local communities; **e)** Private sector; **f)** Multilateral entitites (organisations belonging to the United Nations System); and **g)** Bilateral organisations (donors, development/emergency agencies, Embassies)

Deployment modalities identified are not homogeneous amongst the relief organisations intervining in disasters or areas affected by chronic crisis. Based on the internal reports and lessons learned of documents analysed, each humanitarian organisation has developed its own strategy of intervention according to several variables such as: **a)** Previous presence and expertise working in the affected country; **b)** Trust and appropriateness of relationships with local autorities, local institutions and communities; **c)** Human, financial and logistics resources available in the area of intervention; **d)** Capacity to mobilize resources to set up médium long term development programs; **e)** Technical capacities to set up perfomant systems to provide safe drinking water; **f)** Relationships with bilateral ad multilateral cooperation institutions.

Despite the fact that most of the humanitarian organisations motivate their interventions based on the humanitarian needs gathered and the vulnerability criteria, it is not less true that the scope of incentives to intervine in a given crisis varies significantly from one organisation to another, and other factors may be considered in the decision decisión making

[27] It is a three step process for testing water samples and detect the presence of viruses at the point of use. See **ELRHA, 2019.** *Water, Sanitation and hygiene Innovation Catalogue: A collection of Innovations for the Humanitarian Sector.* Available from: https://www.elrha.org/wp-content/uploads/2019/01/HIF-WASH-innovation-catalogue-WEB_9.5MB.pdf [Accessed 9 May 2019]. WEDC. Loughborough University. Dissertation Research: MSc Infrastructures in Emergencies (2019)

process such as political interest, donor driven intervenitons, strategic opportunities or positionning of organisations or products in the 'humanitarian arena' [28].

It is also well known that intervention modalities implemented by relief organisations usually depend, amongst other factors, on the relationships established among each one of the actors pretending to intervine at the 'theatre of operations'. Each organisation will then consider its capacity to influence the 'humanitarian arena"', its legitimacy to enforce the application of standards and rules, its capacity to coordinate interventions, or simply its ability to influence the decision making process and the final decisions adopted to respond to the crisis. Crossing these elements with the humanitarian architecture and the modalities of intervention implemented in emergencies the research identified the following actors as the most relevant:

- **Organisations belonging to the UN System:** These organisations are characterized by a recognised technical expertise and a solid experience working in humanitarian crisis. They have good communication channels and the possibility to influence the political decision making process and provide qualified advice. Organizations belonging to this group have clear mandates to coordinate and harmonize operations on the ground. Furthermore, these entities are able to mobilize resources rapidely. Nevertheless, these organisations can be affected by other political interest beyond its mandate or its humanitarian principles. They are highly influenced by the political environment and aid delivery decisions can be highly politicized. Last but not least, administrative proceedings are usually burdensome, jeopardazing efficiency and legitimacy to act in some contexts might be compromised. They can directly implement projects/programs but they usually base their interventions on local actors or INGOs through specific fundings tools (e.g. CERF [29]).

- **International Non Governamental Organsiations:** This category of organisations has developed a recognised expertise working with vulnerable groups in such difficult emergency contexts. These organisations are flexible and adapt their internal proceedings to attend population affected by disasters and humanitarian crisis. They usually develop strong work networks and relationships with Governmental authorities, local organisations and members of the civil society. The organisations falling under this category own specialised equipment, and their personal has sufficient technical

[28] Hilhorst, Dorothea & Jansen, Bram. (2010). Humanitarian Space as Arena: A Perspective on the Everyday Politics of Aid. Development and Change. 41. 1117 - 1139. 10.1111/j.1467-7660.2010.01673. x. "'Humanitarian space' denotes the physical or symbolic space which humanitarian agents need to deliver their services. according to the principles they uphold. This concept, which separates humanitarian action from its politicized environment, is widely used in policy documents and academic texts, even though empirical evidence abounds that this space is in fact highly politicized."

[29] Meaning Central emergency Response Fund aiming to implement humanitarian projects aiming to reduce loss of life an enhance a timely and accurate response in underfunded crisis or man made disasters. Available at: https://cerf.un.org. [Accessed 10 Januray 2019].

background to provide HA in emergencies. These organisations have a good knowledge of the humanitarian space and dispose regular access to funding which allows them to intervine immediately or on a short term in the affected areas. They have enough access to the areas affected and well-informed knowledge of the communities in which they will intervene. Nevertheless, its capacity to influence and participate into the decision making process is much more limited than the previous one. Indeed, their capacity to build a solid relationships with the local authorities can be influenced by variables such as the historic of previous interventions in the country or the demand and offer of humanitarian services. This category is composed of a wide range of oganisations with presence in worldwide more important crisis.

- **National NGOs and OSC:** These organisations have a good knowledge of the communities affected by the disaster or the humanitarian crisis. They have the capacity to mobilize rapidely community leaders and easely advocate to remove barriers to HA at local level. Nevertheless, these organisations usually lack of adequate expertise or financial resources to operate under emergency context. They have a huge knowledge about coping and mitigation strategies at local level, they can build strong relationships at local level but usually their capacity and access to influence the global arena is more limited.

- **RC/RC:** It is an-International network, composed of 190 NSoperating worldwide and whose aim is to alleviate the suffering of populations affected by disasters or humanitarian crisis according to the following principles: humanity, impartiality, neutrality, voluntary service, independence, universality. RC/RC have the great advantage of being recognised as an organisation 'auxiliary to the local authorities' [30] . Their legal status is part of the legal foundation of every NS and it is part of the domestic law of each country. Auxiliary status allows not only to have a privileged position and access to the decision making process through regular contacts with the Government but also agree on common responsabilities and activities. As a consequence, RC/RC have a great capacity to rapidly mobilize human and financial ressources. In addition, they have a deep understanding of the communities affected by the disaster due to its regular contact with all the actors of the humanitarian arena and its special contact with local autorities at all levels. This network is usually requested by Governments to implement humanitarian activities. In summary, RC/RC is in a privileged position to work through a holistical

[30] Auxiliary role means that the Red Cross and Red Crescent Societies take advantage of a position that provides them a privileged space for dialogue and partnershp with public authorities in order to enhance that the humanitarian space and activities designed can be implemented more effective and efficient.
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approach, as the RC/RC will remain long after the consequences of the disaster disappeared.

- **Donors:** Non official or official actors that engage financial and human ressources to support humanitarian interventions and alleviate the suffering of populations affected by disasters or other humanitarian crisis. Their influence and participation into the design and decision making process of the HA has increased in the last decade [31]. They have a privileged communication channel with local authorities and INGOs. They are accountable for an efficient use of the official funding committed for a given emergency. Then donors will be driven by cost-efficiency, coordination, accountability, visibility and impact of the interventions funded.

- **Local auhtorities:** Official actors who apply for international assistance in case they are overwhelmed by the scope of the disaster and/or chronic crisis and they cannot face the consequences in the short-mid term period to alleviate the suffering of the affected populations. Their main interest consists in coordinating HA to avoid burden; ensure adequate compliance of humanitarian interventions with local rules and norms. Most of the times local authorities will be interested in taking advantage of the HA for other non-humanitarian purposes or simply to give a low profile to the humanitarian aid received. They have the capacity to enforce rules and norms and provide technical alignment according to the expertise of each institution.

- **Communities affected:** They are usully described as the first responders. They have a good knowledge of their environment and the capacities available at local level to respond in the aftermath of a given disaster. In case of chronic crisis they have already developed coping mechanisms to alleviate their suffering. Their capacity to influence decision making process will depend whether the community is well organised and the relationships with their local leaders. They usually lack of financial ressources but human ressources can be easely mobilized for especific activities. Their main interest is to improve access to basic services and ensure activities proposed ‘do no harm’ to the communitarian dynamics in emergency context.

According to these capacities, motivation and the role-played by each organisation in the humanitarian arena, three main approaches were identified:

- **1st category:** Organisations who have the decision level and operational structures outside the country affected by disaster and/or chronic crisis. These organisations rely on

[31] Joanna Macrae, Sarah Collinson et al., 2002, pp.33-36.

local structures and build on local capacities, expertise, relationships and knowledge of the local “humanitarian arena” to deliver HA.

- **2nd category:** Local organisations and/or networks who rely on their strong knowledge of the local humanitarian context and strong relationships at the community level, to set up amongst other, basic HA. These organisations have scarce ressources, usually obtained at local level to set up among other, water supply activities in the aftermath of a given disaster or a chronic crisis. These organisations can build strong partnerships with bigger local organisations and/or other INGOs to scale up water supply interventions.
- **3rd category:** Organisations who are specilised in providing specific HA independently according to its mandate and humanitarian principles. These organisations plan their interventions to respond to a specific immediate basic need. Their interventions are characterized by carrying out ‘in/out’ interventions or providing support to other organisations, by sharing expertise and ressources with them. They organizations can be federated or part of an extensive worldwide network.

In more details, the first category refers to those organizations who have sufficient structure in terms of logistics, human ressources, and expertise in the area of intervention, but are usually overwhelmed by the scope of the disaster/humanitarian crisis and receives additional support from their headquarters or a hierarchical superior entity to deliver ‘ad hoc’ HA. These organisations can count on a ‘pool’ of specialists that might be deployed shortly at the theatre of operations. Operational and logistic capacities vary enormously among them but they have a catalogue of equipment able to be rapidely mobilized on the field. This equipment is almost standard among each organisation. These organisations usually deploy specialised personal on the field to support other human ressources and organisational structures who are already working in the affected area.

Organizations belonging to the second category are characterized for having less access to financial and logistical ressources. But these organisations count on a good acceptance from the affected communities and have a deep understanding of the dynamics, behaviour practices and relationships established at community level. These organizations has a good capacity to mobilize massive human resources as well as a pivileged channel to advocate and influence the decision-making process at community level. These organizations have the capacity to build strong parternerships with INGOs and/or other bigger local organisations that have an interest in getting an easy and rapid access to the affected areas and scale up operations. If it is the case, INGOs will bring technical and financial support to these organisations.

Last but not least, the third category identified, is characterized by their independence and acting according to their own humanitarian principles. These organizations have developed strong proceedings and accumulate sufficient expertise to do in/out interventions or ensure permanent presence in long standing humanitarian crisis. These organizations have developed strong logistic capacities, human resources and they are able to mobilize rapidly sufficient funding to provide immediate assistance. These organizations have built global partnership strategic relationships with other INGOs and have a solid advocacy structure. Organizations are highly specialised and able to be deployed in the field in a shortest time to tackle the consequences of a given humanitarian crisis.

The RC/RC are in between the second and third category. They are part of a bigger network, named International Federation of RC/RC Societies (IFRC), aiming to mutualise ressources, knowledge and experience to respond in case of emergency, which in my opinion, can be considered as belonging to the third category and an asset to implement HWTSS interventions in emergencies.

CHAPTER 3. METHODOLOGY.

Chapter 3 presents the research process from the design to the setting up and analysis of the data collected. It also describes each stage of the research, which includes the methodology, the selection of target groups participating into the research and the process of data collection and analysis. Finally, it explores the limitations and challenges faced during the two research and data collection process.

3.1. STUDY DESIGN / SETTING.

This research was guided by two research questions mentioned below:

a) What are the enabling factors allowing the effectiveness of HWTSS in 'emergencies' for the humanitarian organisations?

b) Which are the key elements to be considered for the effective deployment of the HWTSS RC/RC ERU system?

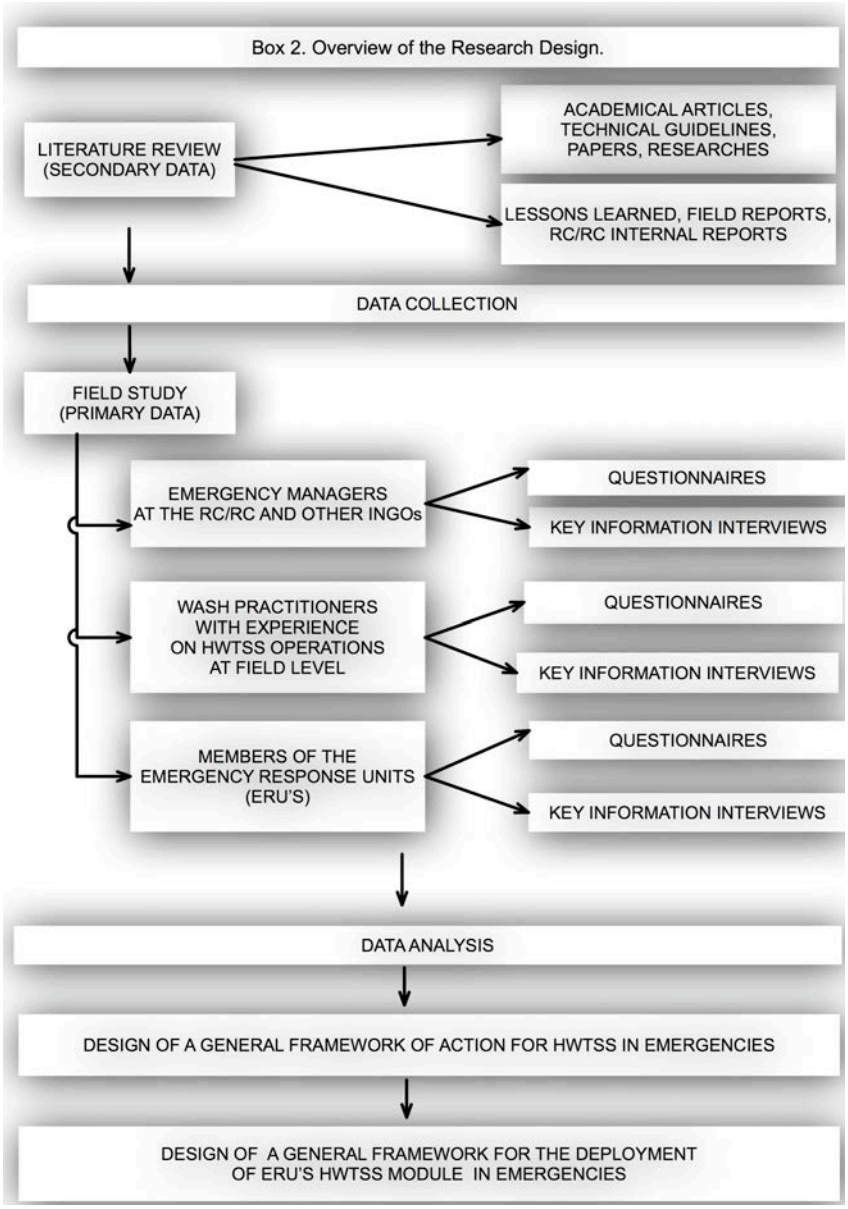
In orther to satisfy the objectives of the dissertation research, a mixed approach was adopted. It was considered that the mixed method selected allowed for the triangulation of information and in further elaborating and better illustrating challenges and enabiling factors on the topic. This method was also retained because it allowed the researcher to collect and analyse more comprehensive data (statistics, testimonies, numbers, reports). On the one hand, the mixed method enables the researcher to answer research questions of different nature and allows interverviewees to base their answers on experieces instead of percpetions. The mixed method adopted also allowed comparing findings in the literature review with the results obtained from qualitative and quantitative methods in order to better support suggestions and recommandations with strong evidence. Qualitative data allows the researcher to provide a description of the experiences of wash practitioners and emergency managers participating in the research, whose insights and opinions will be confronted to the theoretical assumptions found in the literature review. Qualitative information allowed a better understanding of the challenges but also key factors leading to emergency managers and wash practitioners to take decisions when setting up HWTSS. Furthermore, the quantitative method used allow supporting the conclusions made with statistics, percentages and numerical data, in the hope that the mixed method selected lead to more accurate results and reliable set of data to answer each of the research questions.

RESEARCH STAGES.

This research has been divided in two stages. The first stage consists on a review of the articles, journals and documents related to previous HWT interventions and the existing practices implemented by the humanitarian organisations in disaster response 'emergencies' context. More than 33 documents were consulted. Some of them are a systematic review of previous HWTSS interventions in emergencies, others describe HWTSS interventions in specific contexts or provide guidance and technical recommendations for the setting up of HWTSS interventions in general or specific areas of knowledge (monitoring, water quality control, equipment). Documents analysed have mainly focused on water supply emergency interventions in case of natural disasters (e.g. floods, hurricanes, earthquakes) with some insights in other types of emergencies (conflict and social tensions). The literature review has given an overall overview of the adequacy and pertinence and effectiveness of HWTSS in emergencies as well as pre-identified which are the enabling factors of success.

To complete previous the literature review, the researcher also collected information on the existing 'emergency response pre-packaged' approaches available to provide clean water in emergencies as well as the intervention policies proposed by the humanitarian organisations. Information was collected through existing secondary data wich includes the review of studies or surveys, activity and project reports, notes to the file and lessons learned.

The second phase of the research consisted on the development of the HWTSS Module for the RC/RC ERU. Therefore, research will focus on: **a)** Developing a 'FoA' for the deployment of RC/RC ERU HWTSS tools; **b)** Identifying which are the most adequate existing water treatment solutions, items and devices to provide clean water at household level which might be included into the HWTSS tool kit; **c)** Giving recommendations on the enabling actors to ensure the success of the RC/RC ERU HWTSS deployments on the ground.



3.2. DATA COLLECTION ANALYSIS & LIMITATIONS.

DATA COLLECTION.

When conducting research many types of data collection tools and sampling are possible. In the case of our research privileged secondary data collection, questionnaies and personal interviews. Furthermore, the researcher was formally included in the ERU working group created on an 'ad hoc' basis by the Spanish Red Cross (SRC) to improve HWTSS interventions in emergencies. Professionals participating in the research where selected because they have a significant cumulated experience on water supply interventions in emergencies and/or managing emergency operations. The research aimed not only to capture the cumulated experience from participants on the ground, but also to identify what

they considered as the main drivers ensuring a HWTSS successful program implementation. In order to satisfy the objectives of the dissertation four tools were preconised:

- **Collection and analyse of internal reports and field experiences from humanitarian organisations** on HWTSS projects in emergencies, with a special focus on RC/RC ERU interventions.

  Table 1. Internal reports review on HWTSS.

DESCRIPTION	DATE
RC/RC Swedish Red Cross Bangladesh (Cox's Bazar) Populations Movements.	Report, 2018
REACH, Bangaldesh (Cox's Bazar) Populations Movements.	Report, 2018
Acceptability, Effectiveness, and Fouling of Household Membrane Filters. Distributed in South Sudan.	Report, 2018
IFRC database on ERU Deployments (1996-2019).	Internal report, 2018
Workshop Household Water Treatment and Safe Storage.	November 2017
RC/RC-Spanish Red Cross ERU Bulletins (M15)	Internal report, 2017
RC-RC Spanish Red Cross Household Water Treatment and Safe Storage Survey.	Internal report, 2017
RC/RC-IFRC Nepal Earthquake	Report, 2016
RC/RC-Spanish Red Cross ERU Bulletins (M15)	Internal report, 2016
RC/RC- Philippine Red Cross Internal report Typhoon HAIYAN	Report, 2105
RC/RC Evaluacion de algunos sistemas de tratamiento domiciliaro y almacenamiento seguro (HWTS) (M15).	Internal report, 2015

- **Documentary review on HWTSS:** Advanced search tools have been used to initiate the search. Keywords and phrases were entered into the database field browse of Google Scholar, Library Catalogue Plus, and WEDC Resource Centre. Results were screened according to relevance on the topic, quality of the information and expertise of the source of information. Then searches were refined to better answer questions defined by the researcher for each key component of the topic such as ‘HWT’ and/or ‘disaster’ and/or ‘emergencies’ and/or ’safe water storage in emergencies’ and/or ‘HWT technologies’ (see Chapter 2). In addition, the researcher consulted specialised websites [32] with relevant information to have an overall view of the HWTSS and better informed a FoA.

[32] Websites consulted were HWTSS related such as CAWST, ELRHA, Engineering for Change, WHO, HWTSS Global Network. WEDC. Loughborough University. Dissertation Research: MSc Infrastructures in Emergencies (2019)

Table 2. Documentary review on HWTSS.

Source of information	Search strategy	Justification of approach
Library Catalogue Plus	Advanced search tool has been used to initiate the search. Keywords and phrases were entered into the field browse. Results were screened according to relevance on the topic, quality of the information and expertise of the source of information. Then searches were refined to better answer questions defined by the researcher for each key component of the topic such as ***"household water treatment"*** and/or ***"disaster"*** *and/or* ***"emergencies"*** and/or ***"safe water storage in emergencies"*** and/or ***"household water treatment technologies"***	Using keywords the aim was to find articles and journals that matches with each component of the topic searched. Relevant articles/journals were found analysing water supply resonse provided by humanitarian organisations in emergencies. Articles found are relevant and useful to fix some of the research questions defined into the research such as which is the effectiveness of HWTS in emergencies? when and how intervine? which are the critical elements to consider to make HWTS interventions success?
Google/Google scholar	This tool has provided a huge quantity of information touching all the sub-topics designed for the search such as ***"household water treatment technologies"***, ***"water supply in emergencies"***, ***"impact of HWTS interventions to prevent diarreal disease"***. However further analysis is required to screen documents and sifting for relevance.	The matching of search phrases within google scholar *(e.g.'household water treatment in emergencies; 'water supply and diasters' or 'household water treatment technologies')* enabled the researcher to have a first an easy oversight on the topic. Google Search Academic tool was used as an starting point of the search. For further information scientific databases and academic ressources centres were consulted (e.g.Library Catalogue Plus)
Bibliographies	Looking at the list of references and citations other researchers have used, contributed to find relevant information on the topic.	List of references were explored, relevant references screened and articles searched on databases. The research has paid a special attention to the lessons learned and conclusions raised by emergency responders in severe disasters such as the earthquackes in Haiti or the tsunami occured in the Indian Ocean in 2004. It has also identified existing systematic reviews on water treatment in emergencies (Ali, S.I. and Kadir, K., 2016.). Research alowed amongst other to collect information on gaps and weaknesses related to water and sanitation operations in emergencies (Bastable, A. and Russell, L., 2013.)
Personal contacts	I have established a preliminary list of wash proffessionals, NGOs and UN agencies with relevant experience on the topic of research *(e.g. UNICEF, IFRC, OCHA, OXFAM, SPANISH RED CROSS.*	After collecting general information on the topic, the search will move to stablish contacts with key stakeholders and humanitarian practitioners working on HWTS on the ground. Data was collected through personal interviews and questionnaires. In addition, several organisations shared internal reports, guidelines (i.e.OXFAM, IFRC) and relevant documents for the study.
WEDC Ressource Centre	I could get relevant information from Loughborough University Institutional Repository using key words such as 'household water treatment' or 'water supply' or 'water suppy in emergencies' or combining the search by author or by title. Then I move to WEDC Knowledge database. A large quantity of articles, journals, factsheets and guidelines are available into the database. Research sorted a sort of articles available on the collection dedicated to water and sanitation. I refine the search by title and keywords. Articles found on the database were very useful for the purpose of the research. I focused on recent articles and material answering to "research questions", specially the ones dealing with the topic in developing countries.	I have used tools provided through the WEDC Learning module to have an overview about the existing material related to the topic that can be found on the databases. Loughbororough University Institutional Repository (https://dspace.lboro.ac.uk) did not provide valuable information. On the contrary, WEDC Knowledge (https://wedc.lboro.ac.uk/knowledge/know.html) database was interesting to get access to manuals, guideliines or comparative studies in developing countries. Material found was related to health care waste as well as solid waste. I refine the search to get more accurate information.
Agencies Websites	A preliminary research list on websites has been elaborated and some documents of interest have been selected via consulting specialised in Water Supply networks such as CAWST, HWTSS Global Network, WHO, UNICEF and Red Cross & Red Crescent Movement websites.	Key insitutions were selected according to their cumulated and recognised experience on the subject. First, WHO were consulted because this institution provides technical guidance and advice on health care waste management worldwide (books and technical specifications are regularly published by the WHO). Second, International Committee of Red Cross (ICRC) and the International Federation of Red Cross were consulted because of their cumulated experience supporting health structures in low developing countries or failed states.

- **Questionnaires:** Questionnaires were developed and distributed to key stakeholders working on HWTSS related issues such as RC/RC NS and NGOs with relevant experience on the field. Questionnaires were distributed at headquarter level to emergency managers and individually to practitioners at field level. Key institutions were selected according to their cumulated and recognised experience on the subject of emergency interventions in man-made and natural disasters situation, as well as their financial, technical and human resources capacities. Research received 43 valid responses among wash practitioners and emergency managers of which 4,65% belong to specialised bodies and/or research institutions, another 4,65 % of the responses belong to donors; 16,28% belong to UN System organisations and finally 74,42% belongs to International Non Gouvernamental Organisations. Among these last ones 47% of the responses received are from the RC/RC Societies and 53% correspond to other relief organisations.

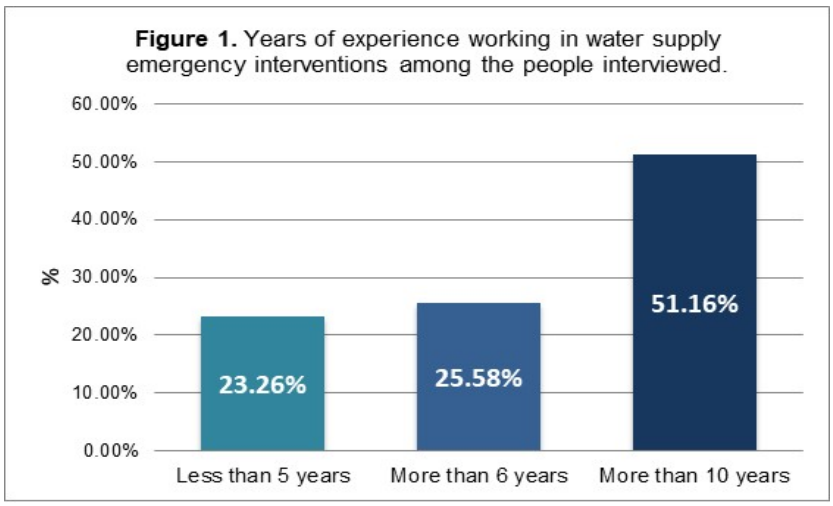


Figure 1. Years of experience working in water supply emergency interventions among the people interviewed.

Source: Author-based on responses from WASH practitioners and emergency managers.

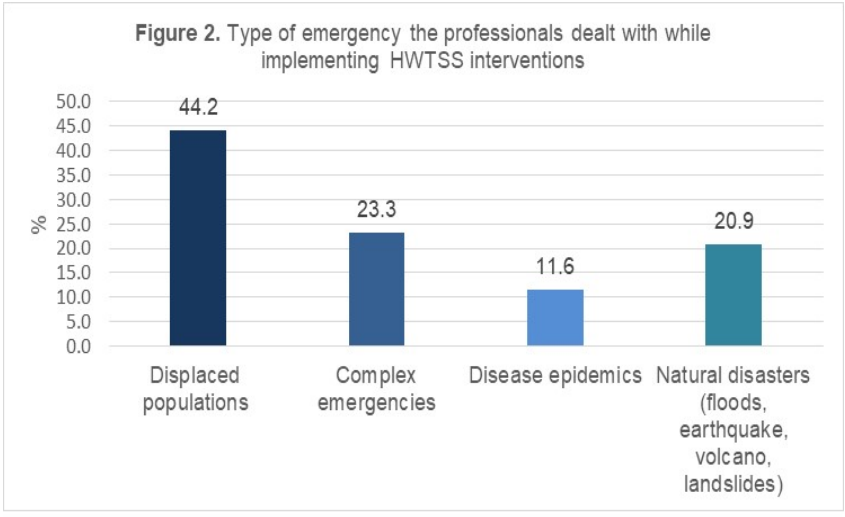


Figure 2. Type of emergency the professionals dealt with while implementing HWTSS interventions

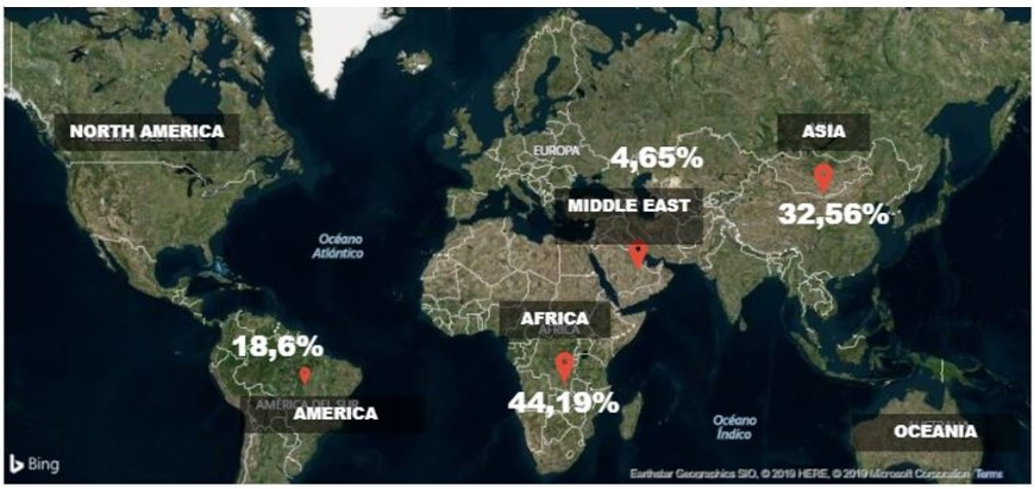
Source: Author-based on responses from WASH practitioners and emergency managers.

67.3% of respondents to the survey were in positions of responsibility as coordinators of water programmes, while 30% indicated that they were currently working as project managers. 2,3% highlighted that they worked as freelance/consultant on water related issues in emergencies. 76% of the people surveyed stated that they had more than 6 years of experience managing emergency programs, and among them 51% more than 10 years. Only 23.26% of the people surveyed stated that they had less than five years of experience managing water supply programmes in emergencies.

People interviewed managed water supply, including household water supply interventions, in Africa (4.19%), Asia (32,56%), America (18,6%) and Middle East (4,65%). Population interviewed work mainly providing humanitarian water services to displaced populations (44.2%), victims of complex emergencies (23.3) or population affected by natural disasters (20.9%) or health emergencies (11.6%). The type of emergency in which the interviewees worked implementing domestic water treatment programs is homogeneous. 37.21% of those interviewed responded that they participated in all the phases of the emergency response cycle, 27% participated only in the acute phase of the emergency (first two weeks), 25.58% worked in during the stabilization phase, and 4.65% provided humanitarian services during the transition and planning and design phase respectively.

- ***Personal interviews:*** Personal structured and semi-structured interviews were of technical members of the RC/RC RC/RC ERU, specialised entities, researchers as well as to the responsible of NGOS and practitioners with relevant field experience participating on clean water supply operations in emergency contexts. Interviews were oriented to answer research questions (see Chapter 1 above). A total of 8 interviews were carried out. A part of the interviews was conducted during the ERU refresh training held in September 2018 in Madrid.

Figure 3. Geographical location of HWTSS operations amongst the people interviewed.



Source: Author-based on responses from WASH practitioners and emergency managers.

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DATA ANALYSIS

The development and use of a general framework of analysis helped to identify the elements and relationships that could potentially be considered in setting up HWTSS interventions in emergencies. The elements contained into the framework analysis gets ispiration from the Institutional Analysis and Development Framework (IAD)[33] elaborated by Elinor Ostrom (2011). This approach was very useful to identify the structural variables, incentives and barriers that are present when implementing HWTSS activities in emergencies. Finally, this approach allows to better inform decision-making process to be used to decide setting up of HWTSS interventions and deployment of 'pre packaged' solutions and/or Emergency Response Units (ERU). First, the research identifies 'external variables' which cannot be controled by emergency practitioners; second the research identifies an 'action arena' which corresponds to the necessity to cover basic water supply needs in the aftermath of a man made or natural disaster. The research assumes that decisions taken by humanitarian practitioners will be based on the way in which emergency and water and sanitation practitioners use their knowledge and information to take decisions; and finally, the availability of resources the organisations brings to the 'humanitarian arena' composed of drivers and rules used by the community to adopt final decisions.

LIMITATIONS

Despite the abundant information about HWTSS technologies, water quality guidelines or safety plans to manage water at houshold level, one of the main challenges of this study was that there is little to not well documented experience on HWTSS interventions and even less on HWTSS interventions implemented under an ERU deployment approach.

ETHICAL CONSIDERATIONS

Project methodology presented involves the collection of information from professionals participating into the surveys and people interviewed through personal interviews. The research took adequate steps to respect dignity, protect data and ensure voluntary participation of the professionals into the study. Participants were informed in writing about the purpose of the research, the reason why they were selected to participate into the survey or the personal interviews and the confidentiality and anonymity of the results.

[33] Ostrom, E., 2011.

4. DISCUSSIONS OF STUDY FINDINGS AND RESULTS

Chapter 4 has been divided in two sections. In Section 1 the research introduces the characteristics, limits and general principles of HWTSS methods in emergencies and presents the results of the study findings, which have been considered of relevance to respond to the research questions. Discussions and study findings will be useful to later develop basic principles leading to the elaboration of a comprenhensive 'FoA' for HWT programs in emergencies, which could be applied to the RC/RC ERU modular system. In this first section, the researcher presents the results of the primary and secondary data gathered from surveys, personal interviews and literature review responding to the research questions formulated in Chapter 1. In Section 2**,** the research introduces the concept of ERU and applies the recommendations of the study findings to propose more detailed ooperational proceedings and endow the 'FoA' with relevant content for practitioners and ERU members.

4.1. FRAMEWORK OF ACTION FOR EMERGENCY RESPONSE UNITS (ERU)

4.1.1. DEFINITION AND CHARACTERISTICS OF HWT AND SAFE STORAGE (DEVELOPMENT VS EMERGENCIES)

The literature review suggests that HWTSS interventions are radically different depending on the context in which the organization is working on. Drivers influencing the decision-making process, timeframes and operation set up can be subjected to different challenges, constraints but also opportunities, depending on the context in which INGOs, local organisations or other stakeholders evolve. As a consequence, implementing contexts to supply safe water at household level may vary greatly. Some of the characteristics describing each one of the contexts have been summarized on the lines below:

- **Emergencies:** Chaotic, unpredictable, spatially and temporally variable, dynamic, requires impartiality, independency and quick decision-making process, challenge logistically, short funding cycles, extreme environments, aiming to saving lives and alleviate the suffering of the populations affected by the disaster.

- **Development:** Predictable, stable, enabling institutional environment to work with Governments, building capacities and consolidate state policies, aiming to getting people out of poverty and solve structural problems, more long funding cycles, long decision-making processes.

In emergencies, according to the literature review, one of the characteristics of HWTSS interventions is that these interventions are very sensitive to the nature of the disaster, whatever the disaster might be (man-made or hazardous disaster), and the coping

mechanisms to supply clean water existing on the ground. Thus, HWT interventions are significantly influenced by previous knowledge on water access and the acceptance by the affected communities of the solutions proposed by relief organisations. In addition to the pevious ones, other elements have to be considered when planning emergency response activities such as the scope, the level of destruction, the geographical area affected, the risks linked to population's public health, and the existing capacities of the community affected to recover of the disaster and restore normal life. Even the effectiveness of HWTSS interventions in emergencies will be highly influenced by the contextual analysis of the demand and the existing offer for HWT products and, later by how each relief organization engage with the receptor communities and incorporates the previous knowledge existing in the targeted area to their humanitarian response.

These differences raise questions about the generalizability of some of the principles applying for HWTSS interventions in development compare to the ones implemented by relief organisations in emergency contexts. It is therefore important, that relief organizations be prepared, contextual analysis advanced and equipment prepositioned to provide a quick and effective response when water supply services in emergencies are needed because of the fact that time of reactiveness is considerably shortened, and life threats are higher working in emergency contexts.

From this point of view, it is important to highlight that working in emergency contexts means that populations are heavily exposed to stressful situations, higher crude mortality rates and likelihood of outbreaks because of a moderate or severe disruption into the normal fonctionning of basic services for a given society. But is not less true that emergency contexts have also the capacity to attract more funding from donors because of the increasing risks associated to the spreading of water borne diseases. Under emergency contexts, expectations, in terms of effectiveness and the achievement of quick and tangible results in the short term, are also much greater. The relief organisations have an obligation to deliver the best possible services in the shortest possible time to alleviate the suffering of those affected by the emergency, regardless of the cause of the emergency situation. Contrary to what usually happens in development contexts, under emergency context time matters and reactiveness it is a key factor to save lives.

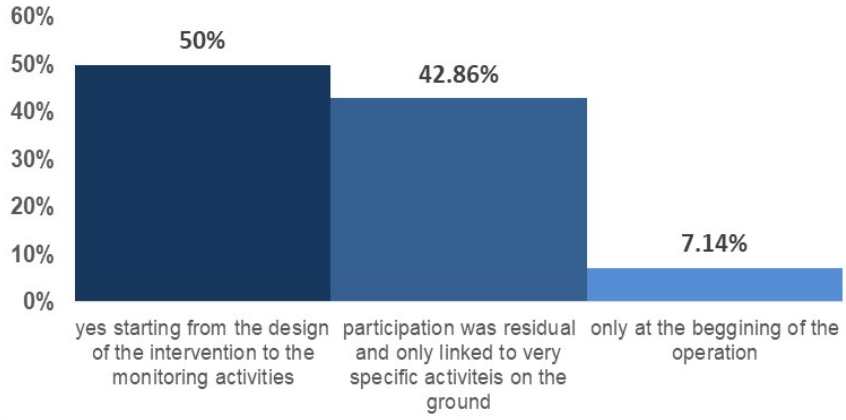
HWT activities implemented in development context have enough time to be socialized with communities and then be aligned with the priorities selected and the reglamentary framework approved by local authorities. On the contrary, timeframe for the projects implemented in emergency contexts, is extremely shortened and INGOs, local organisations and/or

institutions tend towards intervening through pre-packaged and/or modeled solutions using cumulated experience in other emergencies.

A great advantage of HWT projects implemented in development context consists in boosting the ownership through a sustainable participation of the community into the whole project cycle. This approach allows testing the adequacy of HWT technologies selected, and later adapting water supply interventions to the context when necessary. Furthermore, HWT activities implemented under developing contexts allows compliance with local regulatory framework and analyzing of the sustainability and acceptability of the proposed technical solution on the medium and long term. Timeframe makes it easier to harmonize technology, processes, technical requirements as well as enforce regulations for the adequate use of domestic water treatment systems and advice for a clear FoA to boost behavioural change. Lessons learned from HWT operations in development context, such as community engagement and participation can be successfully applied to emergency contexts.

This is aligned with the fact that 50% of the people interviewed mentioned that community participation was residual and only linked to very specific activities on the ground (42.86%) or only at the beginning of the humanitarian operation (7.14%). Data suggests that relief organisations find difficulties including community participation during the whole project cycle. This can be one of the underlying causes which reduces efficiency of HWT projects in the field.

Figure 4. Overview of the community participation when planning HWTSS design interventions.

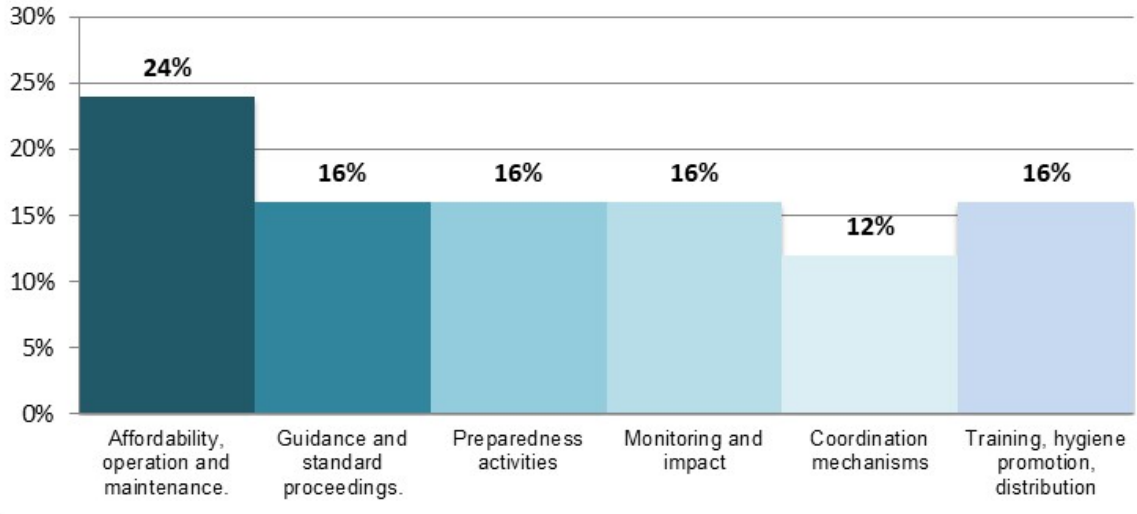


Source: Author-based on responses from WASH practitioners and emergency managers.

Some of the factors mentioned above are usually more flexible such as water quality criteria when applied in emergency context, others will find more difficulty such as the harmonization of HWT methods or the dissemination of hygiene promotion messages among relief organisations in the aftermath the disaster strikes.

As an example, people interviewed highlighted the following areas of interest for improving HWTSS interventions in emergencies: **a)** further research on improving technical HWTSS solutions available (affordable, friendly use, maintenance) and availability in local markets (24%); **b)** Developping guidance, standard proceedings and specialised teams to deliver quality HWTSS services (16%); **c)** Investing on preparedness activities at community level (16%); **d)** Monitoring activites to measure impact of HWTSS (16%); **e)** Training, hygiene promotion and distribution (16%) and **f)** Strenghtenning coordination mechanisms with stakeholders when implementing HWTSS interventions (12%) This data shows that despite the fact that most of ING Os apply the same water treatment products [34] and great effort has been made to standardize intervention protocols, it is not less true that these efforts can be hindered because of a lack of coordination and harmonization among HWT technologies or by the delivery of contradictory hygiene promotion messages by relief organisations acting in the humanitarian arena.

Figure 5. Areas in need of further research for HWTSS in emergencies..



Source: Author-based on responses from WASH practitioners and emergency managers.

Data from the research shows that 21.26 % of the domestic water treatment activities carried out in emergencies were in large-scale disasters compared to only 3,94% per cent of the answers received that highlighted that HWT solutions were applied in medium or small-scale disasters. Around 14.96% of the respondents indicated that HWT interventions were implemented in rural or hard-to-reach areas to meet population's humanitarian needs (9.45%). Regarding the nature of the disaster, the responses are also homogeneous. According to the data collected 7.87% of the emergency interventions were carried out in rapid onset disaster context while a similar percentage, 7.87% were implemented in slow

[34] **World Health Organisation. (2016)** Results of Round I of the WHO International Scheme to Evaluate HWT Technologies. Available at http://apps.who.int/iris/bitstream/10665/204284/1/9789241509947_eng.pdf [Accessed 03 January. 2018].
WEDC. Loughborough University. Dissertation Research: MSc Infrastructures in Emergencies (2019)

onset disaster context. Finally, 7.09% of the HWT activities were carried out in very populated settlements while 5.51% were carried out in dispersed/scattered settlements.

Considering the specificities of implementing 'HWT interventions' in emergency contexts, it thus seems necessary to explore what are the limits of these inteventions in previous emergencies in order to understand what the potential gain of could be defining an alternative role.

Table 3. Characteristics of the disasters when planning HWTSS interventions in emergencies	**%**
Large scale disaster (affect large geographic areas and have a major impact on people and infrastructure and requires national international assistance)	21.26
Interventions occurred in a rural area	14.96
Difficulties to reach populations in need of humanitarian assistance	9.45
Rapid onset disaster	7.87
Slow onset disaster	7.87
Dense settlements	7.09
Chronic crisis	5.51
Easy access to populations in need of humanitarian assistance	5.51
Occurred in an urban area	5.51
Dispersed/scattered settlements	5.51
Medium scale disasters	3.94
Infrequent disaster	3.15
Frequent disaster	2.36

Source: Author-based on responses from WASH practitioners and emergency managers.

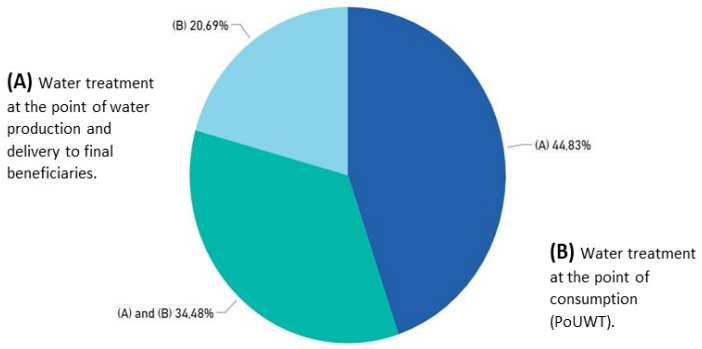
4.1.2. LIMITS OF HWTSS INTERVENTIONS IN EMERGENCIES.

The delivery of HWT services has become one of the possible interventions used by humanitarian practitioners in emergencies to improve the quality of the water supplied. Nevertheless, there is not a common agreement on health effectiveness of HWTSS methods used under recovery and development contexts (e.g. Fewtrell et al., 2005, pp. 42-52; Clansen et al., 2007, pp. 599-600; vs Schmidt and Cairncross, 2009, pp. 986-992) and even less evidence of HWTSS effectiveness in emergencies. Recent studies (Elrha, 2019) have confirmed this statement. Many of the products delivered performed adequately in lab but less so in emergency contexts. The evidence from these studies suggest a variety of factors such as the difficulties to isolate the variables causing real improvements on health, or the fact that there are usually multiple water supply activities implemented in paralel by different organisations and with different approaches, which makes cause and effect relationships more difficutl to establish. In addition to this, there is limited evidence about how beneficiaries

are using the products delivered and how the products performed at each stage of the emergency cycle.

Data from people interviewed shows that organizations put a higher focus on water treatment at the point of water production and delivery to the final beneficiaries, indeed, 44,83% of the total responses, compare to 20.69% of the responders highlighted that the biggest focus was put at the point of consumption (PoUWT). 34.48% of the people interviewed highlighted that water supply interventions mixed both approaches. 55.17% of the organizations implement HWT solutions at any stage of the emergency. This is quite significant as it shows the relevance of using HWT methods for organisations and practitioners in emergencies.

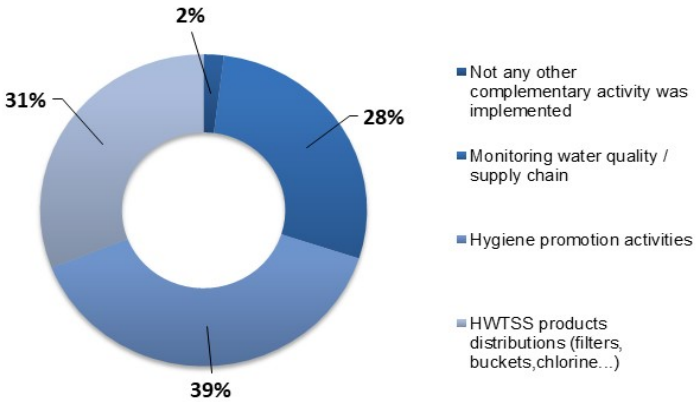
Figure 6. Overall approach adopted by relief organisations when supplying clean water in emergencies.



Source: Author-based on responses from WASH practitioners and emergency managers.

In relation to the question whether the organizations had accompanied the domestic water treatment activities with any other activity aiming to mitigate the risk of contamination and thus improve the impact of the intervention, only 28% mentioned the adoption of specifi measures to monitor the water supply chain and/or control water quality at household level. 39% highlighted hygiene promotion activities and 31% accompanied household water supply interventions with the distribution of other items such as chlorine and buckets for safe storage.

Figure 7. Overview of HWTSS complemetnary activities implemented by relief organisations in emergencies.



Source: Author-based on responses from WASH practitioners and emergency managers.

HWTSS interventions compared to other possible water supply assistance modalities, usually demand increasing the participation of victims or communities affected by the disaster. Furthermore, as mentioned above, efficiency and efficacy of HWTSS interventions are strongly dependent, amongst other factors, on 'behavioural change' and how well, the information delivered by humanitarian organizations is connected and aligned with previous knowledge existing in the area affected by the disaster. In addition to this, HWTSS operations in emergencies are influenced by logistics, and the availability of adequate human resources to fill multiple functions, which are needed to monitor efficiently the quality of these interventions. Unfortunately, most of the time, logistics is reported as an issue because of the scarcity of essential items as well as the tensioning labor markets during emergencies.

Moreover, having the whole control of the entire water supply chain isexpensive and relief organisations do not have enough capacitites to manage the entire water supply chain from water sourcing to household storage and consumption on regular basis. In addition to this, water quality control at household level and vector control of main water borne diseases drivers at household level appeared, in the literature review, as representing a huge challenge to operationalized more efficiently HWTSS solutions.

It is suggested a lost of efficiency on water supply in emergencies due to lack of good enough frameworks to manage "last mile" of the entire water supply chain [35]. In other words, water treatment at the source, transport and water supply at the point of delivery seems to be privileged compare to the 'last mile', referring to water supply interventions implemented in emergencies.

Beyond the fact that documents reviewed establish that organisations are susually distributing 'safe storage items', they do not state clearly what was the effectiveness of the strategies applied by the organisations to ensure 'adequate safe storage and water consumption'. This was recurrently mentioned as one of the factors that can jeopardize the effectiveness of HWT solutions proposed. Also highlighted was the importance of implementing solid strategies to sensitize and monitor the adequate use of HWT methods at that measure real impacts and mitigate the consequences of generating a false feeling of protection among final users.

HWTSS in emergencies are far away from being considered by partners as the main priority. In general, HWTSS interventions are perceived as a complex intervention. Regarding the role given to HWT interventions in emergencies, 49% of the people interviewed considered them

35 For "last mile" it is understood the last steps at the entire water chain, which are mainly "safe storage and consumption" at household level.

as a priority and one of the main strategies to be implemented by the organisation to supply clean water in emergencies. It is significant that 33% considered that HWT interventions are rarely used or only consider under exceptional circumstances. Finally, according to their experience 18% of the people interviewed indicates that HWT activities are commonly used to complete centralized water distribution systems or as an 'exit strategy' in order to consolidate the potential gains for public health of clean water distributions.

Regarding the challenges faced by relief organisations when implenting HWTSS interventions in emergencies, a total 50.71% of the people interviewed mentioned the following as the most important: **a)** Ensure water quality at the point of consumption PoUWT (14.79%); **b)** Operation and maintenance of HWTSS items distributed (11.97%); **c)** Acceptability of the HWTSS solution proposed (11.97%) and **d)** Logistics and getting regular access to the population affected by the disaster (11.97%).

Table 4. Overview of the main challenges faced by relief organisations when implmenting HWTSS activities in emergencies.

Concept	%
Ensuring adequate water quality parameters.	14.79%
Operation and maintenance.	11.97%
Acceptability.	11.97%
Logistics and access to population in need.	11.97%
Water quality at the point of distribution.	9.15%
Affordability of HWTSS products by final users.	8.45%
Adequate use of HWTSS items.	8.45%
Availability of HWTSS in local markets.	6.34%
Appropriateness of the HWTSS solution proposed.	5.63%
Others	12.00%

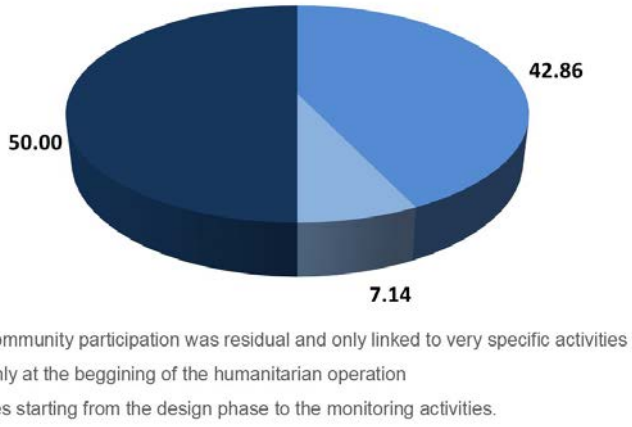
Source: Author-based on responses from WASH practitioners and emergency managers.

In addition to this, a total of 43,66% of the people interviewed also mentioned the following factors: **e)** Affordability of the HWTSS solution proposed, meaning costs and sustainability (8.45%); **f)** training of the beneficiaries on HWTSS methods (8.45%); **g)** Availabililty of HWTSS products in local markets (6.34%); **h)** Appropriateness, meaning water quality and quantity produced (5.63%); **i)** Quality of water tretment at the point of distribution (9.15%). Responses falling under the category of 'enabling factors' was as high as 61.97% of the total responses received whille 38.03% of the responses were associated to 'technical factors' which do not allow to boost adherence of the beneficiary populations to the solutions proposed. It is important to highlight that relief organisations are responsable for enhancing

some of the enabling and technical factors described above. Meaning that relief organisations, for example, are obliged to develop appropriate strategies to monitor the impact of their actions. Another example is that they are responsable for having a previous knowledge of the main water supply systems and customary practices on water supply existing in the targeted area in order to propose the most affordable solution for the population.

Finally, relief organizations are responsable to boost community engagement and participation into the whole project design cycle to avoid lack of adherence to the HWTSS activities implemented. This is not always the case. It is significant that data collected from surveys indicates that 50% of the people interviewed mentioned that community participation was residual and only linked to very specific activities on the ground (42.86%) or only at the beggining of the humanitarian operation (7.14%). Data suggest that relief organisations find it difficult including community participation during the whole project cycle. This can be one of the underlying causes reducing efficiency of HWT projects on the field.

Figure 8. Community participation/involvement into the HWTSS Project cycle.



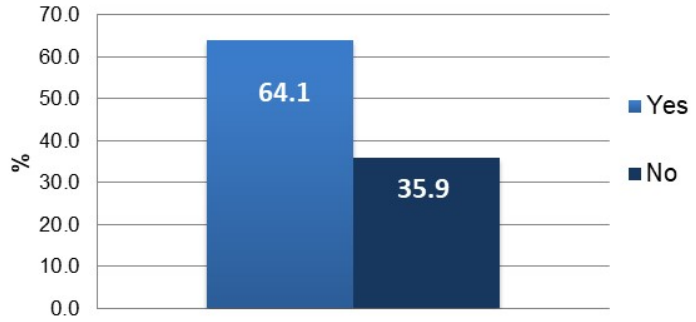
Source: Author-based on responses from WASH practitioners and emergency managers.

The evidence from the sudies suggests a variety of factors related to the environmental conditions and the individual perceptions in which HWTSS programs are implemented. With regard to the environmental factors, understanding of the previous knowledge on HWTSS solutions existing in the targeted area as well as the market functionning and the risk associated to the whole water supply chain can help to select the most adequate solution. Nevertheless, the environmental factors must be accompained by a clear strategy to involved individuals and communities during the whole project cyle in order to boost adherence, and gain in effectiveness. The statistics show that 28,95 % of the profesionals consulted admited that their headquarters do not have a previous knowledge of the existing HWT solutions available at local level and 50 % of the practitioners confirmed a residual or limited

participation of the communities into the designo f the project. Taking into account the statistical data, we can sumarize that limited knowledge and weak involvement of the communities affected can easely jeopardize the effectiveness of the HA delivered, including HWTSS items.

It is significant that around 35.9 % of the people surveyed indicated that HWTSS solutions proposed are not sufficiently efficient to have impact on quantity and quality of the water consumed at household level. This is aligned with the data gathered from the literature review (Elrha, 2019) that shows the lack of simple, aceptable and sustainable HWT related solutions and the urgent need to increase research on new technologies.

Figure 9. Effectiveness of HWTSS inerventions in emergencies (perception of people interviewed).



Source: Author-based on responses from WASH practitioners and emergency managers.

4.1.3. GENERAL PRINCIPLES TO DEVELOP A HWTSS FRAMEWORK OF ACTION.

In order to develop a FoA the researcher took interest in having a better understanding of the reasons, which motivate wash ptractitioners and emergency managers to prioritize HWTSS interventions.

It can be seen form the survey that **35%** of the professionals surveyed prioritized HWT interventions in function of its capacity to complete other ongoing or planned water supply interventions aiming to reduce water borne risks associated to water supply chain. 26% of the practitioners surveyed indicated the lack of access to safe water sources by local populations as the main factor influencing their decision for setting up HWT activities. 29% highlighted effectiveness, relevance, capacity to reach people living in hard to reach areas and acceptability of local populations of the HWT activities proposed. Finally, 10% of the total answers referred to the results of the WASH cluster discussions and the existing coordination mechanisms being in place as the main drivers for setting up HWT interventions. Responders rarely mentioned ‘acceptability by the community’ as a key factor influencing the decision for setting up HWT interventions. According to the statistics, 43% of

the professionals consulted confirmed a residual and occasional participation of the communities affected by the disaster into the design of HWTSS activities and 7% mentioned that the relief workers consulted communities only at the beginning of the humanitarian intervention.

According to the data collected the approach implemented by most of the organisations consisted of providing equipment and material while relying on the existing local capacities.

With regard to the main factors influencing operational decisions on the ground, figures indicate that 20% of the persons surveyed answered that activities were 'needs driven' according to the results of the assessments; 17% indicated that existing 'previous knowledge' in the targeted area was critical to operationalize HWT operations; 17% highlighted access to water sources by the affected populations; 14% mentioned 'coordination' with other stakeholders as the main priority when operationalizing HWT activities on the ground; 11% mentioned time, effectiveness**;** 9% mentioned that its strategy was strongly influenced by the setup of other water supply activities (water tracking, boreholes construction or well/pipeline rehabilitation); 6% logistics (capacity to reach difficult areas); 6% highlighted likelihood of water diseases as the factor around HWT activities, mainly hygiene promotion activities, were organised. This is aligned with the findings gathered from key informants and documents reviewed.

'Move away from only considering chlorine as the option for emergencies. User do not like chlorine (taste and small) and it is expensive to distribute. Using options like filtration, especially when sourced locally, is much more sustainable and will have an impact on the post-emergency situation. Relief organisations should look into what is locally available and what is of quality as many of the imported filters (Life Straw/Sawyer) are poor value for money --> too expensive and not user friendly.'

WASH practitioner interviewed.

In order to have more information on the planning tools existing in each organization for the design of household intervention strategies, the professionals of the sector were asked if they had a well-structured database containing basic information about availability and acceptability of HWT methods in prone disaster areas that allows themt to guide their decision making process.

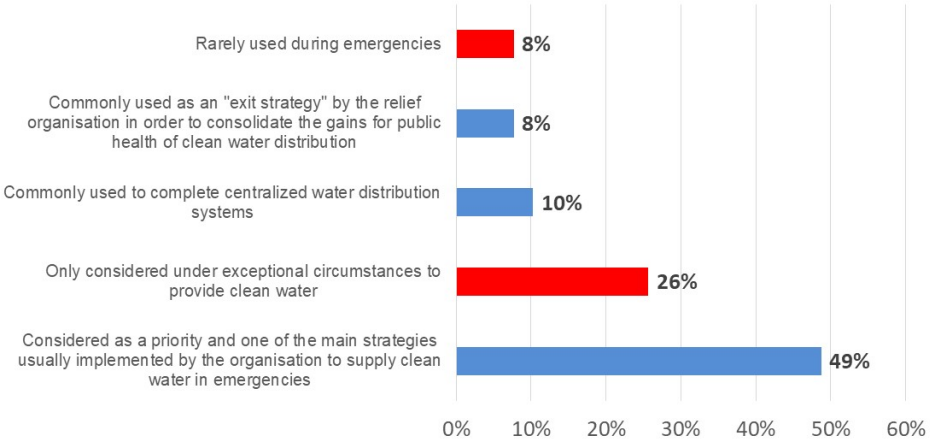
62.5% of the total responses collected confirmed that they had enough contextual information at each organization while 37.5% indicated that they lacked well-structured information tools to better inform the decisión making process. This is aligned with the fact

that approximately 15% of the responders highlighted the need to develop more guidance on how to operationalize more efficiently HWT programs.

When asked what kind of information should be included into the database to make HWT interventions more successful, emergency practitioners prioritized information related to 'acceptability' by local communities, inventory of HWT methods available on the local markets and inventory of water sources as the mínimum requirements to be included as part of the contextual information.

With regard to the approach retained by the organization to supply clean water through HWT interventions 52% of the responders highlighted that the organization implemented a mixed approach which consisted of providing equipment & material while relying on the capacities of local organisations to distribute equipment, train final users and raise awareness on hygiene promotion issues; 17% relied on internal resources already available at local level to run the operation; 17% re-enforced local partners providing technical support, equipment & materials, training and hygiene promotion; and 13% deployed specialist & equipment & material directly from Central Headquarters to run all the operation process (distribution, training, hygiene promotion).

Figure 10. Use of HWTSS interventions in emergencies.



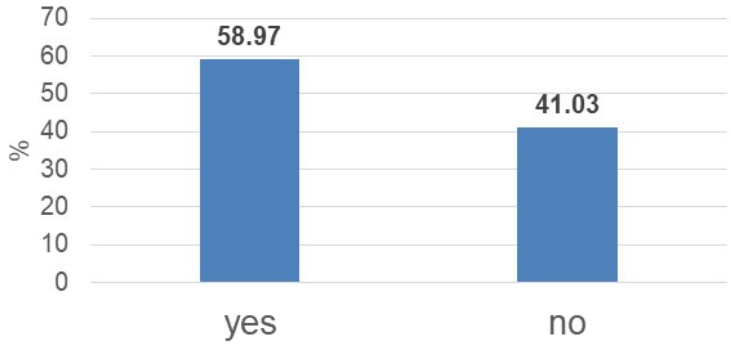
Source: Author-based on responses from WASH practitioners and emergency managers.

It is significant that 82.02% of responders mentioned that their organizations have a previous experience on supplying clean water in the area, while 17.95% do not. To complete this 74.36% of the responders indicated having access to specific operational tool or FoA when designing and implementing HWT interventions at the theatre of operations. However, 25.64% did not have access to specific tools or a detailed FoA when planning HWT interventions. These figures reveal how important it is to provide more guidance on how to plan, design and finally operationalize this type of interventions in order to gain impact.

Amongst the tools most commonly used by practitioner special mention should be made to the Sphere Handbook (45%) specific internal guidelines developed at each organisation level (37%), WHO technical and support documetns (11%), UNICEF resources available on water supply (8%). The numbers show that most of the organisations and practitioners knows of minimum standards and tools applying for the setting up of HWT interventions in emergencies, but only 37% mentioned the use of internal guidelines or FoA which indicates that organisations and, ultimately, practitioners are in need to support their work with a more systematic approach from organizations.

The answers collected indicate that 41.03% of the organizations do not have a specific and pre-packaged system for the implementation and operationalization of HWT programs in emergencies, while 58.97% do. Prepackaged system means a prestablished set of materials and equipment ready to be deployed immediatly on the ground to meet humanitarian water supply needs at household level.

Figure 11. Use of specific HWTSS tools and prepackaged systems for HWTSS in emergencies by WASH/emergency practitioners interviewed.



Source: Author-based on responses from WASH practitioners and emergency managers.

Most of the practitioners interviewed (64.7%) highlighted that their organisations used a mixed approach to implement HWT activities on the ground, while 23.53% mentioned that operations were implemented relying on local partners. Only 11.76% mentioned that their organisations deployed specialised and well-trained teams on the ground to run directly the operations. Data reveals that most of the organisations support their local couterparts deploying on the field equipment, material and specialised professionals while relying on local knowledge and capacities to run hygiene promotion activities, distribution and training of final users. It is significant that 28.95% of the people interviewed highlighted that headquarters had no previous knowledge of the existing HWT solutions in the area affected by the disaster. This data is relevant to show the importance of preparedness for the relief organisations in order to gain efficiency and better plan their humanitarian interventions.

HWT interventions were considered as a cost-efficient alternative by emergency practitioners when people where dispersed/scattered, living in areas difficult to reach or when it was necessary to provide HA for mobile populations. Surveys carried out suggested the advantages of setting up HWT in cases where populations had access to unimproved water sources and it was not possible to install a centralized chlorination system, run a massive water supply distribution (water tracking/bottled distribution) or other water supply activities were not an option on the short term. Finally, practitioners pointed out that this alternative was more efficient in the cases where the populations had a previous knowledge of the HWT methods and relief interventions were coupled with hygiene promotion activities.

'There are volumes of "lessons learned" documents available from a wide array of disasters and I find it stunning that almost no one reads them. This is critical to getting started quickly and avoiding mistakes.'

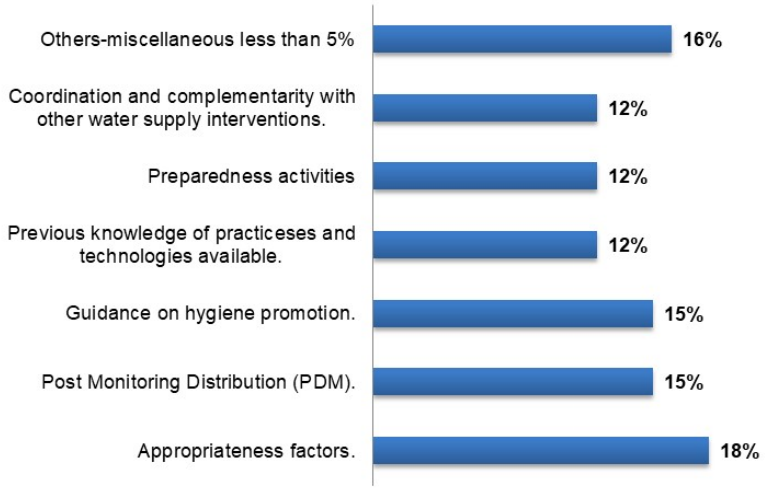
Wash practitioner interviewed.

In summary, emergency practitioners having implemented HWT programs have included it as a part of a more comprehensive strategy to complete other water supply activities such as water tracking and/or boreholes construction/reparation. It is acknowledged the effectiveness and relevance of HWT interventions to target affected populations living in hard to reach areas, as well as its importance in increasing beneficiaries' coverage and complete other water supply interventions. Practitioners highlighted as well how important it is to coordinate activities with stakeholders to gain efficiency when planning HWT interventions. Although it was significant that responders did not retained 'acceptance' as one of the most important factors when implementing HWT interventions, emergency practitioners acknowledged the importance of measuring the existing 'previous knowledge' by the affected populations at the time of operationalizating the intervention strategy. It is significant the importance given by the practitioners to the information collected through rapid assessments on the ground.

Finally, practitioners were asked for their view about how HWTSS interventions could be strengthened. The idea behind the question consists in identifying which were the topics that were perceived as areas in need of further research. 18% of the total responses highlighted the importance of increasing knowledge on appropriateness factors by the affected populations of the HWT solutions proposed and gain an understanding of the environmental impact of HWT solutions; 15% of responses pointed out to the need of improving targeting, post distribution monitoring (PDM) and follow up of HWT activities implemented by relief organisations; 15% also suggested the need for improving guidance on hygiene promotion, behaviour change and context analysis; last but not least, 12% of the surveyed people mentioned the importance of improving data collection about the HWT technologies locally available; also 12% of the total responses emphasized the importance of the link between

preparedness (prepositioning materials, context analysis) and latter implementation of HWT programs; and finally 12% of the total responses called attention to the need to generate more knowledge about the complementarity between HWT programs and other water supply interventions and gains linked to coordination between stakeholders.

Figure 12. Areas in need of improvement when implementing HWTSS in emergencies.



Source: Author-based on responses from WASH practitioners and emergency

The information gathered above has been useful to identify some of the drivers to be considered when carrying out successful operations on HWT. These factors have been divided into two principal categories ***a)*** programmatic and ***b)*** implementing factors.

The category defined as 'programmatic' is directly linked to the range of tools and proceedings that are available at each relief organisation for the design and plan of housheold water interventions in emergencies. More in detail, this category includes the capacity to collect and analyse context, forecast intervention scenarios; explore and select the most adequate HWT technologies; establish rapid procurement proceedings, and/or define adequate deployment modalities. This category is also related to preparedness activities. From this point of view the research identified the following factors as some of the key elements prompting that guaranteeing the success of HWTSS interventions implemented by the relief organisations:

- Having available **clear guidelines and/or framework** for the setting up of HWT interventions;
- **Readiness-** being able to keep human resources and equipment ready to intervene when needed. Identify experienced staff able to rapidly scale up HWT interventions

when these interventions were considered as critical to success in supplying clean water in the areas affected by a given disaster.

- Having structural capacities to carry out studies, **collect and analyse reliable informations** on HWT interventions in the aim to draw lessons learned for improving future interventions;
- Having established **solid supply chain mechanisms** to support efficiently HWT interventions on the field;
- **Technical support** to ensure the adequacy of the 'product' to be supplied when the emergency strikes and then adequate 'placement' and 'support' provided to the final beneficiaries to ensure sustainability of the solutions proposed.
- **Timing** – pre-positioned stock, quick release of funding and early triggers for rapid scale up on HWTSS interventions if factors leading to an effective response, particularly with hygiene kit distribution were met[36].

Second category refers to the implementing perspective or the operational factors, meaning those elements that influence the setting up of HWT interventions by emergency responders. These factors are described below:

- **Adherence:** high adherence was required on the part of households if the public health benefits of HWTSS had to be realised (Elrha, systematic review, 2016). This refers to the ultimate nature of HWTSS interventions, which was intimately tied to behaviour change, awareness and sensitization.
- **Acceptability:** this was directly connected to the first point. This factor consisted in the need that beneficiaires of HWTSS interventions might be familiar with the solutions prompted by the relief organisations during the disaster. This means that the final users must accept taste and/or smell of the water supplied. Moreover, the solution proposed must be effective, easy to use and appropriate to the context in which HWTSS intervention is going to be implemented but also that to some extent, the community must participate as much as possible into the dicision making process.
- **Post Delivery Monitoring, Evaluation and Quality Control:** the importance to monitor results at household level (before, after and during the intervention) was particularly critical when relief organizations were implementing HWT interventions. Observing and measuring free residual chlorine and effective use of HWTSS items delivered during the emergency offered to relief teams valuable information about the impact of their actions.
- **Communication tools and approaches** were critical when implementing HWT methods. Operations set up must consider multiple modes of communication aiming

[36] Yates, T, Allen, J, Leandre Joseph, M and Lantagne, D, 2017.

to reinforce key messages delivered to beneficiaries of the programmes. Literature reviewing evidenced that 'strong radio and face-to-face' methods were found the most preferred by communities to deliver simple clear instructions. Literature highlighted the benefits as well of applying community-driven engagement approaches as a way to empower the community and build a trustful relationship between implementers and beneficiaries. In addition, community-driven interventions, contributed to increase awareness, triggered behaviour change and facilitated local solutions, acceptance and adherence to local solutions proposed.

- **Linking pre-existing knowledge on HWTSS** (e.g. knowing how to use an HWTSS product) increased familiarity and improved the use of HWTSS solutions proposed. Linking development programmes to emergency response activities was found to be successful in multiple contexts.

4.1.4. FRAMEWORK FOR ACTION (FoA).

An overall analysis of the information gathered through the literature review, questionnaires, key informants identified two main categories to be consulted for the setting up of successful HWT intervention in emergencies (without distinction of man-made and/or natural disasters). First category is related to the way that each organization structures its interventions into the 'humanitarian arena', its preparedness and its operational capacity to collect, analyse and design HWT interventions. Second is related to the critical elements to be observed on the ground when organizations are implementing HWT operations. The following principles have been identified as applying for the first category:

a) Robust preparedness activities in terms of:
    1. Training for HWTSS WASH practitioners participating in HWTSS emergencies.
    2. Detailed analysis of previous knowledge, acceptability in prone disaster areas.
    3. Testing HWTSS equipment and analysis cost efficiency according to the WHO guidelines.
    4. Adequate prepositioning of equipment and materials in prone disaster areas.
    5. Development of specific rapid assessment tools for HWTSS to ensure acceptability and affordability related information is captured.
    6. Development of specific tools to include community participatory approaches in all the phases of the project cycle.

While the following principles have been identified as applying for the second category:

i) No implementation without being in compliance with national regulations on HWTSS (if exists) or with Ministry of Health guidelines and recommendations.

j) No distribution of HWTSS items/treatment methods or equipment without training;

k) No implementation of HWTSS activities without adequate PDM protocols established;

l) No implementation without adequate assessment of the existing previous experiences on HWTSS when identifying technical options and/or building the bridge with local practices;

m) No implementation without adequate protocols to ensure community participation during the whole Project cycle.

n) No HWTSS without including a solid 'theory of change', 'behavioural change' coupled with hygiene education activities;

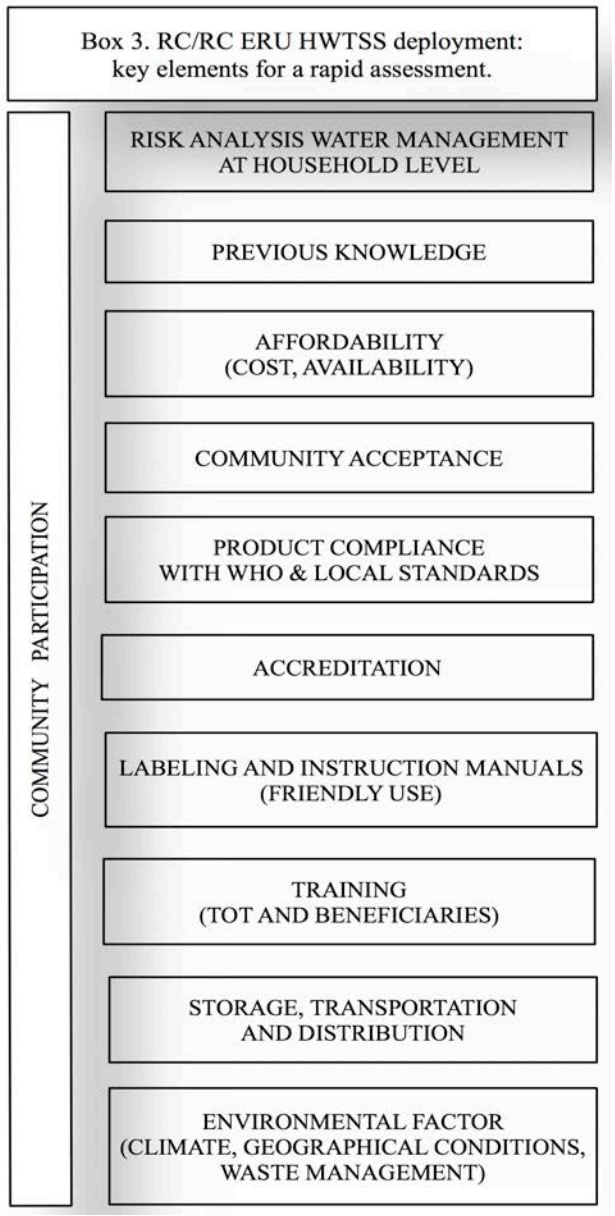
o) No HWTSS without adequate water management safety plans to avoid recontamination of water at household level;

p) No communication without harmonization of key messages with other relief organisations through the coordination of mechanisms established for the emergency response at global/local level.

Based on the previous information it has been suggested the following HWTSS action framework aiming to provide guidance to managers and the staff deployed under ERU Modalities when responding to disasters. HWTSS action framework proposed is grounded on the review and analysis of the existing documents on the subject, and the experience cumulated by wash practitioners, emergency managers and members of the RC/RC Movement.

Action framework will be guided by international standards on clean water supply, in particular the Sphere Standards, the WHO guidance on water quality, and the recommendations made by the International Network of HWT and Safe Storage (HWTSS). Furthermore, the FoA will be driven by RC/RC Movement guidelines, principles and values to promote predictable, effective and timely deliver of humanitarian actions.

HWTSS action framework will be driven by the need to provide clean water to populations affected by humanitarian crisis (disasters or man made hazards), and more specifically might be used to improve access to clean water for most vulnerable groups, victims of sudden humanitarian situations; living in countries with limited capacities; populations in hard to reach areas; and in urgent need to get safe water. HWTSS action framework proposed will contribute to save lives and can be implemented when small or large numbers of a population are threaten by water related diseases.



The framework recommends several actions that could be taken before the ERU deployment (preparedness phase) and during the response phases (acute phase and stabilization phase) in order to gain in efficiency. Approach and activities proposed focuses on the first eight weeks of the humanitarina response. Finally, action framework proposed recognizes the ultimate link among HWTSS interventions in emergencies and development.

As mentioned in the previous chapters, the application of this action framework has to be based on a detailed assessment and analysis of the context. From the very beggining of the operation community participation starting from the assessment and planning phase should be organized by the implementing partner to select the most adequate HWTSS. We, then review the key elements to be part of the analysis:

Risk analysis associated to water management at household level. This is important in order to design a comprehensive Water Safety Plan, including adequate awareness activities to avoid recontamination of the water chain and the setting up of adequate control measures for the regular surveilance of water quality parameters.

Previous knowledge: Previous HWTSS practices existing in the targeted area.

Affordability: the cost of the HWT solutions proposed must be cost-effective and sustainable for the community. Nevertheless, cost-effectiveness can be taken less into account during the acute phase of the emergency where the main objective is to save lives. On the contrary, this parameter is very relevant for the design of efficient exit strategy by the relief workers. This factor includes ‘rapid market system’ to check availability of the products at the local market.

Community acceptance is a key element to ensure a successful deployment of the ERU HWTSS Module. It is extremely important to ensure that the final users are familizarized with the solutions proposed. Some treatment methods may not be accepted by the community due to sociocultural barriers. Therefore, it is critical to be flexible and consider posible barriers, including community perception, when planning HWT interventions in order to find the best coping strategies. Indeed, lack of adherence can easely hinder the efforts made by the humanitarian practitioners to set up successfully the program.

Product Compliance: All PoUWT products should comply with WHO and Government standards and clearly state the compliance on the product.

Accreditation: PoUWT products should have accreditation by a suitably qualified body before its delivery to the public. Local authorities are responsible for accreditation of all PoUWT products, whether produced locally or imported. Nevertheless implementing partners supplying these products have to ensure a correct accreditation.

Labeling and Instruction Manuals: Where applicable, PoUWT products should be accompanied by instructions in local languages sufficiently detailled to enable effective employment. Product data sheets should be available in sufficient quantities to satisfy demand from partners, community groups, and individual households.

Training: The procurement contracts for PoUWT products should contain a requirement for the supplier to provide training at different levels such as federal, regional, zonal level. Implementing partners must ensure effective training is carried out at household level through community structure. For ERU approach, trainings are included into the materials being part of the equipment deployed or produced at local level. In addition, RC/RC local technical staff and volunteers are mobilized to set up as quick as possible adequate training to the population affected. Ensure the correct use of the PoUWT Community awareness and orientation trainings on proper use of the product, handling and storage of treated water to prevent contamination of treated water have to be organised from the very beggining of the operation.

Storage, Transportation and distribution: Proper storage conditions and transportation methods must be matched to the site conditions to prevent damage of the product. In areas with anticipated risk, pre-positioning of PoUWT products should be considered to facilitate a quick response. The use of locally available products should be prioritized if a continued use in the post-disaster phase is prioritized. Effective use of PoUWT requires regular follow-up,

support and monitoring and this should be a prerequisite to adopting it. Availability of storage materials and type of storage should also be included in the selection criteria for appropriate handling, safe storage and effective utilization. Something that cannot be neglicted should be identifying how the distribution of the HWTSS relief items is going to be done to avoid problems and ensure adequate humanitarian assisstance to the population in need.

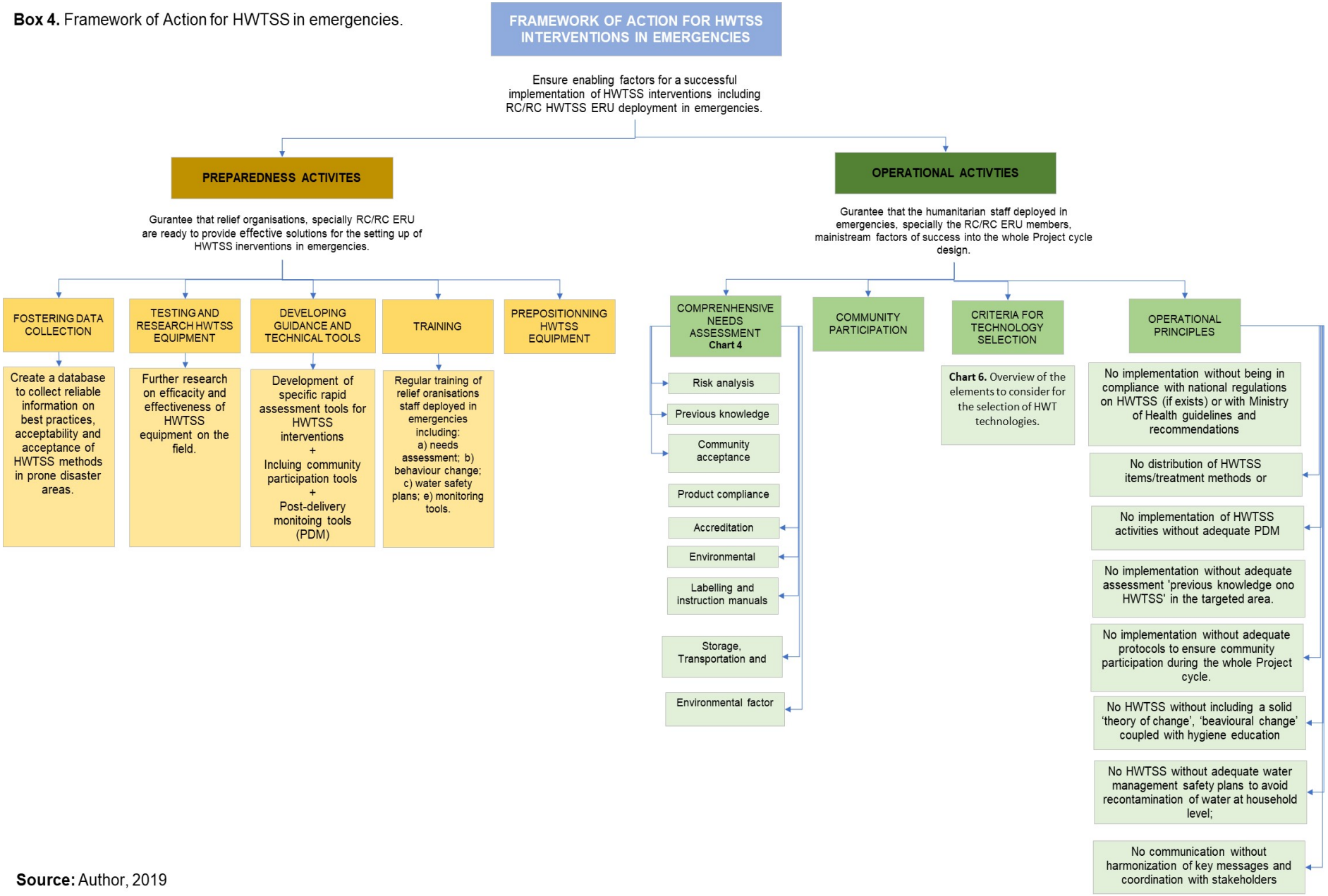
Environmental factor: the environmental impact of a selected treatment has to be taken into consideration prior to selecting a PoUWT option. Environmental factors include local climate and geographical conditions, as well as safe disposal of expired products and packaging materials. Knowledge on the environmental impact of humanitarian interventions and management approach is still quite limited. Nevertheless, research recommends to include as part of the ERU HWTSS module a clear strategy on waste management.

In addition, it is suggested that HWTSS interventions integrate the basic principles of the 'theory of change' [37] as part of their operational tools when distributing HWTSS equipment in order to mitigate risks associated to a bad use of the humanitarian aid delivered, promote a more consistent use by the final beneficiaries and increase final outcomes expected on health.

HWTSS RC/RC ERU approach should integrate the content and principles described into the framework for action accross all the phases of the emergency response from preparedness to early recovery and recovery. In **Chart 4** is presented a proposal of FoA for HWTSS deployment in emergencies. FoA proposed is based on informations collected from WASH practitioners as well factors of success suggested by Ojomo, E. et al (2104, p. 1-4), suggestions brought by Schuelert, L., et al. (2011, p.1-4) and RC/RC ERU guidelines and internal reports and systemathic reviews from ELRAH and others authors such as Daniele Lantagne or Thomas Clasen.

[37] **Yates, T, Allen, J, Leandre Joseph, M and Lantagne, D., 2017.**
WEDC. Loughborough University. Dissertation Research: MSc Infrastructures in Emergencies (2019)

Box 4. Framework of Action for HWTSS in emergencies.



Source: Author, 2019

4.2. OPERATIONAL PROCEEDINGS FOR EMERGENCY RESPONSE UNITS (ERU).

Emergency Response Units (ERU) of the RC/RC Crescent Movement have developed a comprenhensive offer to guarantee clean water supply. Thus, a set of prepackaged tools for the delivery of bulk water in the aftermath of a disaster is available and their efficacity has been tested in numerous disasters. Furthermore, the IFRC has signed collaboration agreements with different service providers for pre-positionning and/or the delivering of, amongst others water supply items, household water related technologies. ERU interventions have been designed to be in compliance with principal global standards and rules providing basic guidelines to ensure an efficient deployment of ERU relief teams on the ground. HWTSS FoA developed in the previous chapter described which are the basic principles and guidelines to be considered when deploying ERU on the field. Section 2 will provide to the readers further information about the IFRC emergency deployment modalities and how those principles mentioned above are operationalized at the local level and translate those principles into clear objectives and indicators.

4.2.1. BRIEF INTRODUCTION TO THE DEPLOYMENT MODALITIES FOR THE INTERNATIONAL FEDERATION OF RED CROSS AND RED CRESCENT SOCIETIES IN EMERGENCIES

IFRC has developed a proactive and comprehensive range of tools able to be deployed in the aftermath of a disaster to be responsive in reducing the number of deaths, injuries and impact from disasters. According to the internal RC/RC Movement regulations[38], IFRC mandate allows the organisation to take the leadership in emergency operations (e.g. natural disasters or some types of man made disasters), while they are under the lead of the ICRC in conflict or war zones. Neverhteless, due to the complexity of modern conflicts the dividing line has been increasingly blurred.

Human and operational resources that might be potentially mobilized through the IFRC can be divided as follows:

- **Human resources:** Skillful resources, specially trained to deal with the humanitarian consequences of natural disasters and man-made hazards. Field Assessment and Coordination Teams (FACT) and/or Regional Disaster Response Teams (RDRT), Emergency Response Units (ERU's).

[38] Available at https://casebook.icrc.org/case-study/seville-agreement. (Accessed 15 February. 2018].

- **Operational resources:** Funding mechanisms which allows the International Federation to make available emergency funding, Disaster Relief Emergency Fund (DREF)1, to tackle the consequences of humanitarian disasters.

These tools rely on the Disaster Management and Information System (DMIS) and other Early Warning and Early Action (EW/EA) methods. IFRC continues to invest on consolidating strong partnerships with external actors such as metereological agencies to strengthen early warning systems as part of the emergency response system that can complete other disaster responsse interventions. This research will focus its reflection on the study of the IFRC ERU deployment modalities.

ERU is part of the operational tool put at disposal to respond to emergency situations by the IFRC in order to deliver immediate lifesaving activities and humanitarian services. ERU system is used in large emergency response operations, when global assistance is needed and the Federation's delegation(s) and the affected NS cannot respond alone because of the scope of the disaster. ERU system consists of a team of trained technical specialists, ready to be deployed at short notice, which uses pre-packed sets of standardized equipment. ERU has been designed to be self-sufficient for up to four months. Once its assignment is completed, the equipment is quite often handed over to the NS withing the country, the regional delegation of the RC or the local authorities. Alternatively, the unit may return to its original base, depending on needs and future plans.

RC/RC ERU were created in 1994 to give immediate support to NSin disaster-affected countries. This emergency response mechanism provide specific support or direct services when local facilities are either destroyed, overwhelmed by need, or inexistant. RC/RC ERU work in close collaboration with Field Assessment Coordination Teams (FACT) in order to verify the appropriateness of their deployment in the field. The RC/RC ERU are the IFRC's disaster response tools and the property of the following National Societies: American, Austrian, the BeNeLux (Belgium, Netherlands and Luxemburg), British, Canadian, Danish, French, Finnish, German, Italian, Japanese, New Zealand, Norwegian, Spanish, Swedish and Swiss Red Cross. Other NScontribute with ERU trained staff (such as Australia, Croatia, Hong Kong, Indonesia, Iceland and Macedonia).[39]

People interviewed and internal information gathered from IFRC identified the following types of RC/RC ERU: a) Relief/ogistics; b) IT & Telecommunication; c) Water: (Module 15 & Module 40); d) Basic Health Care/ Referral Hospital/ Rapid Deployment Hospital e); Sanitation (M20/M11) f) Base Camp. For the purpose of the research, we will focus on the

[39] Information available at https://www.ifrc.org/eru

RC/RC ERU M15/M40. These modules have been adapted to the number of beneficiaries and the quantity of water to be produced and their proceedings are aligned with WHO Drinking Water Guidelines, the Sphere standards and IFRC internal guidelines. RC/RC ERU staff is composed up to 8 water engineers / technicians/ hygiene promoters on average at each module. Main characteristics have been described below:

> ***'WatSan Module 15:*** **Function:** to provide treatment and distribution of water up to 225,000 litres a day for a population of 15,000 people, with a storage capacity of a maximum of 200,000 litres a day. This unit can also provide basic sanitation and hygiene promotion for up to 5,000 people. It is flexible in the sense that it can be deployed and be set up as several stand-alone units for up to five different locations. Integrated in this M15 is distribution and trucking capacity for the transport of treated water to dispersed populations, with a capacity of up to 75,000 litres a day and the option to set up 9 different storage and distribution points. Approximate weight: 20 MT, volume: 160m3. The Austrian, French, German and Spanish Red Cross have the ownership of this module [40].'
>
> ***'WatSan Module 40***: Function: to provide treatment and distribution of water for larger populations. The unit can treat up to 600,000 litres a day for a population of up to 40,000 people. As with the M15 unit, the M40 has an integrated distribution and trucking capacity for the transport of treated water to dispersed populations with a capacity of up to 75,000 litres a day and the possibility to set up nine different storage and distribution points. Approximate weight: 25 MT, volume: 110m3. The Austrian, French, German and Swedish Red Cross have this module. Croatian, Indonesian and Macedonia Red Cross offer staff for the M15 & 40 [41].'

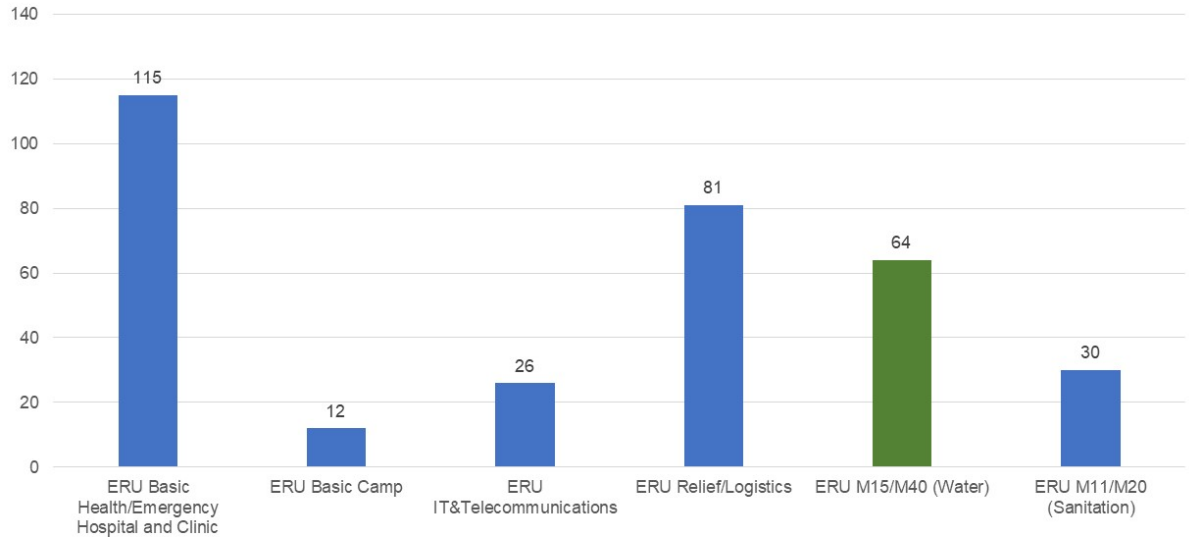
4.2.2. ANALYSIS OF DEPLOYMENTS OF THE RC/RC EMERGENCY RESPONSE UNITS (ERU).

According to the data collected, RC/RC ERU M15/M40 have been deployed 64 times in 4 continents. The RC/RC ERU have sufficient experience responding to humanitarian crisis through standarized modules. The pre-packaged and modelized solutions have been elaborated by the RC/RC Movement with the participation of different NS such as the SRC, the German Red Cross or the Austrian Red Cross. Between 1996 and 2018, the ERU teams has been deployed 65 times on the field to support supply water operations. A brief analysis of the statistics indicates that ERU's have been usually deployed in large-scale disasters to cope with the consequences of natural disasters such as cyclones, typhoons, tsunamis or

[40] Information available at https://www.ifrc.org/eru
[41] Information available at https://www.ifrc.org/eru

floods. Data shows that ERU have been less deployed to supply clean water because of displacement of population or refugees. Finally, the use of RC/RC ERU in conflict, war situations is rare and could not be adequately documented. Data collected from people interviewed shows that RC/RC ERU water and sanitation operations, including HWTSS activities, have evolved over time. Historic data analysis indicates that:

Figure 13. Total ERU deployments (1996-2019).



Source: Author-based on data collected from the IFRC.

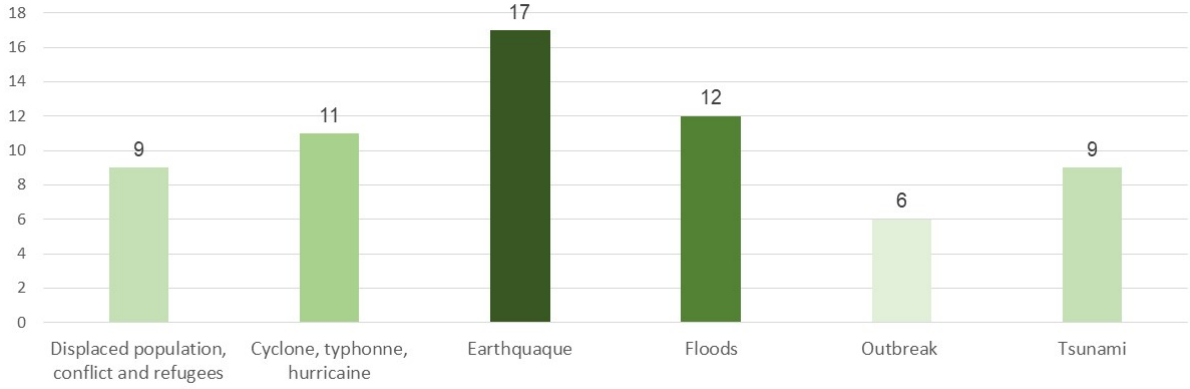
1996-2004: Delivering of equipment and technical staff oriented to provide clean water in emergencies. Early stages of the ERU system. Not accurate ERU rules and proceedings. Privileged other activities than water treatment at the source such as water tracking. Focus on the on the delivery of bulk water in compliance with quality humanitarian parameters. Early stages of hygiene promotion approaches and behavioural change activities.

2004-20016: Supply of equipment and technical staff oriented to provide clean water at the source (PoS) but also oriented to work with local populations implementing some at household level such as HWTSS and hygiene promotion. Distribution of disinfection and chlorination tablets at household level as well as development of hygiene promotion kit to disseminate public health messages and strengthen the impact of the ERU clean water supply programs. Following the recommendations of Sphere and international guidelines as HWTSS contributes decisively to reduce the health risk of drinking unsafe water and provides and incremental health at household level. Strong development of ERU proceedings and rules. High investment on the development of internal systems to select and well-trained human resources. Strengthen of the RC/RC Emergency response mechanisms. But still privilege water treatment at the PoS. HWTSS is still observed as an exit strategy by the ERU team members in order to link emergency and development.

20016-2019: Following Sphere and WHO recommendations and bearing in mind lessons learned from the field, ERU team members has been progressively requesting more and more attention to the implementation of HWTSS on the ground. ERU team members deal with water supply in more complex scenarios such as scattered populations, difficulties to reach vulnerable populatios, inadequacy to deploy water treatment plants, need of temporary solutions for specific needs. After ERU deployments in Haiti and Cox' Bazar, it is realised the advantages that HWTSS interventions have to provide clean water. Then, the need to standardize operational proceedings, develop specific proceedings, trained staff and capitalized experiences from previous experiences.

As mentioned above, according to WHO [42], the use of HWTSS techniques can lead to significant improvements in the quality of drinking water, as well as helping to reduce diarrhoeal diseases, resulting in an immediate improvement in the lives of those who depend on unsafe water sources such as polluted rivers, lakes and, in some cases, unsafe wells or contaminated distribution networks. As previously stated the use of HWTSS methods in emergencies, can be of great help in increasing the range of alternatives to provide clean water, particularly in places with sufficient availability of water or where the quality of communication infrastructure do not allow to supply treated water on regular basis.

Figure 14. Overall view of disasters benefiting from ERU support (1996-2019).



Source: Author-based on data collected from the IFRC.

According to this, the incorporation of HWTSS systems into the water related RC/RC ERU (M15/M40), as well as the definition of specific action protocols, can provide an important benefit for improving RC/RC Unit's response capacity to face emergency situations. **A recent survey done by the Spanish Red Cross showed that 74% of the ERU members considerd that they have been deployed in emergencies where HWTSS interventions were useful (SPRC, 2017, p.9). In addition to this, 68% of the ERU members recognised that they are not aware of any toolkit for planning and monitoring HWTSS interventions.**

[42] Available at http://www.who.int/household_water/en/
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RC/RC ERU operation in 2013 was a turning point for the RC/RC ERU system as for the first time an ERU Team was specifically deployed to work on the reinforcement of domestic water treatment activities in water distribution points that had being dismantled, through the setting up of activities based on the promotion of hygiene among the beneficiaries because of the disaster of the Typhoon Yolanda (Philippines). More recently, in 2018, RC/RC ERU teams were deployed in Cox'sBazar (Bangladesh) as part of the emergency response efforts to povide clean water to the Rohinga displaced population. Efforts were focused on massive HWT and hygiene promotion programs. Among other activities the RC/RC ERU Team preconised, the use of Aquatabs to provide clean water around 40 000 people aiming to reduce water related diseases. HWT activities were implemented to complete other water interventions such as boreholes construction. During the mission, RC/RC ERU Teams deployed were confronted with logistics, administrative and coordination challenges that put in evidence the need to go further into the development of more clear operational guidelines, specially regarding procurement and the adoption of a better definition of the equipment required for the operation. In 2017, HWT activities and equipment were included as one more activity of the RC/RC ERU. In 2107 the RC/RC Movement, under the leadership of the SRC, established a working group to explore the feasability of developping a specific module on HWTSS. This module should be ready to be deployed jointly with the RC/RC ERU Water and/or Sanitation or separately if required by the host National Societies. In 2018, as researcher and member of the RC/RC ERU teams I had the opportunity to participate in a two days RC/RC Workshop held in Madrid aiming to bring clarity on some of the research questions raised thorugh this study.

The debate turns around the technical element that justifies establishing a separate module on HWT, the minimum requirements needed for an effective deployment of HWTSS interventions and, if justified, what the minimum materials, equipment and human ressources required would be to be part of this Module to supply clean water for population in urgent need at household level. Those two days of brainstorming were useful to collect more information about perceptions and cumulated experiences of the RC/RC ERU practitioners and compare them with the findings raised through the literature review.

Posible scnearios were identified for the deployment of a hyphothetical RC/RC ERU HWTSS Module in emergencies are:

a) **Scenario 1:** It is not possible to set up rapidly a centralized water supply system. Populations affected by the disaster are scattered, difficult to reach, are moving constantly in seek of shelter, and or populations are at risk of being exposed to public

health issues and do not have access to safe water sources. Equipment distributed should contribute to respond to mitigate the effects of spreading health sickness existing due to the disaster by breaking the contamination water chain. To achieve this objective, chlorine or sedimentation/flocculation tablets might be distributed. This is the preferred option retained by the organisations consulted. The option selected will depend on water quality parameters (mainly turbidity). In addition, fabric for filtering and 10 liters collapsible plastic jerrycan might be distributed as well to ensure adequate water safe storage. The idea is to avoid the spreading of water borne diseases during the acute phase of the emergency while other water works are achieved (repairing pipeline supply system, shallow wells or build boreholes).

b) **Scenario 2:** It is possible to set up rapidely a centralize water supply. Populations affected by the disaster are not dispersed, living in permanent shelters and at risk of suffering public health issues due to lacke of safe water soruces. HWTSS interventions can be promoted to prevent water borne diseases through the distribution of HWT systems in the acute phase while attending to implement other water supply interventions. The equipment selected will depend on the acceptance of the communities and should be based on previous knowledge existing in the targeted zone. Distribution of these products must be relied on adequate knowledge and skilful human ressources to boost appropriation by beneficiaries. Whether local markets are operational it is suggested considering cash delivery modalities allow the families getting access to HWTSS systems already known and boost local economies.

c) **Scenario 3:** HWTSS activities can be implemented to consolidate public health gains obtained from other water supply interventions in emergencies or as part of a more comprehensive exit strategy.

It becomes an evidence that RC/RC ERU were initially designed to operate in safer and predictable environments where getting access to areas and population affected by disasters. From this point of view RC/RC ERU have been designed to manage operations according to the traditional emergency project cycle consisted on identification, implement and evaluation which assumes that volunteers, technical staff and equipment to supply clean water into the affected areas are at any moment available to be deployed into the affected areas.

In addition to this, the standard RC/RC Water ERU module was initially designed to supply bulk water at the point of delivery. The idea behind was that a small group of qualified specialist with a minimum material and equipment could produce water in massive quantities

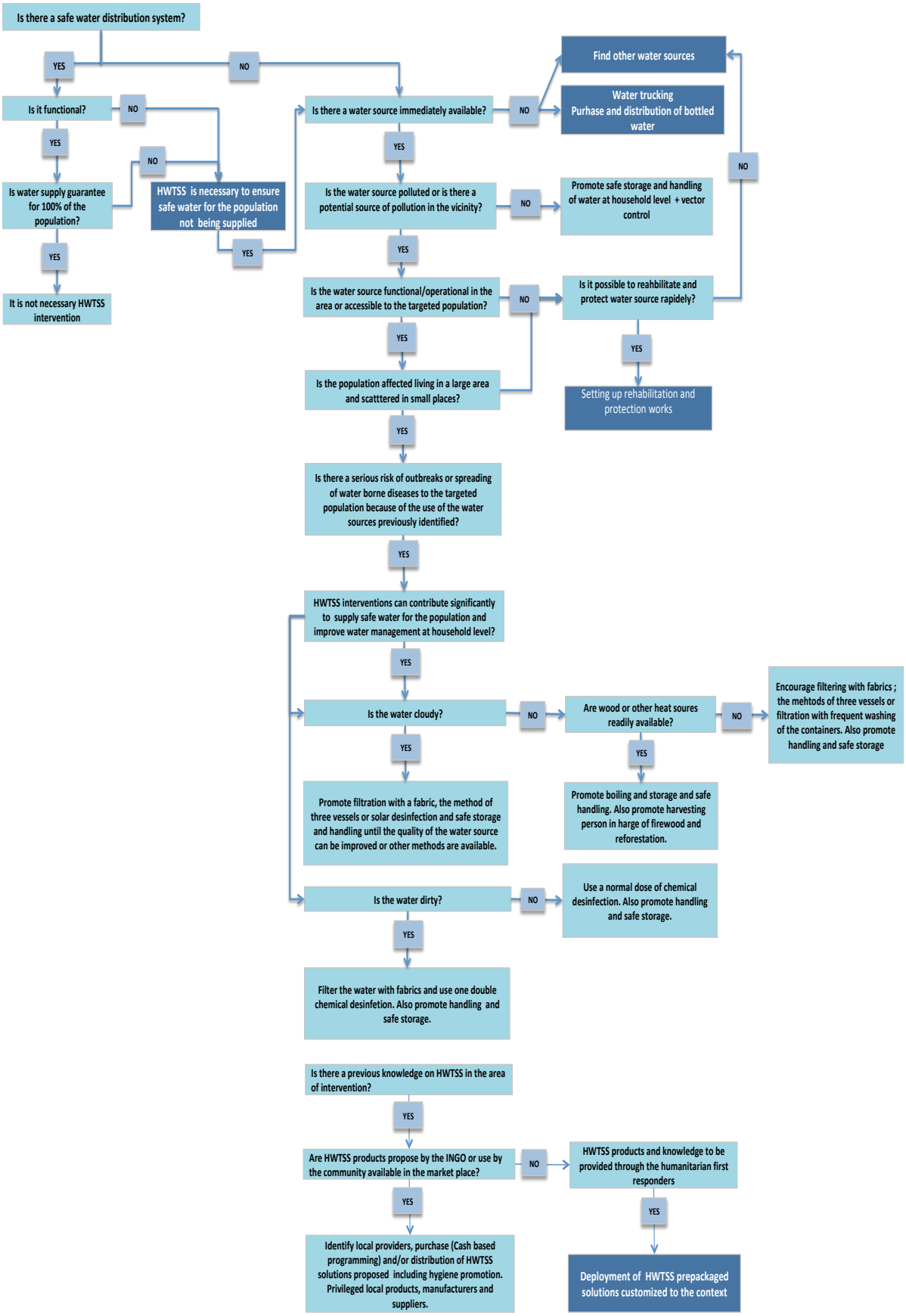
for populations affected by disasters. HWT interventions were included but as a secondary option and usually linked to the distribution of desinfection products and punctual sensitization, awareness activities. A turning point was the ERU intervention during Bangladesh emergency (Cox's Bazar). It was observed that in some contexts the best approach consisted in treating water at the point of consumption and ERU do not have a solid and differentiate approch to set up this type of water supply intervention.

Lessons learned from the emergency response lead the IFRC to think about their intervention strategy to adapt RC/RC ERU HWTSS operations in emergencies and then, contributing to an increasing effectiveness of RC/RC RC/RC ERU future deployments. The idea behind is that HWTSS module proposed below can be deployed separately of the traditional Water and Sanitation RC/RC ERU or in a complementary manner. Nevertheless, it is important to highlight which are the preliminary requirements for an effective deployment of RC/RC ERU:

- The deployment of equipment (water treatment plants) or other material required by the NS, is posible to set up adequately the program;
- It is posible to deploy experimented human resources who will be in charge to run RC/RC ERU equipment available from previous operations within the country affected by the disaster;
- The environmental and operational conditions to run ERU's units are met;
- The deployment of ERU's systems is costly and safety conditions are a strong requirement to avoid the material and equipment might be damaged, destroy or simply not be functional because of socio-economic or political reasons.

Once the preliminary requirements are met, the Chart 4 suggests a decision that can be used by wash practioners and emergency managers to verify the appropriateness of implementing HWTSS in emergencies. HWTSS decision tree proposed in Chart 4 takes into account environmental and technical variables and explore the relationships with other water supply interventions.

Box 5. HWTSS decision tree for ERU deployment.



Source: Author, 2019

4.2.3. HWT MODULE FOR THE EMERGENCY RESPONSE UNITS.

4.2.3.1. EMERGENCY RESPONSE UNITS (RC/RC ERU).

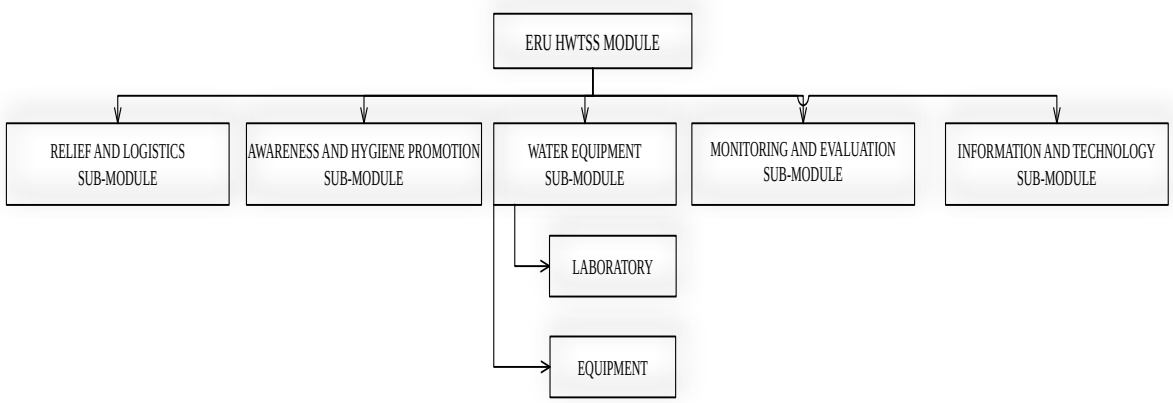
ERU HWTSS Unit would be composed of the following elements: **a)** 'hardware' meaning the modules to be deployed on the ground. According to the RC/RC terminology modules are prepackaged and thematic set of materials and equipment specially designed to address a specific issue; **b)** 'software' which refers to the technical skills and abilities being part of the ERU HWTSS module deployment. For increasing effectiveness, both elements would be completed with a comprehensive FoA which allows the ERU Team to identify critical activities and guide better their decision making process on the field.

As it was mentioned in Section 1, the implementation of HWT activities in an emergency context is going to be strongly influenced by external variables, attributes of the community and the internal factors of each organization in terms of availability of resources, competencies, equipment availability, reactiviness, acceptance by the community and coordination with other actors responding to the same emergency.

The design of the RC/RC HWTSS ERU can build on the elements of success previously identified through this research paper. As a summary, these elements can be grouped together as follows: **a)** community acceptance of the solutions proposed tby the relief organisation (affordability, friendly use); **b)** ensuring the adequate structure and logistics (supply chain) required to carry out the distributions of HWT methods as well as the activities to train users and promote adequate water management at household level; **c)** ensuring the quality criteria and standard norms regarding the provision of clean water in emergencies; **d)** ensuring effective data management and monitoring; **e)** integrating HWTSS into a more comprehensive wash strategy.

Each ERU Unit is composed of several modules that are standarized and can be quickly deployed in the disaster-affected area. Box 6 below suggests which are the modules that could eventually integrate the RC/RC HWTSS ERU Unit. These modules can be deployed all in one or isolated depending on the results of the rapid needs assessment.

Box 6. Composition of the RC/RC HWTSS ERU.



Source: Author- based on data collected from the RC/RC ERU.

Relief & Logistics module: Its function is to effectively manage the arrival and distribution of large amounts of relief goods, either flown in by air or trucked and shipped in, the clearance of these goods, their storage and subsequent forwarding to distribution points. Also, the unit is responsible for the reporting on these items (the unit tracks all incoming goods according to a so-called 'mobilization table'). In addition, the unit supports the clearance of other ERU, often arriving with heavy equipment. Emphasis should be placed on linking the distribution of HWTSS items to the development of training activities by RC/RC volunteers. In case local markets are well-fonctionning the use of CASH transfer modalities[43] to increasing access to water supply, reducing lack of acceptance and improving health impacts for the communities affected by the disaster. It can be serioiusly considered as a cost-efficiency option. Other potential advantages of CASH approach are boosting dignity, empowerment and protagonism of each beneficiary; flexibility and decision making to choose; investment in the local economy and its surroundings; and last but not least multiplier effects and direct linkage between the response phase and the recovery phase. Nevertheless, CASH transfer activities requires an specific approach that is not developed in this research dissertation.

Awareness & hygiene promotion module: This module is composed of a complete kit of hygiene promotion and sensitization materials that are useful to carry out training activities and promote adequate usage of HWT methods as well as to promote adequate water management practices at household level. Hygiene promotion module should be accompained of a comprehensive strategy to promote behaviour change and a sustainable

[43] IFRC has a solid experience using CASH Based intervenitons to covering basic needs in emergencies. In 2018, IFRC America Regional Office reached 31,734 people through 9 emergency operations, 5 of them fall under the category of floods disasters.
WEDC. Loughborough University. Dissertation Research: MSc Infrastructures in Emergencies (2019)

use of HWT items. As a general principle, ERU member should apply the principle of 'no training - no distribution'. On the one hand, awareness and sensitization works can get inspiration from RC/RC positive experiences with the distribution of ceramic filters under emergency context [44]. These activties can be structured following the next steps: **a)** explain; **b)** demonstrate; **c)** practice and test; **d)** HWT delivery. On the other hand, communication in emergencies is a key competence. Communication should seek to provide relevant, action oriented information to people affected by humanitarian situations reducing water related diseases. It is important to avoid burden on communication strategies and meesages transmitted to the community. This is especially relevant when working in HWTSS operations.

Monitoring & Evaluation (M&E) module: Its function is to establish a comprhensive strategy to monitor the impact of HWTSS interventions on the targeted population ensuring that equipment or materials distributed through the RC/RC HWTSS ERU are used effectively, water quality standards at the point of use are met and water related diseases reduced. To achieve this, ERU will carry out systematic monitoring, analysis and assessment of perfomance against the quality standards initially established. The activities designed will provide information on progress towards achievement of the ERU objectives while identifying gaps to adapt interventions. This is related to the set up of water safety plans which allows managing drinking water efficiently at household level and avoiding recontamination of the water. Then, activities falling under this module should include: **a)** comprising assessment of water chain recontamination risks at housheold level; **b)** designing operational monitoring activities to mitigate potential risks including communication strategies.

More in detail, monitoring should provide information on the quality and quantity of water distributed but also health parameters relevant to the prevalence of diaorrehal water diseases in the targeted areas. When the monitoring of standard ERU indcators prestablished is not possible, proxy indicators may be used. Nevertheless it is recommended to use standard indicators agreed by the humanitarian community. ERU M&E module will be composed of one person in charge to establish information collection strategy and data management as well as to coordinate with the NS training and deployment of volunteers on the ground. The person should be in charge of ensuring the data is reliable, taht the report on progress follows agreed healdh outcomes and indicators and feeds reporting systems. Analysis will also contribute to better inform the decision making process at managerial level. The activities to be implemented under the Monitoring & Evaluation module are: **a)** supporting HWTSS activites based on rapid assessments conducted through the NSand/or

[44] http://www.rdic.org/water-ceramic.filtration.php

in coordination with local partners and UN system; **b)** establising water safety plans; **c)** monitoring & analysing, on regular basis, water quality parameters and water management at households; **d)** measuring progress to identify and address gaps identified in providing clean water; **e)** evaluation to provide further analysis of challenges, success elements and lessons learned ; **f)** establish accountability and complaint systems.

Information & Technology module: Its function is to establish local communication networks and links to help ensuring the smooth flow of information in the operation. Furthermore, to assist the host NS with its communication systems. The ERU has a range of technology using satellite phone systems, high-frequency and very high frequency radio systems and VSAT, depending on the geographical location and needs.

HWTSS module: Laboratory module: This module is composed of the necessary equipment to take water samples and carry out e-coli tests, laboratory tests on water quality. This module is important to identify potential risks for public health, and monitor the potential impact of the activities implemented by the ERU Unit on the ground. Its function is to monitor water quality at the point of delivery (PoU) ensuring that water quality is safe at the point of human consumption.

HWTSS module: Equipment: It refers to the equipment and materials required to supply clean water in emergencies. Equipment included into the RC/RC ERU M15 and M40 contains water purification agents (Aquatabs or PurWATER, 10 L), buckets and jerrycans collipsible, water filters (ceramic drip cartigrade, 10 L) and pool tester to monitor water quality on regular basis. The quantity of products is established according to the number of people to be assisted. RC/RC ERU can provide HA up to 40,000 beneficiaries. HWTSS are included as part of the “prepacked equipment” to support clean water delivery up to 5,000 thousand beneficiaries.

4.2.3.2. SELECTION OF HWTSS TECHNOLOGIES.

For any technology to be used in emergencies it will be necessary to evaluate their availability, timeframe and logistics to achieve the targeted population. Since there are numerous types of 'HWT systems'. the research carried out a comprehensive evaluation of the HWT technologies existing in the market, particularly focusing on filter-type, disinfection, and safe storage systems (see Table 5 below). Systems evaluated are commercial type, which can be easily supplied through international markets and which have been commongly used by INGOs in emergencies. This research collected the information avialable about the effecteveness of each one of the methods, but does not include practical test in the laboratory.

The objective of the Table 5 below consist on provide guidance on HWTSS systems that could be incorporated into the RC/RC ERU. Special attention has been paid to filtration and desinfection water treatment systems. Larger water treatment systems, which should be considered in a later development situation, have been discarded into the module. Similarly, solar desinfection systems have not been considered due to the difficulty of ensuring their correct use by the local population.

Table 5. Household Water Treatment Technologies.

Technology types		Removal				Efficiency		Amount of Water		Ease of Use.			
		BACTERIES	VIRUS	PROTOZOOS	HELMINTOS	Turbidity	Water source	Flowrate	Lifespan	Operation & Maintenance	Spare parts	Acceptance	Availability
Ceramic Filters	Tulip siphon filter	Effective (>90%)	SOMEWHAT EFFECTIVE (>80%)	HIGHLY EFFICIENT (>99%)	HIGHLY EFFICIENT (>99%)	Effective in removing turbidity.	Very high turbidity can quickly plug the filter and increase the required backwash frequency.	According to the manufacturer, the filter serves to treat 7000 L. If a family treats 20 L/day, the candle will last a little less than a year.	5 years	Easy	The ceramic candle is fragile and should be replaced if it shows cracks or leaks or if it becomes very thin after frequent cleaning (probably every 6-12 months). Plastic parts last longer, but may need to be replaced.	Not information available about individual and community acceptance.	Manufactured and imported by Basic Water Needs.
	Paul (Portable Aqua Unit for LifeSaving)	Effective (>90%)	Effective (>90%)	Effective (>90%)	Effective (>90%)	N/A	N/A	At least 1200 litres/day (400 persons/day depending on the manufacturer).	10 years.	Easy	If it is not used, the equipment must be rinsed by filling it completely, agitate and dislodge the water by opening the screw cap. Then introduce about 10 liters and cover the top (where the raw water enters) with a plastic.	Easy to use, transport and maintain. Emergency agencies can leave the device at the disaster site once they leave the site as the membrane has a useful life of about 10 years.	Private manufacturer.
	Candle	HIGHLY EFFICIENT (>99%)	Effective (>90%)	HIGHLY EFFICIENT (>99%)	HIGHLY EFFICIENT (>99%)	Effective in removing turbidity and color.	Cloudy water (>50 UNT) should be settled or strained before filtering.	For filters with a ceramic candle, the flow rate is 0.14 L/hour; for filters with two ceramic candles, it is 0.23 L/hour.	Up to three years, usually between six months and a year.	Easy	Ceramic units should be replaced every 6-12 months, or when cracks are observed or the flow rate suddenly increases.	There may be small cracks in the ceramic that are not visible but reduce the effectiveness of the treatment. A good supply chain is necessary to help users get replacement ceramic units every 6-12 months.	Produced by different manufacturers around the world. Typically, candles are imported and filters are assembled locally.
Membrane filters	LifeStraw filter	HIGHLY EFFICIENT (>99%).	There are no independent tests	HIGHLY EFFICIENT (>99%)	HIGHLY EFFICIENT (>99%).	Very effective in treating turbidity. Effective in treating color.	Low turbidity water is preferred. This filter can be used with cloudy water, but may become clogged more frequently and require more frequent	The flow rate varies throughout the cleaning cycle and the life of the filter. 7 L/hr	Up to three years depending on the source water, frequency of use.	Moderate	The filter should be replaced completely at the end of its service life or if it breaks, if the flow rate is suddenly decreased, or if backwashing does not normalize the flow rate.	Not information available about individual and community acceptance.	Must be bought from Vestergaard.
Biosand filter	Hydraid® BioSand Filter	Effective (>90%)	SOMEWHAT EFFECTIVE (>80%)	HIGHLY EFFICIENT (>99%)	HIGHLY EFFICIENT (>99%)	High turbidity elimination. Eliminates iron. Can be modified to remove arsenic (see Kanchan filter). Not effective in removing most other chemical contaminants.	Cloudy water (>50 UNT) should be settled or strained before filtering.	The filter treats 15 L per load and one to four loads per day	Ten years or more.	Moderate	Caps and diffusers may need to be replaced before the rest of the filter body.	It is necessary to add water every one or two days for the biological layer to develop and maintain. Filters should not be moved once installed.	Available for wholesale purchase from partner organizations.

Chemical	**Aquatabs**	HIGHLY EFFICIENT (>99%)	HIGHLY EFFICIENT (>99%)	Not efficient.Assumption based on the performance of other chlorine products. There are no independent trials.	HIGHLY EFFICIENT (>99%)	It is not effective at removing chemical contaminants or turbidity.	Turbidity, organic matter, pH and temperature interfere with the proper functioning of chlorine. Cloudy water (>50 UNT) should be settled or strained before adding chlorine.	The tablets are dosed to treat specific volumes, ranging from 1 L to 2500 L. The minimum treatment time is 30 minutes.	They have a shelf life of 5 years if packaged in strips and 3 years if packaged in jars.	Easy	The product should be purchased periodically.	The manufacturer's instructions must be followed to ensure that the treatment is effective. A continuous supply chain is necessary to replenish the tablets. Some users reject the chlorine smell or taste. Free residual chlorine prevents water from re-contamination.	For sale in many countries. They can be bought wholesale and packaged locally; for that, tablets, packaging materials and a place to work are needed.
	P&G Water Purifier	HIGHLY EFFICIENT (>99%)	HIGHLY EFFICIENT (>99%)	HIGHLY EFFICIENT (>99%)	HIGHLY EFFICIENT (>99%)	Effective in removing turbidity, heavy metals (e.g. arsenic) and chemical contaminants.	Chlorine works best if the pH is 5.5 to 7.5.	Each sachet treats 10 L and the treatment lasts 30 minutes.	Envelopes must be used within 3 years of manufacture. Each envelope is for single use only. The expiration date appears on each envelope.	Easy	The product should be purchased periodically.	It is necessary to teach its use very well, because it has agitation and waiting times, which can increase the probability of improper use.	Manufactured and marketed by Procter & Gamble™
Moringa Seeds (natural coagulants)		SOMEWHAT EFFECTIVE (>80%)	Relevant data werenot found at the literature research		No	N/A	Not especific considerations.	Depends on the dosage and size of the container.	Variable; beans and dried seeds can be stored for a long time in a dry place. Tuna/nopal should be used before the sap dries.	Moderate	New supplies should be chosen and purchased periodically.	N/A	Different types of natural coagulants are available in different regions.

Source: WHO, 2106; IFRC, 2019; ICRC,2019

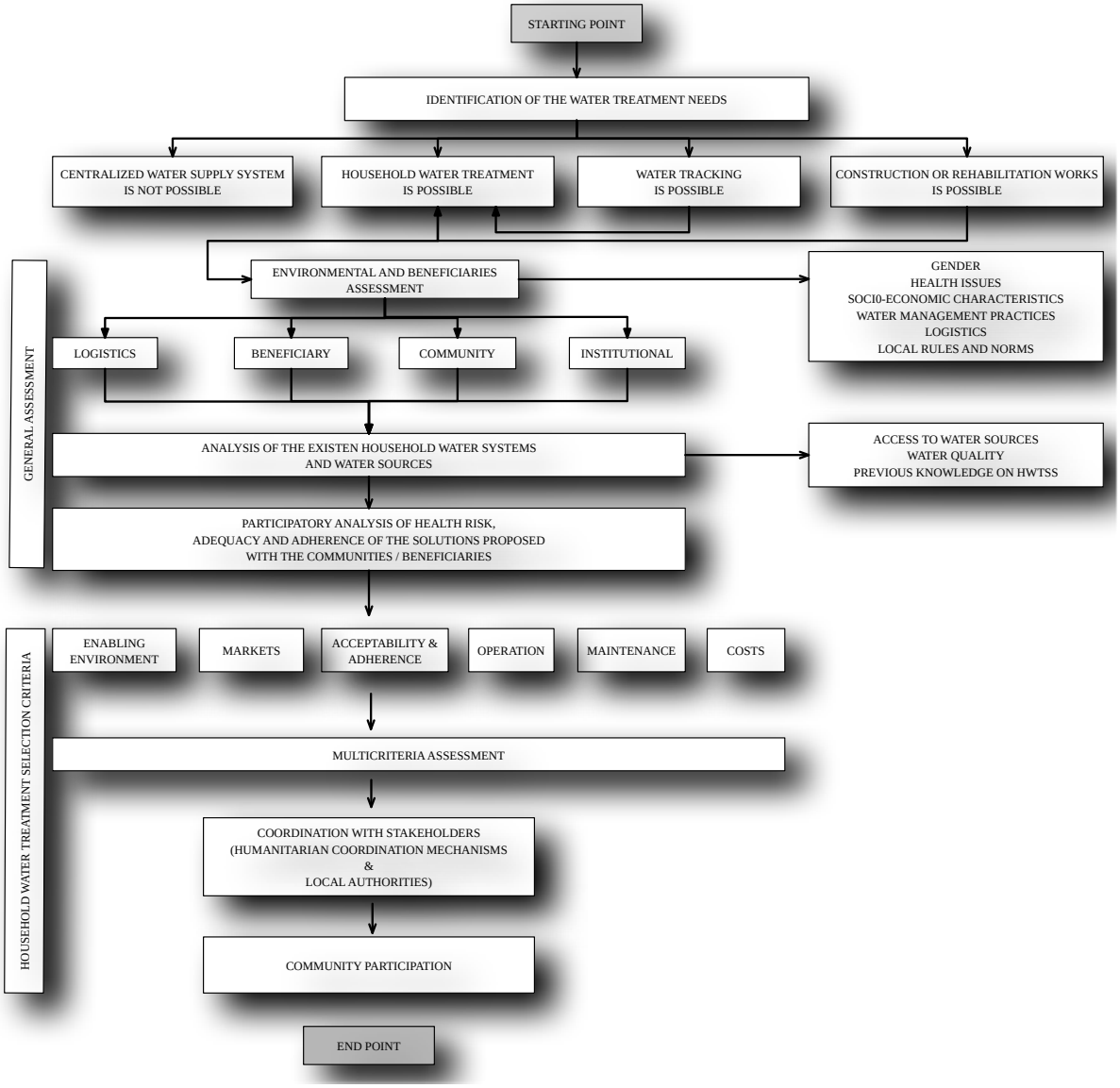
Ideally, the selected system should meet the following requirements: **a)** Small size, which will facilitate transport and distribution logistics; **b)** Reliable and that guaranteeing the healthiness of the water independently of external environmental conditions; **c)** Easy to use by the beneficiaries; **d)** If possible, it should have a residual effect, ensuring water quality for a certain period of time; **e)** Robust and with as few consumables as posible; **f)** Low cost.

Equipment to be included as part of the 'pre-packaged' module will depend as well on the scope of the emergency, quality and quantity of water sources available, health risk to communities, and the previous knowledge of the communities targeted in the affected area. Technical criteria retained for HWTSS technologies are easy to use, robustness, guarantee of results, costs, adherence and acceptance.

Moreover, RC/RC members cumulated experience shows that in these cases where water has low levels of turbidity but there are signs of contamination, beneficiaries may be reluctant to drink it. Perception in HWTSS is 'more than the a half of the path' when setting up HWTSS interventions.

Bearing in mind that 'visual perception' and taste, are key factors, the research suggests the following approach be used by ERU during deployments. As general principle, it would be necessary to include into the packing list flocculant/chlorination products to face situations where turbidity is high. This has been reported by Yates, T et al. (2017) as one of the most 'efficacious interventions' to increase access to safe water. A good alternative is Purified Water. Nevertheless, in cases where turbidity is low, it is suggested to distribute only chlorination products such as Aquatabs or other chlore products available on local markets. It is important that the relief organisation have a previous knowldege of the most common products used by the population in the targeted areas. This is not quite difficult for the RC which counts on an extensive network worldwide able to capture this information. In developing countries these information can be easily collected from concerned local authorities. These products can be rapidely distributed by the INGOs during the acute phase of the emergency in order to mitigate the spreading of water borne diseses. These products have to have an adequate lifetime, be easy to use, to transport, to distribute and to be handlde by the beneficiaries. It is important to highlight that most of these products have been designed to cover temporary needs and shouldn't be used as a sustainable HWTSS strategy by the INGO. Another issue is that instructions for the user have to be translated to the mother tongue of the targeted beneficiaries in order to mitigate risks linked to a bad use of the products supplied. On the Box 7 below it is described which are the main elements to be considered for the effective selection of HWT technologies.

Box 7. Overview of the elements to consider for the selection of HWT technologies.



Source: Author- based on information from WHO, 2016; IFRC, 2017 , Loo, S. L. et al 2012 and Steeleand Clarke, 2008.

4.2.3.3. PLANNING.

RC/RC ERU Unit cannot be efficiently developed withouth investing time in preparedness activities and getting an increasing knowledge on HWTSS local practices in prone disaster areas, identifying potential suppliers and local partners and/or logistic challenges and possible solutions. Investing on HWTSS preparedness lead to a rapid, effective and timely humanitarian response. While operation HWTSS solutions during the acute phase of the emergency, ERU teams should commence early recovery in parallel with ongoing humanitarian response in order to sustain the results of life-saving interventions. Early recovery activities can be linked with rehabilitation/construction of fixed water supply

structures, or promotion of sustainable HWTSS methods, meaning affordable, costless, friendly use and accepted by the community.

It has been briefly explored how HWTSS interventions might be implemented on the ground, what are the steps to be achieved at each phase of the emergency to provide clean water through HWTSS systems and what would be the key actvities to be considered when ERU professionals are deployed on the ground. In summary, the FoA suggested above is not only a theoritical framework but has been also translated into detailed activities and action plans. This research has identified different objectives and activities, at each stage of the emergency response cycle, which will be useful for guiding the operational work done by the professionals deployed at the theatre of operations. These steps are distributed as follows:

1) **Before the treshold:** RC/RC as well as other humanitarian organisations have an extensive network of human resources and headquarters worldwide and count with an active presence in prone disaster areas and the most relevant conflicts. As mentioned before, some of these organisations have cumulated a significant expertise on the production of clean water in emergencies at the PoU and the PoC. Most of them have built local and fruitful partnerships with civil society organisations, local NGOs, authorities and regulatory institutions. This presence can be efficiently be used to carry out sufficient context analysis avoiding risk factors (appropriateness, acceptability) linked to the setting up of HWTSS interventions. Preparedness activities can lead to important gains in terms of effectiveness and reactiveness when implementing HWTSS operations. Bearing in mind this, organisations are encouraged to test in advance the following parameters:
    - Acceptance of HWTSS products in prone disaster areas (smell, test and/or friendly use);
    - Barriers to an efficient delivery of HWTSS products and deployment of HWTSS ERU units;
    - Track and analyse availability of HWTSS prducts on the markets in prone area disasters;
    - Sign agreements with local providers and international suppliers for rapid deployment of materials and equipment;
    - Identify and train key staff at NS (decision makers and volunteers) or other potential partners to set up HWTSS methods;

2) **First 72 hours in the aftermath of the disaster:** RC/RC plays a key role; as they are the first responders in the aftermath of a man-made or hazardous event, jointly with communities and civil protection services. Specialised human, financial resources and

equipment are available at RC/RC. Once the emergency mechanisms are launched, the RC/RC can be immediately deployed on the ground to:

- Establish a rapid assessment to define the scope of the disaster and the targeted beneficiaries;
- Select the most adequate materials and equipment to be distributed to the beneficiaries;
- Ensure accessibility and safe conditions to organise 'door to door' or 'communal distributions'.

3) **Emergency response:** Bearing in mind the modality of ERU deployment, activities have been organised around in 3 team rotations. The duration of each rotation is four weeks approximately. Obectives and activities associated to each rotation are described as follows:

a) **Objective:** Population affected by the hazardous event is provided with immediate access to clean water (water lifesaving activities) through HWTSS in a given area.

Duration: 1st rotation (4 weeks)

- Clarify the responsabilities of the ERU in supporting NS emergency response (i.e. how is the RC/RC ERU going to work with the host NS);
- Logistics proceedings to receive ERU material (customs clearance, permissions);
- Strenghten existing coordination mechanism with NS but also ensure participation in WASH clusters and other humanitarian platforms to ensure response is timely and respectful of humanitarian standards;
- Support NS on establishing rapid assessment to gather relevant WASH information and/or if it is possible to use the information collected through the preparedness activities and previous knowledge acquired in the affected country. Assessment should include market analysis;
- Based on the findings of the rapid assessment establishing adequate strategy to promote water safety plans or multi-barrier approach to mitigate water related diseases issues;
- Identify and train key personal of the host NS to participate in awareness and sensitization campaigns;
- Ensure that volunteers and other staff participating into HWTSS deployment are trained and adequately equipped with training and sensitization materials;
- Set up of effective relief and distribution systems for HWTSS items. When local markets have not been completely disrupted CASH transfer modalities can be used for implementing HWTSS interventions;
- Ensuring that most vulnerable groups are included into HWTSS activites planned;

- Ensure that distribution of HWTSS materials or CASH transfer modalities are adequately coordinated with community leaders and local authorities;
- Ensure that targeted population receive essential and cultural appropriate information on the use of HWTSS methods;
- Ensure that targeted population receiving hygiene promotion items has basic knowledge on the transmission of water borne related diseases;
- Monitor regularly water quality, safe storage and hygiene practices at household level;
- Implementing corrective actions.

b) **Objective:** Population affected by the hazardous event has access to clean water, adequate knowledge on safe storage, water management at household level and basic hygiene practices in order to mitigate the impact of the disaster.

Duration: 2nd rotation (4 weeks)

- Continue to implement activities included into the PoA such as the distribution of inputs for HWTSS if water quality indicators are not consistent to avoid public health risks;
- Continue to implement sensitization and awareness campaigns to ensure adequate use of HWTSS items, knowledge and practice of water management at household level;
- Continue to monitor and evaluate on a regular basis the achievements of the program against benchmarks initially established.;
- Continue to participate in coordination plaforms and generate information to better inform ERU decision making process;
- Evaluate long-term alternatives to sustainable water supply (structural interventions);
- Ensure periodic sensitization and suveillance mechanisms to keep track of possible changes regarding use of HWTSS and its consequences for public health.

c) **Objective:** Population has access to sustainable water supply systems, including water safety plans.

Duration: 2nd rotation (4 weeks)

- Progressively move water supply interventions from HWTSS to more sustainable and structural solutions (pipe distribution; rehabilitation of wells);
- Strenghtenning Water Safety Plans;
- If HWTSS is adopted ensure that technologies and approaches can be replaced step by step by long-term solutions through more structural interventions;

- If it is not the case, then ensure that water technologies and approaches are respectful of national satandards and long-term sustainable development;
- Strenghten local markets and knowledge of local operators to ensure adequate supply of HWTSS systems promoted during the emergency.

5. CONCLUSIONS AND RECOMMENDATIONS.

5.1. CONCLUSIONS.

The following recommendations have been elaborated bearing in mind the respect of the humanitarian standards and principles applying for humanitarian interventions in man-made and/or natural disaster. These recommendations are based on the conclusions coming out from the relevant literature existing on HWT related interventions in emergencies as well as the results of personal interviews and questionnaires and lastly the documents (case studies, lessons learned) collected from the emergency practitioners belonging to most important relief organisations.

The set of recommendations provided pretends to be as practical, realistic and easy as possible to be implemented on the field when deploying RC/RC ERU.

Finally, the set of recommendations provided on the lines below are addressed to RC/RC ERU delegates, persons in charge of ERU Deployments or WASH specialists in the hope to improve ongoing HWT and safe storage practices in emergencies.

5.1.1. DATA COLLECTION ON HWT.

The dissertation research detects some gaps linked to the fact that there is limited information available regarding the impact of HWT activities implemented by relief organisations in emergencies. Lack of information is even more worrying during the acute phase of the emergency while it becomes less and less difficult to find field reports and relief organisations cumulated experience on household water interventions during the stabilization phase and the recovery phase. Final analysis raises some of the barriers found to have more evidence base data about the contribution of HWT methods to the reduction of water borne diseases or their impact on saving lives consists on deficiencies detected during the design phase. These weaknesses are related to the way in which relief organisations define and operationalize their monitoring approaches and tools to achive their health outcomes. In fact, 37.5% of the people surveyed indicate that they lacked well-structured information tools able to better inform their decisión making process on the field. This is also aligned with the fact that approximately 15% of the people interviewed highlighted the need to develop more guidance on how to operationalize more efficiently HWT programs in emergencies.

Recommendation 1:

Adequate strategies have to be design to collect reliable information aiming to better inform the decision-making process. The possibilities offered by the use of new technologies is strongly recommended to boost impact of the household water activities implemented.

In addition, 25.64% of the people questioned highlights that they do not have access to specific tools or detailed FoA when planning HWT. In the light of these figures it becomes clear the need to provide more guidance on how to plan, design and operationalize this type of interventions in order to gain impact. After all, practitioners mention to seek guidance by consulting the Sphere Handbook (45% of the total answers), sepcific internal guidelines developed at each organisation (37%), WHO technical and support documetns (11%), UNICEF resources available on water supply (8%). In a word, we can state that most of the organisations and practitioners knows which are the common ressources and minimum standards and tools required for the setting up of HWT interventions in emergencies, but only 37% of the people interviewed mention that their organisations have developed and used internal guidelines or 'ad hoc' specifc FoA. This information shows that not only organisations but also WASH practitioners are in need to support their work in emergencies with a more systematic approach from humanitarian organizations. Moreover, that 41.02% of the organizations do not have developed a specific and pre-packaged system for the implementation and satisfactory operationalization of HWT programs in emergencies, while 52.98% do.

Recommendation 2:

Organisations and WASH practitioners who are implementing HWTSS activities in the aftermath of a given disaster are responsable for monitoring on regular basis the level of achievement of health outcomes previoulsy established.

As shown above, it becomes more evident the need of developing operational tools and recommendations for an effective set up of household water interventions in emergencies. Then, improvements can be easely accelerated if relief organisations are better prepared in order to have a better knowledge of HWT best practices and solutions in prone disaster areas. In addition to this, findings from the literature review and questionnaires show that having access to clear procedures is not enough for ensuring a successful implementation of HWTSS interventions.

5.1.2. BARRIERS TO HOUSEHOLD WATE INTERVENTIONS.

Recommendation 3:

Communication, accountability and monitoring systems are part of the core elements for ensuring good practices in alignement with humanitarian standards and the Grand Bargain agreement.

Research points out the following challenges as the most important to ensure the adequate implementation of HWTSS on the field **a)** ensure water quality at the point of consumption PoUWT(14.79%); **b)** operation and maintenance of HWT systems distributed (11.97%); **c)** acceptability of the HWTSS solution proposed (11.97%) and finally **d)** logistics and getting regular access to the population affected by the disaster (11.97%).

5.1.3. FACTORS OF SUCCESS TO ENSURE ADEQUATE IMPLEMENTATION OF HWT PROGRAMS.

In a context of increasing exposure to natural disasters and the consequences of socio-political tensions because of the scarcity of natural resources and the consequences of climate change, clean water supply continues to be an essential part of humanitarian interventions lead by relief organisations in order to save lives and avoid the spreading of diseases. As mentioned before, there is 'not one silver bullet' or a 'miraculous solution' to provide clean water to the population affected by man-made or natural disasters.

Recommendation 4:

Understanding what does and does not work across geographic regions, income groups and methods is essential for the interactive improvement of implementation strategies. In turn, this will greatly increase the likelihood of achieving the health goals of HWTSS.

Recommendation 5:

Wash practitioners should make programme design a priority when implementing HWT and safe storage programs in emergencies to ensure adequate participation and boost project ownership of the program during the whole project cycle by the communities affected by the disaster.

It is highly recommended to use the multi-barrier approach to reduce water contamination and protect health. Principles described into the Water Safety Plans (WHO, 2005) can be useful to be implemetned when applying HWTSS operations.

It is also clear that the range of factors influencing successfully HWTSS interventions is more linked to the inmaterials such as having a good knowledge of the emergency contexts, a good monitoring and evaluation system in place to track progress against health outcomes or a clear strategy to train and successfully ensure a water mulit-barrier approach at household level rather than the type of equipment, materials or staff deployed during the emergency. HWT interventions are among a range of water supply interventions which principles are closely linked to have a good understanding of previous knowledge and customary practices. Then, the effectiveness and efficacy of the solutions provided by the relief organisations in the aftermath of the disaster should be guided for some of the principles described below:

- *no water selection technology without community engagement and participation;*
- *no distribution without adequate community training;*
- *no HWT program without strong "behaviour change program";*
- *no delivering of activities without adequate monitoring systems;*
- *no delvery of water services at household level without coordination with stakeholders)*.

5.1.4. IMPACT.

Recommendation 6:

Develop more specific tools to assess public health impact and risk, including sources of water contamination and potential health risks existing at household level. Practitioners must pay special attention to the whole chain of delivery going from point of delivery to the point of consumption in the aftermath of an emergency.

It is also quite significant that around 35.90% of the people surveyed indicates that HWTSS solutions proposed are not enough efficient to have impact on quantity and quality of the water consumed at household level. This is perfectly aligned with the data gathered from the literature review (Elrha, 2019) that show the lack of simple, acceptable and sustainable HWT related solutions and the urgent need to increase research on new technologies. The use of big data management and the development of new technologies applied to monitoring purposes have a great potential to evaluate the efficacy of the solutions proposed and better inform the decision-making process. Some examples might be including water quality sensors on the buckets distributed by the relief organisations in order to better monitor the level of residual chlorine at the point of use by the final beneficiaries or (include ELRHA). Information obtained is relevant to better inform decision-making process, show value for money and anticipate future public health risks.

5.1.5. INCLUDING HWTSS INTO THE EMERGENCY RESPONSE UNIT (RC/RC ERU) DEPLOYMENT MODALITIES.

Including HWTSS strategies as a modality of deployment for the RC/RC ERU can be of great help in increasing the number of beneficiaries, mainly in those areas hard to reach, with greater transport difficulties for scattered/concentrated populations having access to poor quality water. Characteristics of the RC/RC ERU deployments allows flexibility into the design of the solutions proposed while having access to a set of prepackaged tools ready to be rapidely deployed on the field.

HWTSS implementing designs that are not based on strong community participation and a good understanding of the emergency and type of disaster can be easily jeopardize. From this point of view training of RC/RC volunteers is essential to achieve the ultimate goals.

The implementation of HWTSS interventions using Emergency Response Units of the IFRC demands important investments on preparedness activities. ERU practitioners interviewed highlighted the importance of strengthening volunteer system at each NS in order to improve local skills and technical capacities to better identify this type of interventions. There are various reasons, which encourage doubling the efforts into this direction. First, RC volunteer system is a unique and particular system to come in help of vulnerable populations and in some context (violence, political tensions), the first line and the only well-structured response mechanism, excluding armed forces or other emergency services provided by the states, we have for saving lines. Then, volunteers belonging to the NS usually have a better understanding of the community than any other relief organisation. This network allows RC to meet needs for affected populations living in hard to reach areas.

Recommendation 7:

HWTSS interventions may have different options according to the approach and objectives designed for the RC/RC ERU HWTSS module. Then, HWTSS can be implemented to complete other water supply centralized systems and strengthen the effectiveness of the ERU intervention through a better control at household level of water quality parameters. On the other hand, HWTSS may be used itself as a decentralized water treatment solution in cases where centralized water treatment cannot be implemented, packaged water distributions are a temporary solutions or water tracking are so expensive. From this point of view HWTSS module can be deployed independently of the other part of the ERU Wat San components.
Whatever may be the final outcomes expected for the deployment of RC/RC ERU HWTSS module, sanitary surveys must be carefully conducted to assess public health risks associated, prior to the setting up of HWTSS aiming to define appropriateness of the intervention and select the most effective strategic approach.

5.1.6. PROGRAMME DESIGN

There is no one right way to make decisions about when and how HWTSS interventions should be implemented. Nevertheless, a tentative ‘decision tree’ has been provided by the researcher to guide the decision-making process.

Recommandations 8:

Distribution of HWTSS items should be coupled with hygiene promotion and education activities that allow improving water management at household level.

It is significant that data collected from surveys indicates that 50% of the people interviewed mention that community participation is residual and only linked to very specific activities on the ground (42.86%) or communities are only engaged at the beginning of the humanitarian operation (7.14%). Data suggest that relief organisations struggle to mainstream community participation during the whole project cycle. This can be one of the underlying causes reducing efficiency of HWT projects on the field.

Additionally, INGOs often focus on a HWTSS option rather than considering the whole water treatment process. Furthermore, HWTSS efforts can be easily jeopardized if it is not carefully integrated into the project design, as part of the monitoring activities, which are the effect-cause relationships existing with water management at household level or the lack of adequate sanitation or waste management.

Recommendation 9:

Elaborate and include adequate technical protocols required to assess the level of acceptability (palatability, smell, etc.…) by the individuals and the communities of the solution proposed by the relief organisation. Being able to identify in advance an adequate level of tolerance to the level of free residual chlorine may contribute to increase acceptability of the products distributed during emergencies, makes the operation more efficient and avoid rejection the rejection of the population and a waste of products.

There is not best technology for HWTSS. There are many criteria to be considered wgeb selecting HWTSS soluitons. The following variables have to be compulsory taken into account into the design of the relief operation. A robust situation analysis seeking to establish a deep understanding of the context, including previous knowledge and market assessment is an essential requirement to determine the acceptability and appropriateness of the solutions proposed.

5.1.7. EQUIPMENT & WATER TREATMENT.

Recommandations 10:

It is essential to ensure adequate safe storage systems, such as "Jerry Can", to avoid the recontamination of treated water. In the case of the use of chemical reagents, the volume of the "Jerry Can" must coincide with the dose of reagent selected. The use of "Jerry Can" with a tap will minimize the possible manipulation of the treated water.

Although there are a multitude of systems that can be used for the implementation of HWTSS strategies, most of them are not easily adaptable to the infrastructure and way of working of RC RC/RC ERU system. Although none of the systems evaluated meets all the proposed requirements, it is perhaps the chemical disinfection systems, such as Aquatab or PUR WATER, that could be best adapted to the needs. This is mainly due to its low unit cost, ease of use, and small size, which would facilitate its incorporation into the unit's logistics. Similarly, candle filters, such as Tulip water filter, seem a plausible solution, although the high cost of these may discourage their incorporation.

Analysis of water quality parameters (turbidity) and the perception of beneficiaries are key when selecting appropriate HWT methods. Furthermore, solutions already known by the affected communities should be privileged compared to the introduction of new technologies.

To increase effectiveness, it is important to explore the combination of multiple technologies and water treatment methods to increase effectiveness. More in detailed, the effects of those treatments that provide no residual disinfectant, such as solar treatment and filtration could be implemented in combination with chlorination and coupled with safe storage to provide a multi-barrier approach that result in better protection. Research and demonstration of such multi-barrier treatment and storage approaches deserve consideration and are recommended as next steps in the development, evaluation and implementation of improved treatment and storage of water at the household level [45] .

Recommendation 11:

Relief organisations should look into what is locally available and what is of quality as many of the imported filters (Life Straw/Sawyer) may have poor value for money, be too expensive or finally not user friendly for the affected communities.

5.1.8. PREPAREDNESS.

Recommendation 12:

I suggest the NS working in pronet disaster areas and under the lead of the IFRC, can identify which are the main drivers leading to increase the acceptability of the products most commonly used for the setting up of treatment of at HWT. In addition to this a global exercise can be implemented aiming to gather relevant information about HWT enabling factors and barriers worldwide.

Organisations can be better prepared for implementing HWTSS programs in various ways, contributing to the increasing effectiveness of their future operations in emergencies. RC/RC RC/RC ERU is a good example of the importance given to build capacities for ERU staff usually involved into the emergency response. RC/RC ERU system allows the organisation to keep a pool of well-trained specialists able to be rapidly deployed on the field. Nevertheless, there is still a long way to run to work deeply on programmatic HWTSS actions. Some of these programmatic preparedness activities can be directly linked to increasing the existing knowledge on the field, developing lessons learned and having a better understanding of what it works or not in prone disaster areas. Other areas of improvement consist in boosting research to make HWT technologies affordable for communities affected at household level. Finally, monitoring of quality parameters is another important area of development in getting more impact.

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NS working in prone disaster areas and under the lead of the IFRC, can identify which are the main drivers leading to increase the acceptability of the products most commonly used for the setting up of HWT in the targeted area.

Then, strengthening trainings related to the setting up of HWTSS, which should be addressed to National Societies' volunteers and RC/RC managers with WASH responsibilities in the field. These trainings should include practical sessions how to better engage with communities in case of disaster and should have a practical approach and be taken as an opportunity to collect relevant information about concepts such as the acceptability of the solutions proposed.

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7. APPENDICES

Appendix A: Key informant semi-structured inerview questions.

Key informant semi-structured inerview questions.

a) Under which circumstances do you think is it more suitable the use of HWTSS approach to provide clean water in emergencies? (scope of the emergency, type of emergency, distribution of the population targeted)

.....

b) At which stage of the emergency do you consider HWTSS interventions have added value (acute phase of the emergency, stabilization phase, early recovery or recovery phase)?

.....

c) According to your large experience in emergencies, Where do you think the organizations put the biggest focus to provide clean water? and why?
c.1) Water treatment at the point of water production and delivery to final beneficaireis
c.2) Water treatment a the point of consumption
c.3) A mixed approach (point of water production/point of water consumption.

.....

e) Which are the main factors influencing a successful HWTSS strategy in emergencies?

.....

g) Which are the critical elements to be avoided when implementing HWTSS interventions in emergency context?

.....

h) Which are the main criteria for HWTSS technology selection.

.....

i) According to your experience which are the main challenges faced by humanitarian organsitions when implementing HWTSS interventions in emergencies?

.....

j) From your point of view, If it is decided to create a "pre-packaged" module on HWTSS to be ready for emergency deployments, which are the materials&equipments you would include and which are the skills you consider have to be integrated into this module.

.....

k) What are your suggestion to improve HWTS solutions provided by relief organisations in the aftermath of a disaster?

.....

Appendix B: Survey interview questions.

Research survey on HWTS in Emergencies: WASH practitioners

This survey has been elaborated for academic research. Your responses are voluntary, confidential and completely anonymous. Responses will not be identified by individual. All the responses will be compiled together and analyzed as a group. Additionally, your responses are combined with those of many others and summarized in a report to further protect your anonymity. If you need further information or have any questions or concerns, please contact Oscar LLorente Pelayo (Operations Manager and Researcher) at the following address or o.llorente-11@student.lboro.ac.uk. This research project is conducted for the WEDC Loughborough University as part of the MSC studies "Infrastructures in Emergencies". Your responses are in compliance to the Loughborough University Policy related to data management.

Please indicate your GPS coordinates

latitud (x.y °)

longitud (x.y °)

altitud (m)

precisión (m)

Which was last organization you have worked for?

Which is the title of your current position? (please select one option)

- ◯ Director of emergency operations at the Headquarters
- ◯ Project/operation manager at Headquarters
- ◯ Water and sanitation coordinator at Headquarters
- ◯ Freelance/Consultant
- ◯ Other

If other, which is your position?

How many years of experience have you been working in emergencies?

- ◯ less than 5 years
- ◯ more than 6 years
- ◯ more than 10 years

How many years of experience have you been managing water supply interventions in emergencies?

- ◯ less than 5 years
- ◯ more than 6 years
- ◯ more than 10 years

Which was the last emergency you or your team deal with? (indicate the country)

_____

Which was the type of emergency you deal with? (please select one option)

- ◯ earthquake
- ◯ landslides
- ◯ tsunamis
- ◯ avalanches
- ◯ floods
- ◯ cyclones
- ◯ disease epidemics
- ◯ complex emergencies/conflicts
- ◯ displaced populations
- ◯ other

If "other", which kind of disaster?

_____

What was the nature of the disaster? (according to the set of options displayed below, please indicate which were the main characteristics of the disaster)

- [ ] rapid onset disaster
- [ ] slow onset disaster
- [ ] occurred in a rural area
- [ ] occurred in an urban area
- [ ] dense settlements
- [ ] dispersed scattered settlements
- [ ] small scale disaster (a type of disaster only affecting local communities, 1 to 5 deaths, less than 100 Households/building affected, which require assistance beyond the affected community and can be provided by national or international organizations)
- [ ] medium scale (a type of disaster affecting local communities, 1-50 people killed, 100 to 500 households/buildings affected and local economic consequences)
- [ ] large scale disaster (affect large geographic areas and have a major impact on people and infrastructure and requires national international assistance)
- [ ] easy access to populations in need of humanitarian assistance
- [ ] difficulties to reach populations in need of humanitarian assistance
- [ ] frequent disaster
- [ ] infrequent disaster
- [ ] chronic crisis

At which stage of the emergency did you were involved? (please select one option)

- ◯ acute phase (first 2 weeks)
- ◯ transitional phase (3-4 weeks)
- ◯ stabilised phase (from 1 month to 3 months)
- ◯ all the emergency operation
- ◯ planning and design of the intervention

For how many people approximately the implementing project supplied clean water? (please select one option)

- ◯ less than 5 000 people
- ◯ between 5 000 and 10 000 people
- ◯ more than 10 000 people

Where did the organization put the biggest focus to provide clean water? (please select most adequate options)

- ◯ (A) water treatment at the point of water proudcion and delivery (PoS) to final beneficiaires
- ◯ (B) water treatement at the point of consumption (PoUWT) (Household Water Treatment)
- ◯ (A) and (B)
- ◯ other

If other, what was the activities prioritized to provide clean water?

Why this strategy was selected?

How the strategy was developed? and which were the main factors influencing the strategy?

Did the project implement any activity to mitigate the risk of water borne diseases at houshold level? (please mark most adequate options)

- ☐ hygiene promotion activities
- ☐ water items distribution (chlorine, filters,buckets...)
- ☐ monitoring of water quality parameters at the whole water supply chain (including final users)
- ☐ not, any other complementary activity was implemented
- ☐ other

If you answered "OTHER", please indicate which one?

Did the organization have any previous experience working in the area affected by the disaster? (please select one option)

- ◯ yes
- ◯ no

Did you use any sepcific operational tool or framework of action when planning HWTS interventions? (please select one option)

- ◯ yes
- ◯ no

If yes, which one? (please mark most adequate options)

- [ ] Internal guidelines developed by the Emergency Department
- [ ] Sphere Handbook
- [ ] WHO guidelines
- [ ] UNICEF guidelines
- [ ] Other

If you answered "OTHER", please indicate the name of the specific operational tool or framework of action used during the operation?

_____

If "NOT", under which circumstances do you think it is more effective to invest on water supply solutions at household level? (please select one option)

_____

Did the organisation have any specific HWTS "prepackaged" material & equipment & staff to be immediately deployed in the aftermath of the disaster?

- ◯ yes
- ◯ no

If "YES" which kind of emergency items were distributed to the affected population during the emergency? (please select one or several items)

- [ ] chlorine tablets
- [ ] safe storage items - buckets
- [ ] ceramic filters
- [ ] membrane filters
- [ ] flocculation and desinfection tablets
- [ ] other

If you answered "OTHER", which one?

_____

Based on your experience on the field, which are the conditions that you consider the most important for the setting up of successful HWTS interventions in emergencies?

_____

Do you think that current HWTS solutions proposed by relief organisations are really efficient and impact on quantity and quality of the water consumed at household level?

- ◯ yes
- ◯ no

Which are the products or HWTS methods from the list proposed below that you are familiarized with?

- ☐ Aquatab
- ☐ PuR
- ☐ Water Guard TM
- ☐ Ceramic filters
- ☐ Life Straw Family
- ☐ Hydraid® BioSand Filter
- ☐ SODIS
- ☐ Boiling water
- ☐ Other

If you have answered "OTHER", please indicate which one?

_____

Do you think that current HWTS solutions proposed by relief organisations are really efficient and impact on quantity and quality of the water consumed at household level?

- ◯ yes
- ◯ no

How would you improve HWTS solutions provided by relief organisations in the aftermath of a disaster?

_____

Thanks for answering this survey. If you are interested to have further information on the results of this survey you can send a message to the following email : o.llorente-11@student.lboro.ac.uk. Thanks for your collaboration.

Research survey on HWTS in Emergencies: ERU practitioners

This survey has been elaborated for academic research. Your responses are voluntary, confidential and completely anonymous. Responses will not be identified by individual. All the responses will be compiled together and analyzed as a group. Additionally, your responses are combined with those of many others and summarized in a report to further protect your anonymity. If you need further information or have any questions or concerns, please contact Oscar LLorente Pelayo (Operations Manager and Researcher) at the following address or o.llorente-11@student.lboro.ac.uk. This research project is conducted for the WEDC Loughborough University as part of the MSC studies "Infrastructures in Emergencies". Your responses are in compliance to the Loughborough University Policy related to data management.

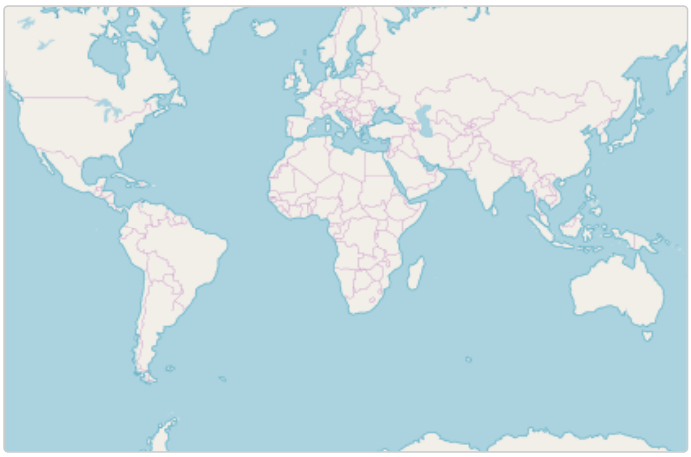
Please indicate your GPS coordinates

latitud (x.y °)

longitud (x.y °)

altitud (m)

precisión (m)



When was the last year you were deployed as member of the ERU?

By which National Society were you deployed?

What was the ERU with which you were deployed last time? (please select an option)

- ◯ Water & Sanitation: Module 15
- ◯ Water & Sanitation: Module 40
- ◯ Water & Sanitation: Module Mass Sanitation 20

Which was your role during the ERU deployment?

How many years of experience have you been working in emergencies?

- ◯ less than 5 years
- ◯ more than 6 years
- ◯ more than 10 years

How many years of experience have you been managing water supply interventions in emergencies?

- ◯ less than 5 years
- ◯ more than 6 years
- ◯ more than 10 years

Which was the last emergency you have participated as a member of the ERU team? (indicate the country)

_____

Which was the type of emergency? (please select one option)

- ◯ earthquacke
- ◯ landsalides
- ◯ tsunamis
- ◯ avalanches
- ◯ floods
- ◯ cyclones
- ◯ disease epidemics
- ◯ complex emergencies/conflicts
- ◯ displaced populations

What was the nature of the disaster? (please mark the most adequate options)

- [ ] rapid onset disaster
- [ ] slow onset disaster
- [ ] occurred in a rural area
- [ ] occurred in an urban area
- [ ] dense settlements
- [ ] dispersed scattered settlements
- [ ] small scale disaster
- [ ] medium scale
- [ ] large scale disaster
- [ ] easy access to populations in need of humanitarian assistance
- [ ] difficulties to reach populations in need of humanitarian assistance

At which stage of the emergency did you were involved? (please select one option)

- ◯ acute phase (first 2 weeks)
- ◯ transitional phase (3-4 weeks)
- ◯ stabilised phase (from 1 month to 3 months)
- ◯ all the emergency operation

When were you deployed by your National Society? (please select one option)

- ◯ initial deployment of the ERU team (1-3 months)
- ◯ 1st rotation of the ERU team (4-6 months)
- ◯ 2nd rotation of the ERU team (7-9 months)
- ◯ other

If you answered "OTHER", please indicate which one?

_____

For how many people approximately the implementing project supplied clean water? (please select one option)

- ◯ less than 5 000 people
- ◯ between 5 000 and 10 000 people
- ◯ more than 10 000 people

Where did the organization put the biggest focus to provide clean water? (please select most adequate options)

- ◯ (A) water treatment at the point of water proudcion and delivery (PoS) to final beneficiaires
- ◯ (B) water treatment at the point of consumption (PoUWT) (Household Water Treatment)
- ◯ (A) and (B)
- ◯ other (water tracking,distribution of packaged water)

Why this strategy was selected?

_____

How the strategy was developed? and which were the main factors influencing the strategy?

_____

Did the ERU implement any activity to mitigate the risk of water borne diseases at household level? (please select an option)

- ☐ hygiene promotion activities
- ☐ water items distribution (chlorine, filters,buckets...)
- ☐ monitoring of water quality parameters at the whole water supply chain (including final users)
- ☐ not, any other complementary activity was implemented
- ☐ other

If you answered "OTHER", could you indicate which one?

_____

Did the ERU team distributed to the population affected by the disaster any household water treatment solution?

- ◯ yes
- ◯ no

Which kind of technical solution did you offer to the population?

- [ ] chlorination through the distribution of Aquatabs tablets
- [ ] distribution of ceramic water filters
- [ ] boiling
- [ ] distribution of biosand water filters
- [ ] solar desinfection
- [ ] UV irradiation
- [ ] plain sedimentation
- [ ] aireation
- [ ] floculant desinfectant PuR
- [ ] floculant desinfectant WaterMaker
- [ ] other

If you answered "OTHER", please indicate which one?

Where Household Water Treatment and Safe Storage (HWTS) items were purchased?

- ◯ items were purchased locally
- ◯ items included into the ERU pre-packaged material
- ◯ other

If you answered "OTHER", please indicate which one?

Which were the measures adopted to minimize post-delivery water contamination? (please mark most adequate options)

- [ ] distribution of clean and appropriate collection and storage containers
- [ ] setting up of regular water quality controls at the point of use (household level) to monitor post-delivery contamination
- [ ] awareness campaigns on the importance of household water treatment and safe storag
- [ ] improved collection and storage practices through trainings at household level
- [ ] regular trainings on HWTS methods
- [ ] none of them
- [ ] other

If you answered "OTHER", please indicate which one?

Previously to be deployed on the field, did you know what household water treatment and hygiene promotion customary practices had local populations in the area of intervention?

- ◯ yes
- ◯ no
- ◯ I have a rough idea on the existing HWTS and hygiene promotion practices in the area affected by the disaster

Population was consulted on adequacy of HWTS to be supplied during the operation?

- ◯ yes
- ◯ no

If you answered "NOT", could you explain why?

Did the household water treatment solution proposed coupled with adequate capacity building?

- ◯ yes
- ◯ no

If you answered "NOT", could you explain why?

Did the household water treatment solution proposed by the NGO coupled with distribution of storage tools?

- ◯ yes
- ◯ no

If you have answered "NOT", could you explain why?

Capacity building and trainings messages on the use of HWTS were coordinated with other organizations and local authorities during the emergency?

- ◯ yes
- ◯ no
- ◯ partially coordinated

If you answered "NOT" or "PARTIALLY COORDINATED", could you explain what was the reason?

Was water quality regularly measured at household level (free residual chlorine, quality parameters) by the ERU during the emergency?

- ◯ yes
- ◯ no

If "YES" which was the frequency of the measurements?

- on daily basis
- on weekly basis
- on quarterly basis

If you answered "NOT", could you explain why?

Was the community affected by the disasters actively involved into the identification and planning of the HWTS activities on the ground? (please select one option)

- ◯ yes starting from design of the intervention to the monitoring activities
- ◯ only at the beggining of the operation
- ◯ participation was residual and only linked to very specific activities on the ground

Under which circumstances do you think it is more effective to invest on water supply solutions at houshehold level?

Do the organisation have any sepcific operational tool or framework of action when planning HWTS interventions? (please select one option)

- ◯ yes
- ◯ no

If "YES", which one? (please mark most adequate options)

- ☐ Internal guidelines developed by the Emergency Department
- ☐ Sphere Handbook
- ☐ WHO guidelines
- ☐ UNICEF guidelines
- ☐ Other

If "OTHER", please could you indicate which one?

Based on your experience, under which circumstances do you think is more effective to invest on water supply solutions at houshehold level?

According to your experience which are the three most important elements to be considered for adequate success of HWTS interventions in emergencies? (please mark most adequate answers)

- ☐ previous knowledge on HWTS by local population affected by the disaster
- ☐ easy humanitarian access to the population affected by the disaster
- ☐ easy access to water sources
- ☐ location of the population: concentrated vs scattered settlements
- ☐ typologie of the disaster
- ☐ availability of water sources into the affected area
- ☐ water treatment technology available in the affected area
- ☐ acceptability by the community of the solution proposed (smell and taste)
- ☐ easy access to material and equipment locally
- ☐ affordability of the water treatment technology chosen by the users
- ☐ compliance with country norms and rules on water supply
- ☐ coordination among relief organizations and harmonization of HWTS interventions
- ☐ coordination with the National Society
- ☐ coordination with local authorities
- ☐ other

If "other", please could you indicate which one?

Which were the main challenges you faced when setting up water supply operations? (please select three options)

- [ ] ensure water quality at the point of treatment and distribution (PoS)
- [ ] ensure water quality at the point of consumption(PoUWT)
- [ ] acceptability of the solution proposed (smell, taste of water)
- [ ] affordability of the solution proposed (costs and sustainability)
- [ ] appropiateness (quality and quantity produced)
- [ ] operation and maintenance of water treatment systems
- [ ] training of the beneficiaries of household water treatment
- [ ] monitoring sustainable impact of the water distribution activities
- [ ] availability of local materials
- [ ] compliance with national rules and standards on water supply
- [ ] logistics and getting access to the population affected
- [ ] security issues
- [ ] other

If "OTHER", please could you indicate which one?

Do you think current "equipment" available for setting up of ERUs HWTS operations is adapted to the needs in emergencies?

- ◯ yes
- ◯ no

If "NOT", what do you consider have to be included into the deployment kit to improve the delivery?

Thanks for answering this survey. If you are interested to have further information on the results of this survey you can send a message to the following email : o.llorente-11@student.lboro.ac.uk. Thanks for your collaboration.