URBAN WASH IN EMERGENCIES: Technologies and Applications Solutions

A DISSERTATION THESIS

FOR SPECIALISED MASTER DEGREE IN HUMANITARIAN WASH

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DEDICATION

"To all in humanitarian WASH, active, aged, retired and recruited"

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ABSTRACT

Urban WASH in Emergencies is typically bedeviled by complex challenges resulting from the presence of built-up/ paved environments, inundations, piles of debris, hazardous and dangerous materials and inadequate/ limited space which usually hinder effective installation of water supply and sanitation infrastructures. The strategies and techniques adopted for meeting water, sanitation and hygiene demands of the affected population are mostly restricted to water trucking/tankering, small-scale water scheme (scan-water), and bottle water. Smart sanitation solutions such as Portable Urine Diversion Toilet, (Biodegradable) PeePoo Bag, chemical toilets (Porta-Loos), and floating pit latrines are innovative technologies mostly adapted to urban emergencies. Hygiene promotion and smart hygiene solution involving portable handwashing station (using soap as disinfectant), access to safe drinking water and safe excreta disposal are the main messaging/tools that facilitate sustainable WASH intervention in emergencies. Typical mass media and person-to-person, door-to-door dissemination of hygiene messaging are proven to be effective in urban WASH in Emergencies. Drainage in case of natural disasters further fill up and overflow septic tank and sewerage which exacerbate contamination of water sources. Adopting risk reduction measures that builds on knowledge of the affected population proves effective in managing outbreaks of sanitation diseases. Solid waste and a minute part of vector control in urban WASH during emergencies is cross-sectoral and multi-sectoral with WASH acting in sustainable remediation, recycling and reclamation.

Key words:

1. Urban WASH
2. Emergency Technologies
3. Sanitation Solutions
4. Hygiene Promotion
5. Risk Reduction

ABBREVIATIONS

ACF Action Contre la Faim

ALNAP Active Learning Network for Accountability and Performance in Humanitarian Action

DRR Disaster Risk Reduction

GTZ German Agency for Technical Cooperation (GIZ)

ICRC International Committee of the Red Cross

IDP Internally Displaced Persons

IEC Information, Education and Communication

IFRC International Federation of the Red Cross and Red Crescent Societies

INGO International Non-Governmental Organizations

MSF Medecins Sans Frontiers

NWP Netherland Water Partnership

OD Open Defecation

UN United Nations

UNICEF United Nations Children Funds

UNHCR United Nation High Commission for Refugees

WASH Water Sanitation and Hygiene

WHO World Health Organization

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CHAPTER 1: INTRODUCTION

URBAN WASH IN EMERGENCIES

Emergencies often occur after disaster (natural or manmade) has taken place which can thus be defined as "a serious disruption of the functioning of a community or a society involving widespread human, material, economy or environment losses and impacts which exceed the ability of the affected community or society to cope using its own resources" IFRC.

It is apparent to state that disaster be it armed conflict Tsunamis, flooding, cyclones, earthquakes, drought, hurricanes, or disease epidemics are not limited in its geographical spread. Pinera and Reed (2007) have identified as many as 150 cities and towns in developing countries which have been affected by armed conflicts alone between 1975 and 2004. Waterline (2012)

"Urban" in the context of humanitarian responses can be defined as "the area within which civilians vulnerable to disruption in essential services (WASH) reside and the network of components supporting those services.

Urban emergencies vary widely and include sudden-onset natural disasters, protracted conflict or governance-related insecurity, slow-onset economic crises, or crises affecting a migrant population that fled from the rural areas. Opportunities to link social protection systems and longer- term development outcomes to the emergency response, though very important, will vary by setting. USAID (2008)

It therefore means disaster/emergency in the Urban context differs from rural in that a network of services are often available within a residing population as against sparse and scanty services obtained in the rural context/setting.

Traditional humanitarian approaches have been largely developed in rural contexts, addressing vulnerabilities and specific needs of urban populations under protracted crisis requires complex socio-technical approaches and long-term solutions that go beyond the current humanitarian-development divide and often beyond the capacity and skill-set of humanitarian actors in terms of sanitation challenges, it also means that humanitarian organizations need to deal with more complex offsite sanitation systems and services, and sometimes the rehabilitation sewer-based systems and largescale centralized treatment plants. In the conception of the UNHCR, emergency situation clearly exist when the following indicators are above (or below) threshold.'"

EMERGENCY INDICATORS

These are set of key indicators that serve as signals to show whether the prevailing situation can be described as an emergency or not. They are scientific/systematic ways to ascertain emergency levels

INDICATOR	EMERGENCY LEVELS
MOTALITY RATE	>2per 10,000 per day
NUTRITIONAL STATUS OF CHILDREN	>10% with less than 80% weigh for height
FOOD	<2,100 calories/ person/day
WATER QUALITY	< 10 litres per person per day
WATER QUANTITY	>25% of people with diarrheal
SITE SPACE	<30Sq meters per person (this figure does not include garden space
SHELTER SPACE	< 3.5 Sq meters per person

Table 1 Table of Indicators Showing Threshold of Emergencies

Becks (2015) state that more than half of refugees serviced by UNHCR live in urban areas and form new high density settlement, settling in urban slums or living with host families.

River flooding could pose a threat to over 379million urban residents and over 283 million people could potentially be affected by earthquakes. It further enumerated that natural disaster and other shocks such as human pandemics and conflicts are likely to occur more often in urban settings.

AFFECTED POPULATION

The United Nation has declared that access to safe water and sanitation is a human right that applies in time of peace and emergencies.

In emergency setting, people often leave their homes in search of safer surroundings. In many instances the water, sanitation and hygiene conditions of the new surroundings might not be adequate (not up to standards). In other instances, people might be left in their home surroundings but with destroyed or damaged societal and physical infrastructure including water, sanitation and health care System. (John Hopkins and IFRC 2011).

GWN (2022) defined "Urban services are the provision of commodities, actions or other items of value to an urban population. Essential urban services are those that are vital to ensure the

subsistence of the population, including electricity, health, water, wastewater collection and treatment, and solid waste disposal. All urban services require three elements in order to function: people (e.g. service providers, private-sector contractors and entrepreneurs), hardware (e.g. infrastructure, equipment, heavy machinery) and consumables (e.g fuel, chlorine, medicines). Disruption to an essential service is understood to occur when the functions of any of the critical people, hardware or consumables are compromised".

In urban emergencies communities are normally less neatly defined and engaging them in cluster/ families/ tribes becomes more complex. They are not easily geographically identified but either on un-documented interest or opportunities. Vulnerable individuals in urban emergencies include street children, new arrivals, people with disabilities and high profile residents (having post disaster stress syndrome) RedR and ALNAP 2015.

The consequences are:
–the sudden loss of means of subsistence/livelihoods (commercial exchanges, market access, Agricultural activities, sanitary infrastructure etc.);
–the weakening of internal mechanisms of regulation;
–the displacement of populations inside and/or outside of the country

CASE STUDY 1. (**MULTIPLE CHALLENGES AND OPORTUNITIES: PORT AU PRINCE HAÏTI)**

In Port au Prince Haiti, the challenges of post-earthquake of 2010 were strong. Debris, the bodies of victims, power and communication, sanitation, the pollution of water supplies, security and looting and land tenure issues in a crowded space were ail challenges for an effective humanitarian response.

These were balanced however by opportunities to start afresh in a better urban System as well as promoting existing local capacities including local water vendors

Source: RedR and ALNAP (2015).

Fig 1. Sri Lanka tsunami destruction (2002) ©

CHAPTER II. OBJECTIVE OF BIBLIOGRAPHIC RESEARCH

The objective of the bibliographic research on "URBAN WASH IN EMERGENCIES" is to provide a synthetic overview and review of major points, concepts and services in the field of Urban humanitarian WASH as identified from the reported works of several sources/authors.
It is in the long run a detail and a holistic description of known "water, sanitation and hygiene" components of emergency operations in urban setting will be re-exam and reported. . The unknown variable is properly identified and appraised in gap analysis.

AIM

The principle aim of "Urban WASH in Emergencies" is to categorize the various WASH strategies and scenarios, techniques and technologies, involved in displaced populations of I) the existing urban settlements (II) Advance urban water and sanitation services III) control human development as against rural settlement in which WASH facilities/services are non-existent or near basic.

Emergency and conflict situations around the world are increasing rapidly. In 2014 the number of forcibly displaced people reached 54.9 million, three times that of 2010 and this is the highest since 1945. There are currently 14.4 refugees and more than twice as many internally displaced as a result of conflicts, poverty and natural disasters (UN 2014).

Urban WASH in these emergencies has comparatively fewer coping strategies and potentially more vulnerable due to over dependent upon services (public water/power, utilities, sewerage etc).

Since disaster, natural or man-made event often leads to physical loss or damage, economic and social disruption, ail known pre-existing infrastructure and facilities are instantly reduced to rubbles or rendered unusable (unserviceable). The ensuring challenge is how WASH humanitarians can effectively work in the early stages of an urban emergency.

In meeting the demands of urban WASH in times of emergencies, innovations in smart solutions that take cognizance of urban environments must be identified and deployed rapidly to forestall any incident of health risk and disease transmission.

CHAPTER III. LITERATURE REVIEW

The genres of literature outlining Urban WASH in emergencies consist of recent published works of INGOs/agencies, Institutional training packs, project reports, compendium, and few publish text books for instance Carter 2015.

Urban disaster response skills are still in its infancy and specialists/experts only recently begin to define a charter (UNICEF 2013). One of reason for this is that urban context is much more complex than many rural or camp-focused emergencies (RedR Training 2014). The nature of the various responses as stated by RedR 2014 to urban emergencies is determined mostly by the type of disaster that has occurred and as well as the different urban environments (mega cities, high density towns, slums, peri-urban, etc.)

UNICEF (2013) is a joint collaborative document between UNICEF, UNHCR and UN-HABITAT with other global partners. It outlined a step-up operational framework for urban humanitarian WASH.

Brown et al (2012) gives a summary review of current knowledge about what works to prevent diseases in emergency WASH response. They argue that WASH has chiefest intervention responsibility to interrupt diarrheal disease transmission and to reduce the burden of morbidity and mortality associated with faecal-oral infection in emergencies.

Carter (2015) recently documented an array of humanitarian WASH responses in different context and settings of disaster occurrences.

ACF (2005) "Water, Sanitation, and Hygiene for Population at Risk" is an institutional publication of Action Contre la Faim that documents a genre of emergencies relief interventions in several scenarios and settings. In this publication urban, rural and camp-based WASH interventions using diverse options, technologies and strategies were highlighted. ACF 2005 States that " The first interventions of water and sanitation programm focus on the coverage of the basic and immediate needs , while at the same time seeking to reinforce and stabilished the foundation for development in the community in a way that will reduce or eliminate the risks link to these vulnerable situations".

Recently more smart technologies were re-modelled and field test in response to emerging urban WASH. (Del Aqua Kit). The present publication captures most of ACF experience and expertise to promote water supply, sanitation and hygiene for population in danger, disasters and emergencies.

"Public Health Engineering in Precarious Situation" MSF (2010) is a manual publish by Médecin Sans Frontières intended for setting up public Health programmes (to which all

WASH intervention comes under) in disadvantage areas, with more preference given to refugees and IDPs camps focused interventions. A lot of technologies adopted by MSF are useful in water supply and sanitation provided a remnant of natural space is avoidable for navigation, logistics, construction and installations, etc. such as slums, peri-urban settings.

Pinera (2012) looked at the provision of essential water supply services in emergencies that are pre-dominated and fuelled by military armed conflicts.

Ruberto and Johannesson (2009) succinctly discussed various technologies in emergency sanitation focusing also on dense (urban) context. They argued that people are spread out and centralized sanitation Systems are not possible (e.g. in Floods situation in Asia...)

ICRC (2015) enumerated the catastrophic impact of armed conflicts in urban areas resulting in failure in entire Systems and public services (water system, electricity, untreated waste water, solid waste, hospital and health care infrastructure.

A formalized attempt, "Sphère Project" (2011) to improve guidance and provide minimum standards for humanitarian responses across six sec tors including WASH in both urban and rural context.

Mecks (2015) most recently discussed and documented a spectra of innovative smart technologies for urban WASH in emergencies. It is a great departure from the ancient tradition of cluster/grouped sanitary infrastructure.

WHO (2011) "Guidance on Water Supply and Sanitation in Extreme Events" is a response to call of standardized practice in Urban WASH in Emergencies. The document is a result of an extensive consultation process involving experts and institutions from many countries. It outlined and described scientific findings, provides communication issues, addresses the vulnerability of coastal areas, discusses impact on human health and places extreme weather events in the context of water safety plans and formalities advice for adaptation measures for water supply and sanitation services during such events.

CHAPTER IV. METHODOLOGY

Bibliographic research (literature based review) is the basis on which this present dissertation "Urban WASH in Emergencies" was undertaken. The review was systematically limited to publication in printed text, electronic format (e-format), internet webpage and institutional briefs and technical reports.

The nature of reference materials consulted are biased to those that either separately and jointly discussed on

1. Water in emergencies
2. WASH services in emergencies
3. Sanitation
4. Hygiene
5. Urban WASH
6. Vector control
7. Disaster waste

Hence the dissertation is a synthetic overview to arrive at a compilation of the best practices in Urban WASH in emergencies. As some of these topics out rightly falls under development contexts, they are majorly treated partially and partly. This thus implies insufficient account for industrial waste management.

As Urban WASH in emergencies is still emerging this means scanty and scarcity of current articles/papers in journals and published text. The most recent published text, Carter (2015) is not available as online resources. Given this backdrop, a genre of literature spanning ten years 2005-2015 were predominantly consulted for the dissertation, with 2015 thoughts dominating the inputs

Publically available document in the English language were specifically consulted which were either in the print or the e-format. The intent of the using the French resources of the host institution which could have rake in a rich pool of reference were hampered by limited French language skills.

METHODOLOGICAL GAP

Methodological gap or WASH gap analysis are captured as research recommendations for future directions in Urban WASH in emergencies.

Being bibliographic research, the principal intention is to derive as much review from literatures as possible and to proffer solutions in such areas as has been clearly identified as opportunities

CHAPTER V. DISCUSSION AND ANALYSIS

Emergency situations are challenging environments for WASH implementation and the need for more suitable approaches and technologies for rapid deployment to emergencies has been widely acknowledged in the humanitarian sector. WASH has a lot of strategies and approaches in terms of safer water supply, innovative sanitation solutions and hygiene promotion materials that have deplored by relief organizations during diverse urban emergencies.

The discussion in this dissertation attempts to review the existing guidance on best practice for WASH delivery in urban emergencies contexts. More complex contexts and Systems demand a greater level of skill and hence a need for specialists, perhaps on a rota system to improve response time globally. As staff from local water and sewerage companies are likely to still be there in most urban emergencies, increasing the capacity of local engineers to assess urban water and waste treatment is also essential. This will give them the capacities to effect small scale repairs that will be needful to meet emergencies limits for survival.

WATER SUPPLY

Urban context" is defined in this report as the area within which civilians vulnerable to disruptions in essential services reside and the network of components supporting those services.

All urban water supply services require three elements in order to function: people (i.e. service provider staff, private-sector contractors and entrepreneurs), hardware (e.g. infrastructure, equipment, heavy machinery) and consumables (e.g. fuel, chlorine, reagents). However, in emergencies the factors that affect the choice of the drinking water Systems usually differ considerably from the factors influencing such choices in development situations

In emergencies according to DeVeer (2011) the most important decisive factors for drinking water interventions often are:

- Security situation regarding accessibility to the area for national/international organizations and peoples freedom of movement;
- Access to the area in terms of roads and topography;
- Socio-political, legal and cultural constraints;
- Availability of water sources and their characteristics;
- Time required to develop the water sources;
- Time required to mobilize the required resources;

- Characteristics of the affected population (number of people, displaced or not, extent

to which coping mechanisms are still in place, etc.).

CASE STUDY 1 MOGADISHU SOMALIA.

Mogadishu lacked a mains water supply or electricity so local people and refugees depended on water from privately-owned wells, community bore holes that were only available at restricted times, or water bought from local vendors using donkey carts. Therefore, WASH agencies concentrated on providing storage facilities, using local resources. Larger tankers to store water and refill overnight were used, a system more common to refugee camps. The social fabric of the city did still exist, with people going about their lives as best they could, though refugees struggled and were completely dependent on aid agencies for food, water and health provision. In this urban environment, people in need were present throughout the city, and not conveniently clustered together as in a camp. As a result, agencies dealt with 50-100 community representatives who spoke for their own specific community, still intact within the city.

WATER TRUCKING/TANKERING

In most urban emergencies drinking water supply is provided to the affected population by water tankers. This is reason for the name 'water trucking or water tanking'. Safe water or municipal treated water are collected in large capacity truck of different constructions and can be carried in a variety of different containers, some specifically design for the task and others fabricated to meet an urgent need. The fact of meeting the survival needs of the IDPs/refugees at the first phase of emergencies warrants the deployment of this strategy because of the complexity of its management and the high costs

Fig. 2 Water Trucking by a joint Red Cross and UNICEF Collaboration © ICRC

Water delivery points are organized in such a way that there is sufficient space for the truck to off load quickly in large enough tanks (Onion tanks, Oxfam Tank, or flexible/pillow tanks). Distribution points/tap stands can hence be situated at sufficient distance from the tanks to avoid overcrowding and injuries.

MOBILE WATER TREAT UNIT IN EMERGENCIES-SCAN WATER LMS

This a mobile unit develop by Scandinavian Water called SCAN WATER LMS 6m3 that is able to treat 60001itres of water in an hour for an effective working hours of more than 12 hours in a day. The mobile kit consist of virtually all the elements of water treatment: Coagulation chamber, flocculation camber, sand filter, activated carbon and chlorine dosing pump.

Adduction and distribution of water in Emergencies

Fig 3. Water Adduction from Surface Pond into Onion Tanks for Treatment

Fig 4. Water from Pre-Treatment Storage Tanks Finally Treated by LMS Scan Water

Fig 5. Package Treated Drinking Water for Distribution

SANITATION

The Compendium of Sanitation Technologies in Emergencies defined sanitation system as "a multi-step process in which sanitation products such as human excreta and wastewater are managed from the point of generation to the point of use or ultimate disposal. It is a context-specific series of technologies and services for the management of these sanitation products, i.e. for their collection, containment, transport, treatment, transformation, use or disposal. A sanitation system comprises functional groups of technologies that can be selected according to context" (GWC 2021)

Harvey et al (2000) defined emergency sanitation consideration as to include the following areas of (i) excreta disposal (ii) solid waste management (iii) waste management of medical centers (iv) dead body management (v) hygiene promotion.

Safe sanitation is essential for health, for prevention of infectious diseases, for improving both mental and social health and of wellbeing. The absence of safe sanitation infrastructure/systems often leads to infections and diseases such as

a. Diarrheal Pruss Ustun et al 2016

b. Neglected tropical diseases WHO 2017

c. Vector-borne diseases eg West Nile Virus, Lymphatic Filiariasis Curtin's et al 2002; van den Berg Kelly Hope & Lindsay 2013

Among the first priorities in urban WASH in emergencies must be containing and disposing human feces which must not contaminate the environment including drinking water sources, and thus lead to diseases. Appropriate facilities for defecation are vital to people's health as well as their dignity, safety and wellbeing. (John Hopkins and IFRC).

Urban WASH continues to pose significant challenge more especially in terms of sanitation infrastructure. Emergency sanitation is often a problem due to insufficient space after disaster to install emergency latrines in which digging pit latrines is impossible. Paved surfaces, built up areas, top at dangerous or hazardous materials (debris, pipes, metals, wires/cables, etc.) makes it practically impossible to navigate.

In peri-urban areas and slums (e.g. Port-au-Prince, Haiti), Poor environment sanitation, poor household sanitation, inadequate drainage and non-existent waste management has further exacerbate urban WASH. This in itself is a budding disaster, which naturally complicates emergency response. Cholera outbreaks are very frequent and have a massive impact on population health. [Picture "Port-au-Prince]

SANITATIONS OPTION AND SMART SOLUTIONS

Emergency agencies distinguish between two main ways in which people are displaced during emergency (1) in site and (2) displaced. (Ruberto & Johannesson 2009).

"In site" people are spread out and centralized sanitation Systems are not possible (Floods).

"Displaced population" e.g. in camps, mosques, warehouses, markets, schools, churches, parks/gardens, Police stations/Barracks, etc. where aid agencies construct blocks for water and sanitation. In some rare cases, existing sanitary facilities in the form of latrines/toilets, urinals and sometimes showers are often use and very inadequate.

This group can be divided into 2 categories:

a) Dense (urban) context

b) Scattered context

As earlier enumerated on the challenges posed by urban disasters, sanitation options and smart solutions are few and far between. Sanitation here comprises of excreta disposal, vector control, solid waste management and drainage for stream-and rain-water.

1. PORTABLE URINE DIVERSION TOILET

The Great East Japan Earthquake that took place on llth March 2011 caused a massive damage, besides dead and missing persons (20,000) about 300,000 of houses destroyed.

Securing sanitation (i.e. proper excreta management) was the greatest challenge and concern for ail relief workers. To help checkmate Open Defecation (OD) on newspaper health hazard and environmental degradation the portable urine diversion toilet was developed and summarily accepted by the IDPs,

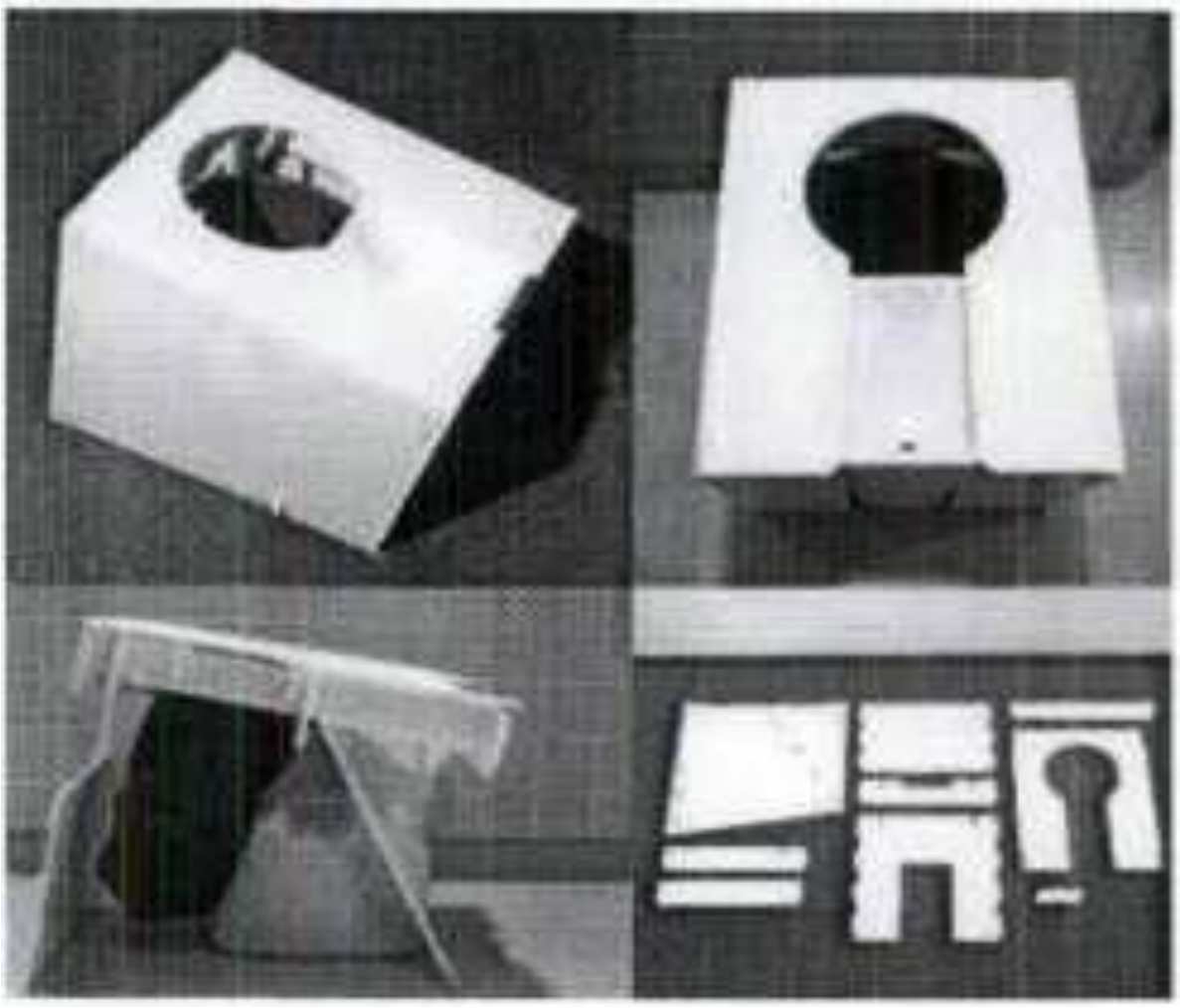

Fig 6 Portable Urine Diversion Toilet made from Plastic Cardboard

Containment and treatments of forces was the utmost priority than urine handling which has - less biological risk (Harada et al). Container-based sanitation (CBS) consists of an end-to-end service in which toilets collect excreta in sealable, removable containers (also called cartridges). The containers are regularly collected and transported to treatment facilities when full (Russel et al. 2019),

This toilet is made from plastic cardboard and ready to assemble, easily stocked and transported. It is a stand-alone device and can be mounted on a toilet bowl by removing the back panel. Treatment is by line or carbonated rice husk.

The fecal mixture is stored in a temporary bucket which is later collected re-stored and evacuated for safe disposal.

2. **PEEPOO BAG (NON TOILET OPTION**)

During emergency in urban (and slum poor urban areas), the absence of hygienic sanitation facilities which were destroyed and reduced to rubbles poses an enormous problem. The modification of the use of flying toilets (a plastic bag that is thrown outside) gives rise to the Pee Poo Bag.

Pepo bag is biodegradable plastic bag with a thin inner tube that is to be used once for defecation and urination. It is clean enough to handle and odour free for about 12-24 hours after use

Each bag contains urea which destroys ail pathogens within 2-4 weeks and makes the excreta safe to be use as fertilizer. Collection can be initiated in mega cities for proper evacuation to safe dumping site. The Pee Poo bag is a temporary alternative method for hygienic sanitation to checkmate open defecation in urban WASH.

Fig 7. Biodegradable Pee Poo Bag (Source: Pee Poo)

3**. CHEMICAL TOILETS "PORTA LOOs**"

Chemical toilets or otherwise named Porta Loos are rigid industrial/corrugated plastic materials/toilets that are portable, hygienic and minimized odour. They are easily and rapidly deployed and are specially installed on flat surfaces. Feces are treated in site and regularly serviced by evacuation/ emptying to safe area.

Fig 8. Chemical Toilet (Internet Sourced)

4. **RAISED PIT LATRINES**

Raised pit latrines as the name implies may be constructed on-site or prefabricated above the grand level to provide a raised platform and adequate sanitary facilities in difficult circumstances (e.g. flooding, rocky underground, paved surface). Both VIP and twin pit latrines can all be raised MSF (2010)

Fig 9. Raise Pit Larine Installation by Rosa Crosa

Fig 10 Elevated Pit Latrine Installation in an IDP Camp (Internet Sourced)

In this pre-fabricated rural pit latrines the substructure is made of corrugated plastic (or sometimes High Density Polyethylene HDPE) material and treated with chemical to reduce odour and fly nuisance. It is a smart alternative for excreta disposal in urban emergencies. Raised latrines constructed in flood-prone areas are often accessible even during the floods and also prevent excreta from escaping from the pit causing widespread contamination. Elevation of the pit can be achieved through concrete rings that also protect the pit from water ingress. Raised Latrines are built entirely above ground, the excreta must be collected in a sealed vault below the user interface. As no percolation occurs from the sealed vault, raised latrines that are entirely above ground have a high sludge accumulation rate. Storage facilities need regular emptying and a sludge management system is necessary GWN 2022. Raised Latrines can either be built as a single pit solution (with ventilation or as a toilet block with several cubicles in a row and a trench or larger storage tank underneath. In toilet blocks ventilation is a challenge and thus odours and flies can become an issue.

5. FLOATING PIT LATRINE

Mecks (2015) depicted a recent deployment of floating pit latrine in Tondo Manila Philippines' which was ravaged by typhoon Hycean hence resulting in massive flooding in most of the city This is a pre-fabricated pit latrine having an array of buoys that allow the pit latrine to float. Faeces are similarly contained like in the chemical toilet. The containment chamber/receptacle can easily be withdrawn and safely disposed off with modem trawler type desludging machine

Fig 11 Floating Pit Latrine with HDPE Drums as Containment Chamber (Internet Source)

6. DEFECATION FIELD, TRENCH AND PIT LATRINES

These sanitation options for urban humanitarian context are often very sure methods of minimizing immediate public health risks and absolutely a fast implementation protocol. It is not widely documented as appropriate solution for long term intervention for the cases we mention in urban settings. Nonetheless they are quickly deployed at the immediate on-set of emergencies as measures for excreta containment provided that are enough space available for their construction.

Defecation field represent a very basic disposal method to avoid excreta spreading all over the displaced people camp and to curtail the risk of diseases transmission by any known route. Defecation field are only rational during the early phase of urban emergencies and are possible in the areas where the climate is dry and hot and non-flooding. Defecation field are particularly suitable in urban setting where there are insufficient and limited space for installation of sanitation infrastructures. These are known to be temporary measures until safe and permanent installations are designed and constructed.

These, defecation fields are wide expand of area demarcated, segregated into sexes, fenced with narrow trenches as drop holes (optional) and top soil for burying excreta. Ropes and stakes are often used to indicate the presence and use of defecation field/zone.

A Deep Trench Latrine is a widely-used communal latrine option for emergencies. It can be quickly implemented (within 1–2 days) and consists of several cubicles aligned up above a single trench. A trench lining can prevent the latrine from collapsing and provide support to the super-structure (GWN 2022). They are simply and rapidly constructed especially with prefabricated materials such as squat slabs, plastic sheeting and corrugated iron sheets.

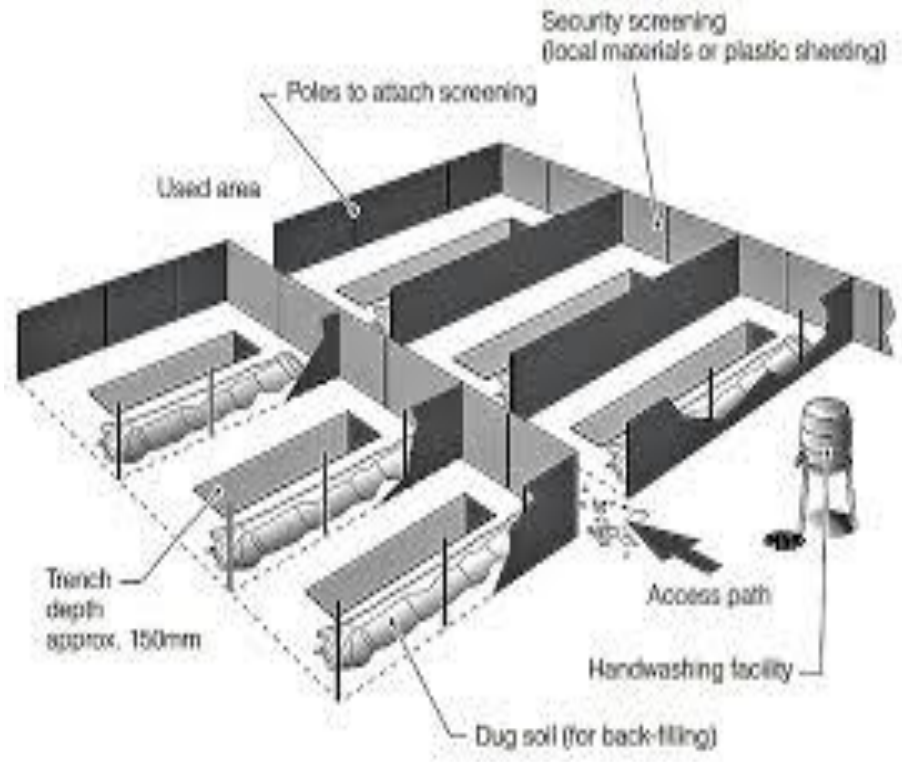

Fig 12 Deep Trench Latrine (Internet Source)

7. POTTIES FOR CH1LDREN AND ELDERLY

Children and elderly are often a vulnerable group in time of emergencies and if left unattended to they contribute significantly to the transmission of faeco-oral diseases. The normal sanitation options described above pose a lot of problems to this group. Hence the potties, a special designed receptacle to contain excreta should be readily made available to the affected population either as a component of hygiene kits, or as non-food item during routine distribution of WASH items. . Excreta safe disposal/handling is part of hygiene promotion that urban WASH experts use to ascertain transmission route is interrupted.

CASE STUDY 2 *Children Sanitation in Ethiopia In Ethiopian relief camps in the mid-1980s, special defecation trenches for children were used successfully by the Save the Children Fund. Mothers sat on one side of the trench with their feet propped on the other side, and placed the children between their feet. When the children had defecated, they left via a hand-washing facility. Each time a mother left, a latrine guard shoveled earth over the faeces (Appleton & Save the Children Fund Ethiopia Team, 1987).*

In this context the use deep trenches for defecation was highlighted and the use of hygiene promoters to ensure proper use of sanitation infrastructure and the maintenance of the defecation environment after use to ensure no spread of diseases as a result improper containment of excreta.

B. DISASTER WASTE MANAGEMENT

GWN (2022) said "Solid waste can be broadly defined as any unwanted solid product or material generated by people or industrial processes that has no value for the one who discards it. Other terms for solid waste are "garbage", "trash", "refuse" and "rubbish". The cycle of waste management system starts from waste generation through storage, collection, transport, recycling, treatment and final disposal.

During urban disasters and emergencies the volume and quantity of the waste generated is often enormous and overwhelming. In urban settings and during emergencies the following normally constitute disaster waste: hazardous waste (gases, liquids), building debris, hospital & healthcare waste, military hardware and unexploded ordnance (UXOs), household possessions. Disaster wastes are both context and cause specific and can be enumerated as thus:

1. Tsunami: Vegetation, human- and animal- carcasses, building debris, municipal, Camp and relief material s
2. Earthquake: Building debris, healthcare
3. Floods: Household goods, healthcare, animal- and human- carcasses, camp,
4. Hurricanes/Typhoons: Similar to flood plus building debris and vegetation
5. Post Conflicts: Destroyed buildings, military hardware, unexploded ordinances (UXOs), depleted uranium (DU), camp and relief materials

WASH chief responsibility is to maintain public health as it relates to water supply and sanitation. However a collaborative effort are made with other sector leads to enhance proper handling of waste in time of urban emergencies.

A plan for sustainable operation of waste management services must consider social acceptance,

Financial sustainability, workers' skills and capacities as well as a suitable legal and institutional setup. Routines should be rapidly developed and implemented for waste storage, collection and disposal. This is particularly important in high-density sites such as refugee and IDPs camps. GWN (2022)

In great Eastern Japan Earthquake of 2011, the containment of uranium waste from contaminating groundwater supplies was achieved by the proper understanding of the Groundwater System by WASH experts: engineering and construction industries as well as land resources experts.

TECHNIQUES FOR SOLID WASTE MANAGEMENT

In urban emergencies solid waste are categorized and characterized based on waste assessment which must primarily be undertaken as the first step. Types that are hazardous and dangerous must be exceptionally handled at the on-set to prevent health risk and further disasters. These assessments normally lead to the determination of types, quantities, quality, source etc.

The various options for waste management are: encapsulation; sort and recover; dig and dump/bury.

1. **CONTROLLED TIPPING AND SANITARY LANDFILL**

This method is dependent upon sufficient space and access to mechanical equipment. Ideally this is a large scale disposal of disaster waste and any other waste that might be easily evacuated using heavy duty machineries. Waste are carried out off-site through tipping and covered with earth materials to prevent scavenging and vector breeding. Sphere (2011).

2. ENCAPSULATION

Encapsulation of waste refers to the technique of packing hazardous waste in containers which are made of impervious and non-reactive materials (such as glass, ceramics, dense plastics) and sealing off these containers in another one made of concrete, plastics or steel for burial or storage (Sanitation Course. Master WASH 2015)

3. SORT AND RECOVER

Waste management is a cross-sectional issue with challenges and opportunities for other sectors: recycled rubbles, metal and concrete can provide building materials for shelter, reconstruction and income; Disaster waste can be sorted out industrially into aggregates, glasses, plastics, timbers, etc.

These recovered materials can also be re-used and the environment rendered free of hazardous and dangerous substances.

CASE STUDY 3 Community Debris Removal in Carrefour Feuilles Haiti

Disaster Waster Recovery DWR is a UK based NGO specializing in solid waste recover and is implementing a debris collection and processing project in two neighborhoods of Carrefour Feuilles, assisting to process an estimated 160,000 m3 of earthquake debris. The project was managed at community level, through 2-neighbourhood committees (11 members), selected from over 200-civil society groups in CF. A Town Hall representative was also present on committee. All the committee members were paid daily rates, as there is considerable work involved in organizing the communities and getting agreement. DWR, in collaboration with the committees, identified buildings to be demolished/removed. A MoU was signed with building owner and authorities, legally permitting the buildings removal. Demolition then takes place, either using an excavator or manually depending on access. Debris is then transported to the treatment site, where it is passed through a crusher and then a grader. The processed aggregates are suitable for foundations (roads & buildings), and for block making. Several NGOs and other organizations established agreements to collect aggregates free of charge.

HYGIENE (PROMOTION)

Hygiene refers to the practice of keeping oneself and ones surrounding clean and healthy especially in order to prevent illness or the spread of diseases. It basically borders on the behaviors and practices that are used to break the chain of infection transmission in home, IDPs/refugee camps and community NWP (2010

Hygiene promotion interventions differ according to the context, including the phase of an emergency. Common categories used to distinguish phases are (1) acute response, (2) stabilization and (3) recovery. Additional longer-term phases that may need to be taken into consideration are (4) protracted crisis and (5) development GWN (2023)

Hygiene promotion that supports behavioral change, community engagement and actions to reduce the risk of disease is fundamental to a successful WASH response. It has been increasingly recognized that hygiene promotion in emergency response is well placed to respond to broader public health programming. In effect hygiene promotion intervention and implementation has demonstrated he capacity to successfully limit the adverse consequences disease outbreak such as was witnessed in the Ebola pandemic or COVID-19 much recently.

Emergencies can usually cause an increase of water-, sanitation-, and hygiene-, related diseases and in some cases cause epidemic outbreaks, putting many people's lives in danger ACF (2005).

Hygiene promotion focuses on reducing the main risks related to health and the use of water supply and sanitation facilities though an improvement in people's knowledge and behavior. Accordingly ACF 2005 outline that Hygiene depends on people's habits, and these habits depend mainly on 5 factors namely:

1. Belief sand taboos
2. Knowledge
3. Behavior and existing habits
4. Perception of risk
5. Availability of facilities

In most WASH interventions in urban emergencies, the aim is to sustain life and improve on the wellbeing of the affected population thus preventing hygiene related illnesses such diarrhea diseases, pneumonia and other respiratory infections. The main tool to achieve this is hygiene promotion, which seek to improve people knowledge and behavioral change.

An emergency Hygiene Promotion assessment process usually entails: (1) Planning the assessment, (2) Immediate rapid assessment, (3) In-depth assessments or formative assessment as time allows, (4) Ongoing discussions with and feedback from the community and other stakeholders. On the basis of the outcome of the rapid assessment during urban emergencies

several hygiene approaches have been designed and implemented cutting across diverged population groups, ages, cultures and civilization. Typically the promotion of hand hygiene at the five critical times has been very successful the breaking diseases burden and transmission. One fundamentally approach has been the Participatory Hygiene and Sanitation Transformation (PHAST) and the Community-Led Total Sanitation (CLTS).

Fig 13 Promotion of Hand Washing at Critical Times as Disease Risk Reduction (Internet Sourced)

In urban emergencies the major hygiene promotion dissemination/communication media are

1. Disease transmission routes
2. Proper water use in terms of collection, storage, and consumption
3. Appropriate use of water and sanitation facilities/infrastructures
4. Personal, food, environmental, child and menstrual hygiene

Hygiene promotion in the urban setting in terms of emergencies is both contextual and conceptual specific. In the terms of context because within a city there are several strata of the population: middle income and slum areas; host and migrant population; high profile inhabitants, etc. In all these groupings, their conception and perception differs with varying degrees of exposures, experiences, needs, cultures, customs and capacities.

Hence adaptive and effective information dissemination can use both formal structure (families, tribes/race,) and mass media (radios, IEC)

URBAN HYGIENE PROMOTION:

Lebanon's current refugee population occupied a diverse range of housing across the country including slums, peri-urban and modem centers with

Accompanying range of hygiene promotion needs. Group meetings were often difficult, so door-to-door visits were used as well as mass media such as radio. The rapid move slum dwellers can hamper effective targeting but some Lebanese government institutions could be partnered with in such areas to ensure continuity. (Source: RedR & ALNAP 2014)

SMART HYGIENE SOLUTIONS

Rapidly deployed pre-fabricated hand washing stations with provision for soaps receptacle in urban emergencies by Rosa Croxa Espanola (Spanish Red Cross) in some WASH interventions have been effective in checkmating spread of diarrheal disease. Irrespective of the of the social or societal strata of affected population during urban emergencies, as hand washing under running water with soap is a key primary barrier in breaking disease transmission, it is one of the earliest hygiene messaging tool which can only be accompanied by a hardware such as described above.

The distribution of disposable personal hygiene kits which takes into consideration the context and cultures of beneficiaries is viewed as a viable strategy in hygiene promotion. Several items can be found in these kits and there are no standard contents of what should be the minimum allowable unit. Sphere (2011) recommend inclusion of these as components of Personal hygiene

- 75ml/100g toothpaste
— One toothbrush
—250ml shampoo
~ 250ml lotion for infants and children up to 2 years of age
~ One disposable razor
~ Underwear for women and girls of menstrual age
— One hair brush and/or comb
— nail clippers
— Nappies (diapers) and potties (dependent on household need)

CHAPTER VI. RECOMMENDATIONS

Recent research has noted that the 'need for improved WASH strategies for emergencies has generated a number of new approaches that have been explored by relief organizations, leading to rapid innovation' Bastable and Russell 2013

In line of the foregoing this present dissertation will attempt to propose that research is needed to modify or reconfigure existing technologies for rapid distribution in urban emergencies to enable beneficiaries more access to WASH services in diverse urban setting.

These researches should borders both on rapid deployment of treated drinking water units and the effective distribution methods for safeguarding water supplies to the point of use.

Challenges in urban WASH such as high water table and flooding, high population density, paved surfaces, sludge containment need effective skills and expertise to further prevent secondary disasters. Capacity building remains a major challenge on several front. Skilled competences must exist to handle urban disasters in terms of human capacity and preparedness. Full and increasing resources are needful prior, during and post crisis periods.

To meet WASH services in urban emergencies pre-supposes response planning, strengthening national preparedness System and partnership/collaboration with organization that are competent and versatile

There is need of research on the rapid latrines with non-rigid collapsible pre-fabricated super- and sub-structure which can be easily shipped and erected on site at the on-set of emergencies.

Linkage between emergency WASH and development will form the basis of the next years. This calls for the development of more latrines models whose designs are semi-permanent elevated latrines in flood prone areas such as Philippines, Indonesia, Myanmar, etc. Such needs also exist of mobile, portable, automatic or semi-automatic kits for emptying/desludging latrines. This design should consist of extra-long collapsible or rigid suction hose which can be easy to transport/freighted and light weight.

In the first phase of emergencies biodegradable bags should be immediately be available before environmental degradation set-in. These bags should be innovative, decent and easily biodegradable. Aid agencies are encouraged to research on biodegradable bags and stock pile as response preparedness strategy.

Newer hand washing hardware adaptable to urban WASH in emergencies which may use both soap and non-soap options are virgin field. Potentiality and effectiveness of Participatory Hygiene and Sanitation Transformation (PHAST) and/or Community Led Total Sanitation (CLTS) during emergencies could be initiated to assess other context- crisis times.

Post urban disaster has several opportunities in terms of disaster waste management. An effective inter-industrial collaboration between the WASH sector and other sectors should form disaster risk reduction strategies

1. Organization Readiness Capacity There are specific needs for all humanitarian WASH actors to develop and trained its personnel to be able to respond to greater urban WASH in Emergencies such at the Ebola epidemics and as well as the COVID 19 cases that was widely unattended to. This response strategy will map out the availability of a) Service providers who are able to provide affordable, sustainable, economical and resilient infrastructures (b) expertise of both technical and social that will be required to support Urban WASH in Emergencies programming. Majority of these experts may requires some degree of training and retraining. In other context the use of use of private sector with major experience in engineering consultancies and academia with proven tracts records can also be deployed.
2. Partnership and Coordination. In responding to Urban WASH in Emergencies partnership and Coordination will essentially eradicate duplicity and maximize resources. Partnership with other WASH actors especially with UN system can go a long way in responding to Urban WASH Emergencies and in the long run reduce exposure to risk and health hazard.
3. Funding and Grant Mobilization of financial resources to ensure rapid respond to the onset of urban WASH is the main criteria at arriving at sustainable programming. The cost and complexity of urban services warrants the availability of spares, parts, machines, equipment, pumps and consumables.
4. Community Support and Strengthening. Provision of WASH services in urban emergencies will be sustainable and durable with the support of the community stakeholders at all strata of the society. All of WASH components are developed with the sole objective of public health and sustainability. Ownership of WASH infrastructure by the community in terms of operations and maintenance will ensure

CHAPTER VII CONCLUSION

Fewer and fewer humanitarian aid agencies are well equipped with the appropriate skills, technological innovations and technical expertise to handle large scale urban humanitarian WASH. The daunting challenges is especially true in terms of sanitation where space constraints and restricted access to services/facilities are common problems.

City regulations, paved surfaces and sub-surface infrastructures such as water mains, drainage, and power lines have constituted some daunting task in the use of pit latrines besides the massive amount and type of disaster waste. Nonetheless WASH services have been deployed as lifesaving strategies and medium to prevent diseases and health hazard.

Models such as flat packed raised toilets, mobile latrines, portable latrines and floating latrines are nowadays the best fit to immediately meet the sanitation need of the affected population in the First phase of urban emergencies.

Hygiene promotion using mass dissemination in Lebanon has been very effective in a lot of conflict affect cities where group meeting has been shown to fail totally. Hand washing stations that take into consideration the context and social strata of the beneficiaries are now being designed and deployed across various urban context.

Capacity strengthening of various WASH actors in Urban Emergencies should be planned for and place at organizational, (inter)sectoral or community level. The strategic aim is to strengthen knowledge, skills and behavior to enable people and organizations to effectively address WASH needs and increase their resilience to future crises. For a number of other reasons, disaster risk reduction DRR and emergency response and preparedness should incorporate capacity strengthening. Training and learning must support the development of key Hygiene Promotion competencies and the deployment of hygiene promoters in urban emergencies.

To avoid the creation of secondary disaster in the event of urban disaster, the effective and efficient management and evacuation of disaster waste has formed the major responsibility of both WASH and other sector leads,

There has been a continual effort in designing and deploying innovative solutions for WASH response in urban emergencies anchoring environmental sustainability taking into consideration the economy, equity, safety and hygienically. These solutions have proven to be the technology of choice.

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