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OPTIMISATION OF WATER-RELATED PREPAREDNESS MEASURES - CASE STUDY: FLOODS IN TANZANIA

Diploma Thesis

Natural Resources Management and Ecological Engineering

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This diploma thesis was composed at the Institute of Sanitary Engineering and Water Pollution Control of the University of Natural Resources and Applied Life Sciences Vienna. Under the direction of the Head of Institute, Raimund Haberl, and Helmut Jung it was possible to create an interdisciplinary work that combines technical approaches, socio-economic aspects and integrated risk concepts.

Special thanks go to Helmut, whose day seems to have 30 hours. By coincidence he became my main advisor as regards the content. It is not common to step into someone's office and stay there for hours as a practically unknown person. Helmut Jung stopped his work immediately and together we started formulating a research question. First contact to the Austrian Red Cross had already been established during my time in New Zealand, but conceptions for the diploma thesis' content were very vague at that time. Hence, Helmut used his connections to contact staff from the Austrian Red Cross, who we met one day later. I have only met a few people in my life that were that experienced, passionate about a job, able to think "outside the box" and modest at the same time.

The most time consuming task, besides waiting for answers from international Red Cross National Societies, was to formulate a research question. On one hand, the research approach had to fit actual needs of the Red Cross and Red Crescent Societies. On the other hand, it had to be resolvable for one student in a single diploma thesis.

Juergen Hoegl, Guenter Stummer, Wolfgang Stoeckl and Martin Janda from the Austrian Red Cross were involved in the formulation of the research question. Juergen Hoegl and Guenter Stummer provided important information that was hard or impossible for me to access. These documents came partly from the Red Cross disaster management information system, a real-time online database for emergency operations. Additionally, I received internal papers on emergency water supply and sanitation, vulnerability and capacity assessment and field operations.

As the research question gradually focused on the evaluation of water and sanitation-kits in Africa and Asia, it became necessary to contact the coordinators in Geneva. Uli Jaspers, head of the water and sanitation units, arranged the contact to William Carter, one of the three officers for the Water, Sanitation and Emergency Health Units. The result of a long phone call was the idea of the questionnaire. He even agreed to forward the questionnaire to the corresponding National Societies, whereby the rate of return could be returned. Finally, Skype interviews and phone calls to Tanzania and Cape Verde led to results on actual kit performance and preparedness training, because William Carter was busy in Haiti.

At last I would like to thank my parents for being patient until their son's diploma thesis-odyssey came to an end. Unfortunately, it is not completely over. Since this thesis serves as the basis for a dissertation, a corresponding proposal has already been sent to BOKU's research support office.

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Abstract English

Supported by the International Federation of Red Cross and Red Crescent Societies, this diploma thesis is focused on disaster preparedness in the water sector. Both literature research and expert interviews confirm the higher efficiency of preliminary actions against acute intervention.

Based on the concept of vulnerability, current disaster preparedness and relief approaches are illustrated within the context of international political strategies for developing and threshold countries. Water and Sanitation preparedness kits (WatSan-Kits) of the Red Cross Federation, which were pre-positioned in 14 African and Asian countries, are a novel strategy to decrease vulnerabilities regarding water supply, sanitation and hygiene practices. According Red Cross coordinators in Geneva, their actual performance and acceptance has never been assessed.

Expensive emergency response equipment mostly runs at low degrees of utilization. Relief teams often lack the creation of sustainable benefits for the affected population. Additionally, their orientation is purely technical. The major advantages of WatSan-Kits are that they give potentially affected societies an instrument to mitigate small scale disasters, which might pave the way for bigger ones. Therefore, delegates are deployed to practice operation and maintenance in emergency situations with National Societies on the spot. In case of disasters on bigger scale, the kits serve as a buffer or substitute for external help.

Kit performance was assessed by expert interviews and a questionnaire. The United Republic of Tanzania, the only country that could gain experience with the new system after a natural disaster, serves as a case study. Consultations with Red Cross staff led to a concentration of the questionnaire on the system's barriers, location, acceptance and training. Results are illustrated in a SWOT-analysis and encompass weaknesses, such as the system's complexity or lack of spare parts.

Furthermore, this diploma thesis serves as the basis for a related dissertation, which deals with the design of the ideal environment for preparedness activities and suitable locations.

Key Words: Disaster management, Preparedness, Tanzania, Vulnerability, Water Supply and Saniation

Abstract German

Unterstützt von der Internationalen Rot Kreuz Föderation konzentriert sich diese Diplomarbeit auf Katastrophenvorbereitungsmaßnahmen in den Bereichen Wasserver- und Entsorgung. Literaturrecherche und Experteninterviews bestätigen die deutlich höhere Effizienz von Aktivitäten, die lokale und regionale Vulnerabilitäten mindern, gegenüber Akutinterventionen.

Basierend auf dem Konzept der Vulnerabilität werden aktuelle Vorbereitungs- und Interventionsmaßnahmen im Bezug auf internationale politische Rahmenbedingungen für Entwicklungs- und Schwellenländer illustriert. Zwischen 2008 und 2009 wurden sogenannte „Water and Sanitation Preparedness Kits" des Roten Kreuzes in 14 Naturkatastrophen-affinen Staaten Afrikas und Asiens verteilt. Laut Aussage der Rot Kreuz Koordinatoren in Genf fehlte bis jetzt eine Evaluierung des tatsächlichen Verhaltens der Kits an den Einsatzorten, um Aussagen über deren Effekt auf Vulnerabilitäten treffen zu können.

Die Kapazitäten des teuren Materials, das normalerweise bei Katastropheneinsätzen im Wassersektor eingesetzt wird, werden oft nicht ausgelastet. Zusätzlich bewirkt die rein technische Orientierung kaum einen nachhaltigen Nutzen für die betroffene Bevölkerung. Der größte Vorteil der Kits ist, dass sie auch bei kleinen Desastern, die oft den Weg für Auswirkungen größerer ebnen, angewendet werden können. Deshalb entsendet das Rote Kreuz Delegierte, die mit den jeweiligen Nationalen Gesellschaften vor Ort an den Kits für den

Ernstfall trainieren. Sind die Kapazitäten erschöpft, gibt es im Falle einer Katastrophe zu großen Ausmaßes noch immer die Möglichkeit, externe Hilfe anzufordern.

Das Verhalten der Kits wurde mittels Experteninterviews und eines Fragebogens evaluiert. Tansania, das einzige Land, das die Kits bis jetzt im Ernstfall testen konnte, dient dabei als Fallstudie. Im Zentrum stehen Fragen bezüglich Hindernissen für den effizienten Einsatz Akzeptanz, Training und Positionierung der Kits. Die Resultate wurden mittels SWOT-analyse veranschaulicht und beinhalten beispielsweise Schwächen des Systems hinsichtlich fehlender Ersatzteile oder zu hoher technischer Komplexität.

Zusätzlich dient diese Diplomarbeit als Basis für eine Dissertation, die sich mit dem Design der ideal Umgebung für Katastrophenvorbereitung den Bereichen Wasserversorgung, -entsorgung und Hygiene befasst.

Schlüsselwörter: Abwasserentsorgung, Katastrophenmanagement, Katastrophenvorbereitung, Tansania, Vulnerabilität, Wasserversorgung

1. Introduction and Problem Outline

During the last decades it has become the state-of-the-art approach of disaster management to intervene, although nearly every concept or strategy highlights the higher efficiency of preparedness-activities. Both emergency response after the impact of a (natural) disaster and development cooperation are subject to a countless number of handicaps – some of them appear in the chaotic situation after the disasters, others within the time of reconstruction. Some examples: There is currently no internationally accepted major institution that could coordinate the work of governments, multilateral development organisations, NGOs, UN-organisations, regional development banks, foundations, etc. The high number of donors and their often maladjusted concepts overstrain the capacities of many developing or threshold countries. Some countries are not even integrated in the decision-making about their own reconstruction. Donation processes are non-transparent, which gives the administrative machinery a chance to consume a big part of the money itself.

Kofi Annan, former secretary General of the United Nations, stated that the biggest advantage of preparedness is that something will not happen. The “invisibility” of such an approach obviously makes financial expenses for preparedness difficult to justify in front of donors. Nevertheless, preparedness measures have the big advantage of being able to address root causes and dynamic pressures instead of symptoms in a system, which is more stable than after a disaster.

On one hand, emergency equipment of the Red Cross and Red Crescent Movement for water treatment and sanitation is becoming more powerful. On the other hand, the degree of utilisation of the biggest treatment unit (Water and Sanitation Module 40) often falls below 20 percent. In the chaotic situation of a natural disaster, relief organisations tend to apply well-known approaches, regardless of their sustainable use for the victims.

The dimension of a natural catastrophe goes far beyond what is presented in the media. The fact that nature is personified as “evil” leads to drastic consequences – people are decoupled from their natural surroundings, responsibilities are passed on. People’s vulnerabilities can have countless reasons, whereas poverty is often presented as the major root cause. Actually, poverty is one crucial reason for high communal vulnerability, which triggers further interconnected weaknesses of the system, but it is by far not the only one. Many people in threshold- and developing countries suffer “slow-onset” disasters that are not as impressive as their huge-scale counterparts. These circumstances often serve as a breeding ground for “rapid-onset” disasters like floods or thunderstorms and increase their impact. Capacity building is nearly impossible, if economy and the political system are instable. Lack of knowledge transfer and education nurtures the dispersal of diseases, etc. Chapter 3.4 about vulnerability will discuss this topic in detail.

Another major problem of disaster management is that international teams are well prepared, but the victims are not. Consequences are little trust in and understanding of the helping teams’ activities. Furthermore, National Societies of the Red Cross Movement run the risk of losing face in front of their governments, if they admit that a certain disaster exceeds their capacities.

Water and Sanitation Kits were designed to serve as a buffer before international assistance is requested. Experts from the Red Cross and Red Crescent Movement help National Societies to practice on one of the three different types of WatSan-Kits in their own country to increase preparedness. Approximately one year ago, the kits were pre-positioned in 14 African and Asian countries.

The Austrian Red Cross owns both Water and Sanitation Emergency Response Units and WatSan-Kits. At the same time the Institute of Sanitary Engineering and Water Pollution Control (University of Natural Resources and Applied Life Sciences, Austria) and the Faculty of Environment, Society and Design (Lincoln University, New Zealand) employs experts in water

resource management and development cooperation. This background serves as the ideal working environment for implementing theoretical concepts into feasible approaches. Additionally, the purely technical approach of disaster intervention and preparation can be widened. Advisors from the Austrian Red Cross and from the headquarter in Geneva highlighted the need for practical suggestions. Following the principle “after the disaster is before the disaster” research was carried out as holistic as possible.

Investigations started in June 2009. The focus clearly lies on natural disasters, not warlike conflicts.

1.1 Structure

After having introduced the problem outline, objectives and research questions in chapter one, chapter two finally deals with the general background of water-related disaster management. It encompasses a description of the current Red Cross disaster management approach and its weaknesses. The concept of vulnerability is being referred to as a key-parameter. Furthermore, Water and Sanitation-Kits are introduced as the most recent water-related preparedness activity and linked to the necessity of strategies that are not purely technically oriented.

Chapter three deals with the state of the art of science and technology to explain the necessity for interdisciplinary disaster preparedness.

Relevant key terms are defined in chapter 3.1, whereas relations to each other are explained, like in case of risk and hazard. The definition of “disaster” and “catastrophe” is added a sub-chapter about the medial construction of natural disasters, which aims at eliminating the image of “god-given” or “faith-related” disasters. The chapter ends with an explanation of the risk formula, which is the basis of most modern risk concepts.

In Chapter 3.2, risk management, risks are classified and the risk governance framework is explained. A new idealized risk management cycle is created by combining and adapting two overlapping concepts. Topics like the classification of disaster-consequences or urbanisation are visualised.

Climate change, as the strongest trigger for imbalances in the hydro-meteorological cycle, including possible ways of mitigation and practical examples for adaptation, are highlighted in chapter 3.3. Results of the Intergovernmental Panel on Climate Change are thereby summarized and taken for granted. The Climate Vulnerability Index plays a crucial role in vulnerability mapping. Illustrations show climate vulnerability on global scale and for one exemplary country, Peru, whereas component values are specified. At last, Indian monsoon impacts are taken as an example for effects of climate change in real life.

Chapter 3.4 is dedicated to the big issue of vulnerability. Beginning with constraints of the millennium development goals in relation to developing cooperation, the chapter continues with the role of water pollution and a statistical analysis of casualties, number/frequency of disasters and economic loss. Based on the pressure and release model the problem of overpopulation is examined. The term “resilience” embraces the reaction of systemic stability on external perturbations. Practical international examples are to give the term a seizable dimension. Disaster vulnerability of Small Island Developing States (SIDS) is given special attention.

Political background and principles of international disaster relief are the content of chapter 3.5, which moreover deals with the humanitarian system, its most powerful organisations and institutional preparedness of Red Cross National Societies. The most recent relevant strategies, such as the EU-Strategy for Disaster Risk Reduction in Developing Countries, the Seville Agreement, the Hyogo Framework for Action or the Sphere Project, are investigated with regard to the thesis’ objectives. Recent guidelines on water, sanitation and hygiene promotion are compared.

Chapter 3.6 opposes equipment and strategies of the International Red Cross for acute intervention with approaches on preparedness. The sequence of emergency operations is

illustrated in a chart. Current technology and locations of Water and Sanitation-Kits, including the background of hygiene promotion complete the chapter.

Assessment of performance, vulnerability and risk is the content of chapter 3.7. Red Cross acute intervention is evaluated; the effect of pre-disaster management on post-disaster effects is assessed from different perspectives. The situation in Sri Lanka serves as an example for disaster risk mapping and depicts cumulative factors resulting in landslide vulnerability. Finally, the Red Cross approach on Vulnerability and Capacity Assessment (VCA) is described from the first steps of defining the degree and kind of participation to completion and documentation.

Chapter four, materials and methods, illustrates the long process of identifying the research questions. Sources of official and internal (Red Cross) information are listed and search methodologies described. Chapter five illustrates the questionnaire's objectives and structure. An interpretation key was developed particularly with regard to answering the research questions.

Chapter six deals with a recent flood disaster in the United Republic of Tanzania and results of the questionnaire to give the concept of preparedness a more practical dimension.

The core of this thesis is chapter seven, results. It summarizes outputs of the interviews about emergency training and the questionnaire's answer to the research questions in chapter one. A SWOT-analysis (strengths, weaknesses, opportunities, threats) of the WatSan-Kit approach describes the findings. Based on recent literature, the results are discussed and interpreted in chapter eight.

Chapters nine contains an executive summary of this thesis. Future recommendations, such as the continuation of research in a dissertation, are listed in chapter ten.

1.2 Objectives

Theoretically, a higher degree of preparedness requires less external support (Figure 1.1). However, this diploma thesis considers the capacities before and after the impact of a natural disaster. Catastrophes have the potential to decrease formerly elaborated preparedness activities to a minimum. Water and sanitation kits are prepositioned in disaster prone countries and relatively easy to move. There is currently no scientific basis for prepositioning the kits, which demands multi-level risk, vulnerability and capacity assessments. This complex, time-consuming task cannot be fulfilled by means of one single thesis. Hence, the major objective of this thesis is to proof the hypothesis, if water and sanitation preparedness kits have a significant buffering effect, before international assistance has to be demanded.

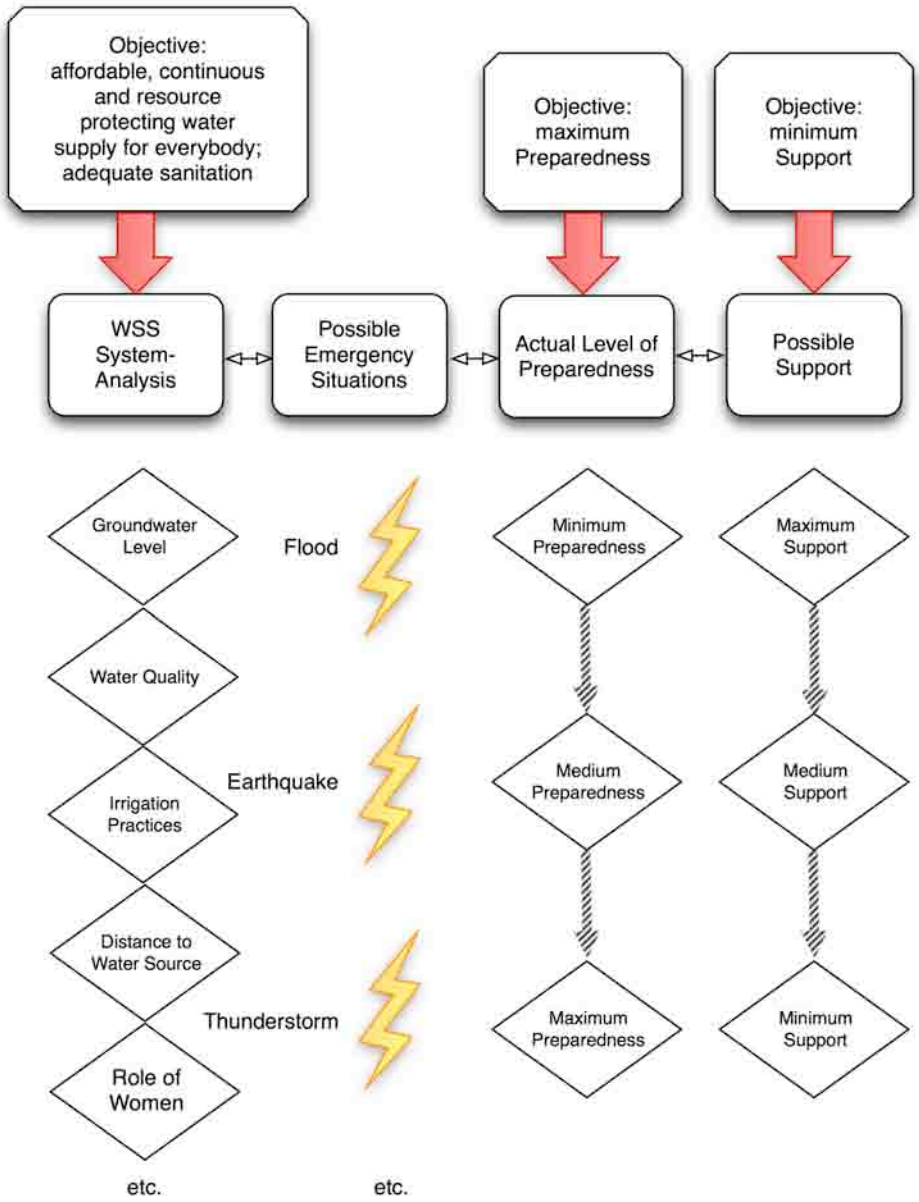


Figure 1.1: Interaction of Preparedness and acute Intervention for Water-related Disasters, WSS stands for Water Supply and Sanitation (JUNG, 2009)

After having studied Red Cross guidelines, procedures and equipment, a series of expert interviews with Helmut Jung (University of Natural Resources and Applied Life Sciences), Juergen Hoegl, Guenter Stummer (both Austrian Red Cross) and William Carter (Red Cross headquarter, Geneva) enabled the formulation of practically relevant research questions.

1.3 Research Questions in Detail

The research questions of this diploma thesis are:

- What are barriers for Red Cross National Societies to cope with the WatSan-Kit system on site?
- Are the kits' locations considered as appropriate by the host National Societies?
- What are the kits current conditions?
- How often do National Societies practice with the kits for emergency situations?
- Were the kits already used in a disaster situation?
- If not, are there more efficient, possibly traditional tools used in disaster situations?
- What are potentials to optimise WatSan-Kit training and operation?
- Do the kits efficiently contribute to disaster preparedness on local, regional or national scale?
- What is the political and scientific basis for interdisciplinary disaster preparedness activities?

The last question aims at fortifying the necessity to invest in and join forces on internationally coordinated preparedness activities. Despite broadly based knowledge about higher efficiency of preparedness measures in comparison to acute intervention, it still seems difficult for relief organisations to justify investments into "invisible activities" like knowledge transfer and capacity building.

Therefore, this diploma thesis is based on a broad basis of literature - international guidelines, theoretical concepts on preparedness, their practical implementations and constraints, case studies and internal papers of the Red Cross and Red Crescent Movement.

The original plan of sending a bilingual questionnaire to all 14 African and Asian National Societies that are currently working with the WatSan-Kit system had to be adapted. After the earthquake in Haiti (January 2010) the Red Cross Headquarter in Geneva and especially the coordinator of the kits, William Carter, were extremely busy with emergency response and reconstruction. The research approach shifted towards assessing the performance of the kits in the only country that actually used them in a disaster – the United Republic of Tanzania. It aimed at gathering as much information as possible by posing simple qualitative or open questions. You will find the original questionnaire in the appendix. Its analysis and interpretation led to answers of the research questions in chapter seven and future recommendations in chapter ten.

2. General Background

Disaster management can generally be distinguished into pre- and post-disaster activities. Organisations that are specialised on development cooperation or disaster relief have to cope with a chaotic system, a high degree of uncertainty, unclear allocation of rights and duties, the problem of finding immediate solutions with sustainable long-term effects, corruption in the receiving country, etc (DEVELOPMENT AND PEACE FOUNDATION, 2010). Concentrating capacities on preparedness gives aid organisations the chance to decrease the degree of uncertainty, to support local institutions in finding more adapted and accepted approaches. Missing time pressure paves the way for interdisciplinary solutions, transparent responsibilities and processes.

Every year the Federation of Red Cross and Red Crescent have to deal with more than 30 million refugees and victims. 90 percent of all people affected by small and large-scale natural disasters are found in developing and threshold countries, although financial loss is about one third higher in their industrialised counterparts (investigated timeframe: 1991-2000). These numbers originate from research of the Munich Reinsurance Company (MUNICH RE GROUP, 2008). Together with the Intergovernmental Panel on Climate Chance (IPCC) the Munich Re Group serves as a reliable source of information for the gradual increase of hydro-meteorological extreme events. In times of decreasing expenditures on development aid and rising investments in acute intervention it is essential to limit or decrease local vulnerabilities by solutions that are flexible enough to cope with changes in population density, settlement structure, risk distribution and climate change.

Directly after a catastrophe has been reported to the Red Cross headquarter in Geneva, Field Assessment and Coordination Teams (FACT) are sent to the place of accident. According to their appraisement, different Emergency Response Units (ERUs) can be requested. These teams work with standardised equipment, know each other in advance and have different fields of specialisation – water and sanitation, logistics, communication, health care, etc. This conventional approach has basically dominated international relief activities during the last decades and is now extended by Water and Sanitation-Kits that serve as a not purely technical preparedness measure for Red Cross National Societies in disaster prone countries.

Following the research of LEWIS (1999), vulnerability can have countless reasons, but cannot be efficiently “controlled” or limited by ad-hoc interventions. It is impossible to guarantee the sustainability of actions and therefore a long-term benefit by technical means only. Juergen Hoegl (2009) from the Austrian Red Cross stated that the workload of emergency response units’ team leaders leaves hardly any space for the reasonable consideration of long-term effects. Additionally, staff is mainly technically trained, which limits the outcome of a relief operation to the reconstruction of the system’s “status quo ante”. According to the WORLD WATER FORUM (2006), purely technical approaches impede multi-level efforts to decrease vulnerabilities. Reconstruction can be regarded as a unique chance to avoid the repetition of errors. That is why the hectic relief phase should gradually switch over to the development of definite prevention works to ensure a better safety level.

The aim of Water and Sanitation-Kits is not to replace ERUs, but to serve as a complementary approach before hazards turn into disasters. While the largest ERU module produces water for up to 40 000 people per day, water sanitation kits (WatSan-Kits) can daily serve 10 000 beneficiaries at most. They are locally prepositioned, a lot easier to transport and operate than the equipment of ERU. National Societies of the Red Cross in developing countries still have the opportunity of requesting emergency response units or single delegates, but the kits are aiming at smaller disasters that mostly serve as a breeding ground for their huge-scale counterparts.

The International Federation of Red Cross and Red Crescent Societies published a Disaster Management Strategy for 2009-2010 (IIFRC, s.a.A). It is relatively explicit concerning the

importance of an interface between acute-help (relief, rehabilitation), preparative measures and developing cooperation.

In order to improve risk management the detailed programme components are:

- Promotion and updating of guidelines, vulnerability and capacity assessments
- Better linkages of policy makers and practical implementation
- More technical assistance in disaster management for National Societies
- Constant information and knowledge management to enable innovation and anticipate risk
- Capacity building
- Effective planning and stewardship of donations to offer vital services to a higher number of vulnerable communities

Additionally, it mentions the necessity of „competency based disaster management staff development“, to improve preparedness, relief und recovery programmes. However, people in a disaster situation are paralyzed. They have to be prepared for cooperation with international emergency response teams and their solutions. Otherwise the results of emergency operations might lead to a worse situation than before the event or to other negative impacts, such as the destruction of civil structures or the resource base.

Some principles of L.R.R.D. (Linking Relief, Rehabilitation and Development) have been covering the process of preparedness since the mid 1990s, but are strongly focused on the point of view of helpers. The development-aspect of L.R.R.D is not restricted to a physical dimension. It mainly includes the concise catchwords capacity- and awareness building, local empowerment, knowledge-transfer and public participation (COMMISSION OF THE EUROPEAN COMMUNITIES, 2001).

Nearly all IFRC-papers deal with the interface of acute help and development cooperation in a very theoretical way. Precise, systematic approaches to support preparedness at a time when threatened people are still able to collaborate with future-helpers and to prepare for the disaster situation, hardly exist.

The Summary Report of Recovery Operations (IFRC, 2006) approves that many helpers misunderstand the sustainability of actions as physical reconstruction. The cooperation with local health-workers, public participation, support of local structures and the ability of affected societies to help themselves deserve a clear strategy to be sustainable. Also VENRO (2006), a German collaboration of non-governmental organisations, highlights the negative long-term effects of a perception, which excludes intangible efforts. It states that a holistic L.R.R.D-strategy must not be restricted to a physical dimension. Furthermore, developing countries people must not be pushed towards dependencies on Western relief organisations if the objective is to establish sustainable disaster management.

Of course the question of financial feasibility and availability of personnel cannot and must not be neglected, but in the end preparative measures always save money compared to emergency response. Documentation and long-term evaluation of „invisible“ development efforts, represented by the catchwords of the upper paragraph are essential.

WatSan-Kits extend the common term preparedness towards a second dimension, so that both preparedness against the disaster itself trust towards rescue teams can be established. Especially when a huge-scale disaster exceeds the kits' capacities the interaction of technical solutions and participative approaches is crucial for the operation's sustainability. However, WatSan-Kits aim at strengthening local and regional capacities to a degree that does not require international assistance.

3. State of the Art of Science and Technology

The following chapters will define relevant key terms and discuss the following topics in detail:

- Risk Management
- Climate Change
- Vulnerability
- Political background and principles of international disaster relief
- Red Cross interventions in the water sector and
- Assessment of performance, vulnerability and risk

3.1 Definitions

Risk, hazard and vulnerability are interconnected key terms of this thesis. An unambiguous definition is therefore necessary. The anthropocentric perception of the terms “disaster” and “catastrophe” deserves an explanation, related conclusions and possible direct or indirect effects need to be distinguished.

3.1.1 Definition of the Terms “Risk” and “Hazard”

The term risk evolved in the 16th century after terms like hazards, uncertainty and coincidence had already been used for a long time (LUHMANN, 1993, cited in PROSKE, 2006).

In the scientific community more than 30 definitions are known. If the existing risk is lower than or equals the accepted risk, a situation is perceived as safety. If the existing risk is higher than the accepted risk, no feeling of safety can be created. Safety itself is described as “the only goal of states”. Since governments are not able to completely fulfil this task, it is re-exported to citizens in terms of laws (PROSKE, 2006).

Three components contribute to risk (WORLD WATER FORUM, 2006):

- The hazard’s magnitude and frequency
- Exposure of the population and economic activities and
- Vulnerability of these activities and the society itself to the exposure.

KAPLAN and GARRICK (1980) define the term risk as a likelihood of conversion of a potential source of damage, the hazard, “into actual delivery of loss, injury, or some form of damage”. They depict safeguards as the opportunity to minimise risk, but point out that it can never be zero. These safeguards can be physical or intangible like for instance knowledge about a hazard.

Risk is always relative to the observer and consists of both probability and consequence. Qualitatively, risk depends on real actions and the perfection of knowledge. The quantitative definition is far more complex. KAPLAN AND GARRICK (1980) state that risk analysis is based on three questions, triplets, which are combined with uncertainty. Uncertainty itself as a “degree of confidence” has to be distinguished from the term “frequency” that represents the outcome of an experiment with repeated trials.

The three questions are:

- What can happen or what can go wrong?
- How likely is it that it happens?
- What are the consequences if it happens?

It is not sufficient to communicate risk as a single number or a single curve. Decision support requires a complex family of curves and integration of costs and benefits to finally depict the acceptable risk.

SMITH (2005) describes hazard as an “inescapable part of life”, which often becomes routine as a chronic threat. Hazards are naturally occurring or human-induced processes or events that incorporate the potential of creating future loss. He agrees with KAPLAN and GARRICK (1980) that living in a risk-free environment is impossible. Risk is defined as “actual exposure of something of human value to a hazard”. Therefore, hazard can be regarded as “a potential threat to humans and their welfare”, risk as the “probability of a hazard occurring and creating loss”.

3.1.2 Definition of the Terms “Disaster” and “Catastrophe”

Similar to SMITH’s (2005) definition of “risk” the term „catastrophe“ can be regarded as highly anthropocentric. Impacts of natural events were not only essential for the creation of the earth’s surface and atmosphere since its creation. They are still crucial elements in the evolution of habitats. In riparian forests, for example, the alternation of floods and dry periods is responsible for a high variety of species. They serve as natural retention basins by buffering the discharge in case of flood events and recharging groundwater layers.

The media would never depict the flooding of a riparian forest as a “disaster” or “catastrophe”. Only when human lives or manmade physical assets are concerned the natural event is called a “catastrophe”.

The common definition is: A disaster is an event, which causes a severe threat to society. Loss of lives and physical damages result in failure of societal structures or essential components (PLATE and MERZ, 2001).

This definition implies two important conclusions (DFG, 2001):

1) Affected people depend on external help after the catastrophe.

2) A catastrophe always consists of two parts – a triggering, extremely negative natural event and the group of people, whose lives and possessions are threatened.

The triggering natural event can be created by processes in the earth’s interior (e.g. vulcanic eruptions, earthquakes) or processes in the atmosphere (e.g. thunderstorms, extreme precipitation). Natural catastrophes that are related to water are the most common. The direct destructive effect of floods often results in indirect effects like landslides, failures of dams or barrage fixes, overcharge of catchment basins, water contamination, epidemics or the promotion of water-related diseases (DFG, 2001).

Droughts have a special status, because they start gradually with the absence of precipitation. They are defined as a natural catastrophe, but strongly related to political and administrative questions like access to land (PLAPP, 2003).

Figure 3.1 shows that more extreme impacts are generally less frequent. Their threat has to be regarded as a combination of probability and consequence.

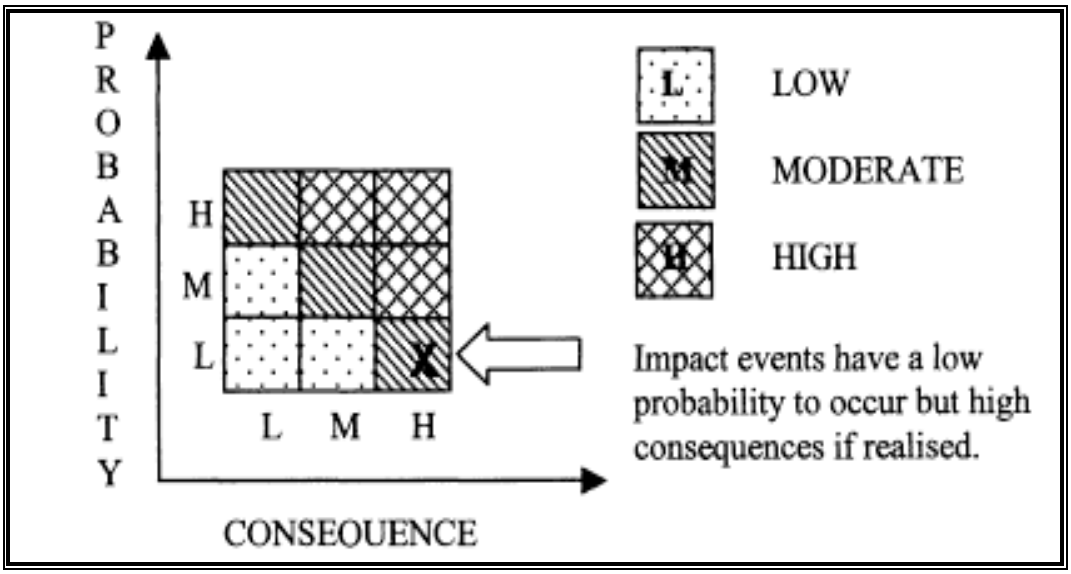


Figure 3.1: Categorisation of risk by probability of impact and consequence (GRITZNER, 2001)

According to MECHLER (2003, cited in PROSKE, 2004) an event is called disaster, if it shows one or more of the following characteristics:

- More than 100 casualties
- More than 1 % of the population is affected
- Financial damage is more than 1 % of the Gross National Product,
- The affected country declares the state of emergency,
- The affected country asks for international help
-

Hereby, the key defining properties of disasters are (MECHLER, 2003, cited in PROSKE, 2004):

1. Length of forewarning
2. Magnitude of the event
3. Scope of impact
4. Duration of impact

3.1.3 The medial Construction of Natural Disasters

PLOUGHMAN (1995) investigated five global disasters that had taken place in 1985 and were clearly depicted as natural disasters by US-print media, although their hybrid natural-man-made origin was obvious. The media had simplified processes to finally suggest that there was no direct correlation between human behaviour and the response of natural activities. “Alleged cause-effect relationships” continuously distort people’s perception and make them believe that natural disasters cannot be avoided. While some natural events are truly uncoupled from man-made activities, (e.g. earthquakes that are caused by tensions between tectonic plates or volcanic eruptions) the impact of floods or landslides shows a direct relation to human behaviour.

The five analysed disasters were starvation in Sudan and Ethiopia, a cyclone in Bangladesh (25th of May), earthquakes in Mexico City (20th of September) mudslides in Puerto Rico (7th of October) and volcanic lahars in Colombia (15th of November). They were chosen due to their medial presentation as “natural disasters”, the greatest frequency of coverage in the Reader’s Guide to Periodical Literature and the New York Times Index. PLOUGHMAN investigated the disaster from a socio-technical, socio-political and socio-economic perspective. By clearly

distinguishing “news from truth” PLOUGHMAN called these five events “constructed realities” and quotes BENTHALL (1993, cited at PLOUGMAN, 1995) with the statement that “disasters do not exist – except for their unfortunate victims and those who suffer in their aftermath – unless publicized by the media.”

While lack of rainfall was the superficial explanation for the African drought that lead to famine in Sudan and Ethiopia, the root causes were far more complex and interacting. A small amount of precipitation over a long period and crop failures triggered the famine, but that was not the ultimate reason for the famine. Ploughman mentions land-use, overpopulation, foreign aid policies, international economic order and national security policies as the real causes.

In case of a Newsweek-article about the cyclone and following ocean surges that killed thousands of people it takes five paragraphs before the reader finds out that the “deadly wall of water” had been detected by US-satellite warning systems. However, the little number of communication devices and easily accessible roads made forewarning and evacuation impossible. Shelters that had been built in the 1970s hardly protected physical assets. Small islands, the “Chars”, were literally swept away, but likely to be resettled directly after the event due to fertile land.

“Puerto Rico’s Grave of Mud” was Newsweek’s headline about the landslide of 1985. Once more nature was depicted as a villain, referring to three days of extreme rainfall events. The event itself was depicted as a “battle against nature”. The New York Times mentioned the fact that affected district had been built on a slope with an inclination of 30 degrees, but did not explain why. The medial construction of the 1985 Colombian lahars was similar, but it stated that there had been evacuation plans, which could have decreased the event’s impact. The government, that had to deal with civil war and an economic crisis, admitted that there had just not been enough time for evacuation.

According to ZSCHAU (2009) fortifying five percent of the most instable buildings would save 15 percent of all expected victims’ lives in case of earthquakes. Besides collapsing buildings, bursting electrical or gas lines that cause fires, are a risk during and after earthquakes. Secondary effects, like tsunamis, landslides or floods, often cause more damage than the event itself. What the media liked to call a “killer-quake” in Mexico City, mainly had an enormous impact due to the town’s location, building codes and lack of preparedness. Additionally, it was indicated that the country’s weak economy could result in limited recovery.

3.1.4 Definition of the Term “Vulnerability”

Vulnerability is defined by the factors that decide, whether societies and their physical assets are able to cope with the impact of a disaster or not. People, whose strategies of coping with catastrophes are limited, who are affected the most by the impact and whose potential to recover is very low, suffer from the highest degree of vulnerability (BOHLE et al., 1994).

According to SULLIVAN and HUNTINGFORD (2009) a key aspect of vulnerability is that it is spatially variable, reflecting local economic, social and cultural characteristics, as well as local physical conditions.

3.1.4.1 United Nations Definition

The UNITED NATIONS INTERNATIONAL STRATEGY FOR DISATER REDUCTION (2002) defines vulnerability as “the degree to which a socio-economic system or physical assets are either susceptible or resilient to the impact of natural hazards.” The combination of “awareness of hazards, public policy and administration, the wealth of a given society and organized abilities in all fields of disaster and risk management” further concretises the term.

Lowering vulnerability means more knowledge, more preparedness, more commitment from public authorities, interdisciplinary and intersectoral partnerships (UNITED NATIONS INTERNATIONAL STRATEGY FOR DISASTER REDUCTION, 2002).

3.1.4.2 Lewis' Definition

Individual vulnerability, the „degree of susceptibility to a natural hazard", is a key component of this diploma thesis and the core idea of preparative activities. It can be defined as the "product of sets of prevailing conditions in which disasters occur". The most sustainable approach would be to make vulnerability decreasing activities part of day-to-day management. Separating post-disaster interventions from pre-disaster contexts impedes the creation of efficient strategies. Understanding the mechanisms of vulnerability means a big advantage in the battle against natural disasters. Whether man-made or not, these disasters cause further possibilities, which justifies the statement: "after the catastrophe is before the catastrophe" (LEWIS, 1999)

3.1.4.3 Climate-Change-related Vulnerability

SULLIVAN et al. (2006) state that the appropriateness of the spatial scale has to be given high priority when assessing climate related vulnerability to make appropriate adaptation responses possible. The WORLD BANK (2002) formulates climate-change–related vulnerability as follows: "the linkages of climate change impacts to poverty are dynamic, often inter-connected, and context-specific – reflecting geographic location; economic, social, and cultural characteristics; prioritization and concerns of individuals, households, and social groups; as well as institutional and political constraints."

3.1.5 Risk Formula

The following risk formula (Figure 3.2) combines the likelihood of a disaster and the value of the object at risk with its vulnerability and probability of presence. It broadens the conventional risk-approach, which is a simple multiplication of likelihood of impact and consequence or hazard and vulnerability.

$$R = f\,(\underbrace{p_{Si}}_{p},\ \underbrace{p_{Oj,Si},\ A_{Oj},\ v_{Oj,\,Si}}_{\text{extent of damage}})$$

$R_{i,j}$ = risk, dependent on scenario *i* and object *j*
p_{Si} = probability of occurrence of scenario *i*
A_{Oj} = value of object *j* ('values at risk')
$v_{Oj,\,Si}$ = vulnerability of object *j*, dependent on scenario *i*
$p_{Oj,\,Si}$ = probability of presence of object *j* for scenario *i*

Figure 3.2: Risk Formula (FUCHS et al., 2001)

3.2 Risk Management

This chapter addresses ways of classifying risks and consequences of environmental disasters with regard to the risk governance framework and the disaster management cycle.

3.2.1 Classification of Risks

The INTERNATIONAL RISK GOVERNANCE COUNCIL (2008) specifies a number of risks that influence the process of risk governance or changes in science/technology:

- Degree of novelty (Has the risk already been part of management decisions? Is it emerging, re-emerging or increasing in importance?
- Scope (local, dispersed, transboundary, global)
- Range (What is influences by the risk's effects)
- Time horizon (for risk analysis)
- Type of hazard (omnipresent, persistent and/or irreversible)
- Insurability
- Latency (between triggering event and effects)
- Level of public concern and/or degree of stakeholder involvement
- Level of compliance (are guidelines, standards or regulations followed or is a laissez-faire approach dominant)
- Form of public-private-partnerships

Concerning risk analysis PROSKE (2006) distinguishes four main groups of risk:

- Health and social risks
- Natural risks (floods, earthquakes, etc.)
- Technical risks (dam failures, industrial accidents, etc.)
- Natural-technical risks (possible in case of landslides, floods, etc.)

SMITH (2005) classifies risks according to the following characteristics (Figure 3.3):

- Origin/Reason (natural, hybrid natural manmade, manmade)
- Arbitrariness (from involuntary to voluntary)
- Hazards that show a high level of human causation are generally more voluntary concerning acceptance, but also more diffuse concerning their impact.

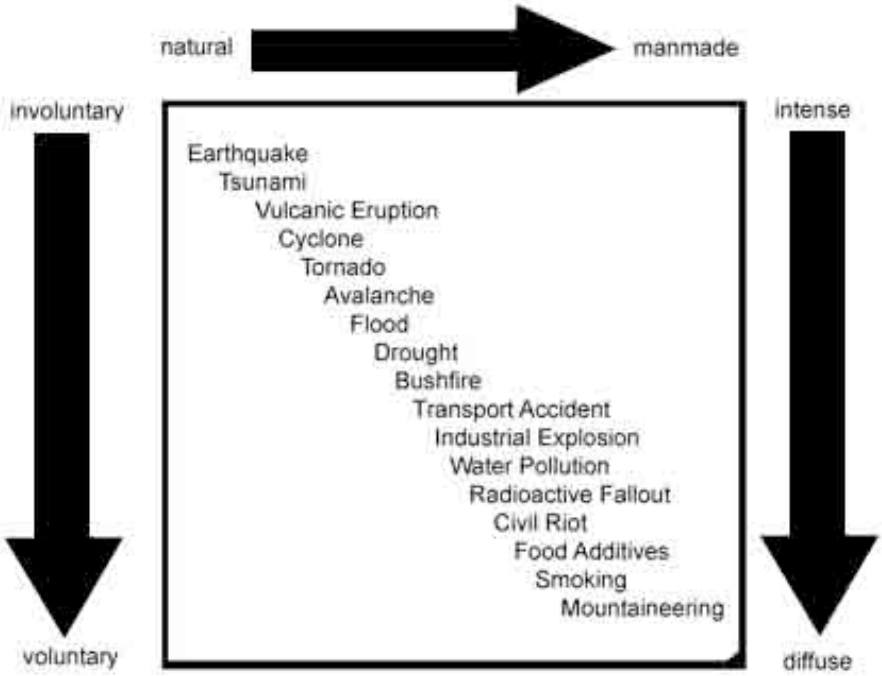


Figure 3.3: Risk Classification (SMITH, 2005)

3.2.2 Risk Governance

The INTERNATIONAL RISK GOVERNANCE COUNCIL (2008) developed a risk governance model, which places risk management between two surrounding spheres. The first one encompasses analysing and understanding the problem. The second one deals with solving it, whereas the risk factor is evaluated depending on socio-cultural acceptance.

This framework highlights the need of adequate action and the cognitive dimension, which “constructs” the perception of risk within a society. In addition, the governance-perspective includes institutional arrangements that steer social processes.

Although the model is rather focused on the willingness and capacity to take and accept risk in an industrialised society, its principles can be useful for risk management in developing countries. Societies should to be enabled to benefit from change (like adaptations to climate change or technology transfer), while negative consequences of the associated risk have to be mitigated. Thus the framework supports decision makers in management of complex situations of high uncertainty by raising relevant questions.

The five phases of risk governance, pre-assessment, appraisal, characterisation and evaluation, management and communication aim at minimising:

- Inequitable risk distribution between countries, institutions or societies
- Multiple approaches to manage the same risk
- Disproportionally strong focus on high profile risks with little probability
- Inappropriate risk trade-offs
- Missing links between related problems
- Ignorance of public perceptions
- Loss of public trust

Figure 3.4 illustrates the continuum of risk governance between understanding and decision-making:

1. Pre-assessment deals with the definition of the issue, early warning and the determination of scientific guidelines.

2. Appraisal defines hazards and their effects. It includes an assessment of risk and vulnerability. Social risk perception and socio-economic influences are added.

3. A risk profile is established to judge the risks consequences and opportunities for mitigation (understanding). Afterwards risk tolerances and acceptances are evaluated and the necessity to mitigate the risk is defined (decision-making).

4. The risk-management sphere identifies, evaluates and ranks alternatives for implementation. Feedback after practical experience is processed and monitoring established.

5. Communication enables stakeholders and civil society to conceive their role in the risk governance cycle. It is a crucial step to explain decisions and clarify responsibilities.

Figure 3.4: Five Phases of Risk Governance embedded between the two Spheres of Decision-Making and Understanding (INTERNATIONAL RISK GOVERNANCE COUNCIL, 2008)

3.2.3 The Disaster Management Cycle

The discussion of links between hazards, exposure and vulnerability should take place in a balanced way, whereas statements that lack scientific confirmation have to be avoided by all means. It is crucial for local authorities to assign specific weights to each risk factor. Measures to lower vulnerability have economic consequences, which have to be justifiable with respect to economic survival of the region. In certain cases coping with disaster prone areas may be a

better choice than to have no place to live at all. Therefore, mitigation strategies have to consider both risk and chance for development (WORLD WATER FORUM, 2006).

According to PLATE and MERZ (2001), the pre-stage for controlling a natural extreme event is the creation of societal general principles that are based on development objectives. The core question is, which priority the protection against natural hazards has, compared to other needs. Answering this question is the task of risk management. Residual risks are difficult to handle and to justify, because society demands maximum protection at minimal costs. Since risk perception is individual, expenses for protection deserve the assignment of priorities. Participative processes can be difficult due to lack of public knowledge or biased perception.

Figure 3.5 shows an idealized risk management cycle, which combines various state-of-the-art approaches and illustrates the connection of recent and future consequences of disasters.

Figure 3.5: The idealized Risk Management Cycle (adapted and translated from DFG, 2001 and INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE, 2008)

Ideally, technical and planning alternatives, both based on research, connect natural sciences and political decisions by transferring societal demands into quantifiable data and proposals for the achievement of objectives. Most modern western societies allow themselves a “luxurious” and expensive protection against natural hazards. Protection against 100 years design floods is the standard in

industrial countries like Austria and a classical preparative measure, but hardly affordable for developing countries (JUNG, 2009).

Both spheres of risk management, preparation and relief, are problematic in developing countries. Lack of knowledge and financial resources or the absence of early warning systems make preparation difficult. Disaster management without international help is often impossible and has lead to dependencies. Even if early warning systems are installed and work efficiently, predictions have to be transferred into warnings. In this regard, lack of communication systems is another risk advancing factor in developing countries (WORLD WATER FORUM, 2006).

Nevertheless, the WORLD WATER FORUM (2006) encourages science and technology to try to break financial barriers and to install holistic early warning concepts. However, external financing of early warning systems without long-term planning is useless. Several countries in Latin America and the Caribbean serve as examples. They are lacking necessary capacities in trained personnel and equipment to get reliable short to medium term forecasts. Financial constraints of local governments to provide operation and maintenance have made these state-of-the-art systems unsustainable.

3.2.4 "No-regret" and "non-reversible" measures

Some German counties went a new way in flood disaster risk reduction. They proposed to raise the level of 100 years design floods by 15 % to satisfy possibly increasing flood levels through climate change. Of course, construction gets more expensive following this concept, which is one major constraint for its implementation in the third world. In Switzerland, calculations are carried out for extreme events exceeding standard design floods. If the damage remains acceptable, the protection is considered as sufficiently flexible to handle future extreme events (World Water Forum, 2006).

Another concept is the avoidance of "non reversible" measures – a strategy, which longs for flexible, future oriented actions. One example is the inter-dependence of hydropower and agriculture. Crops, respectively irrigation perimeters, are often inflexible concerning the water household. Hydropower can be substituted by other ways of energy generation. In this regard, the WORLD WATER FORUM (2006) proposes thermal power generation.

This approach runs a high likelihood of shifting risk towards higher emissions. However, the construction of reservoirs makes adaptations to climatic change easier, because the unreliable part of water can be used for hydropower, the reliable part for irrigation.

3.2.5 Consequences of Environmental Disasters

SMITH (2005) differentiates tangible and intangible damage potentials, direct and indirect effects, losses and gains (Figure 3.6).

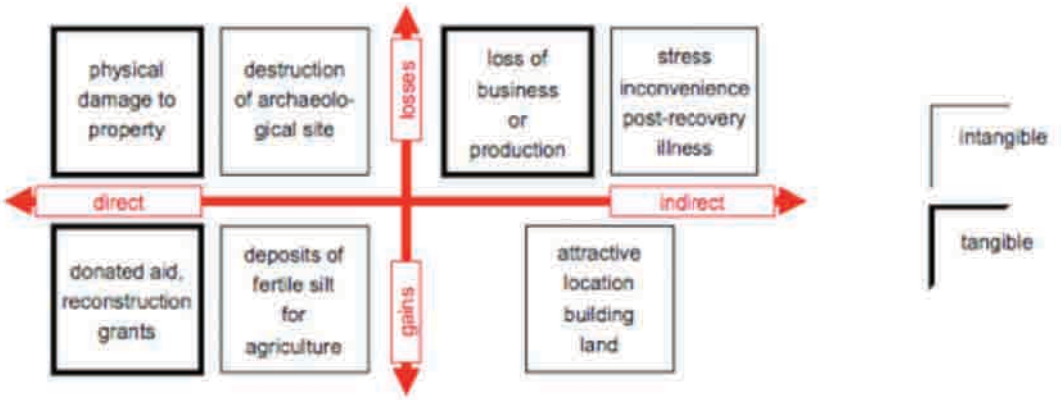


Figure 3.6: Consequences of environmental disasters (SMITH, 2005)

Direct effects, such as fatalities or damage to buildings, belong to the first visible effects of a disaster. Although they are often not the most significant outcome of a disaster, they are relatively easy to measure. Indirect effects appear later. Their connection to the actual disaster is often not obvious (disruption of social and economic activities, illnesses, rise in unemployment, decreasing property prices, etc.). In case of tangible effects it is possible to assign reasonable monetary values, such as replacement of damaged products or buildings. In contrast to tangible losses, their intangible counterparts cannot be expressed in monetary terms. The section about direct gains represents positive effects that a disaster could have in the long run. SMITH (2005) puts external aid into that section. Since external aid often has a negative effect on the system's vulnerability due to misrouted investment in the long run, I strongly disagree. History has shown that disasters can have direct positive effects, like the volcanic eruption in Iceland (1973), which finally led to extraction of geothermal heat from the volcanic core. Indirect gains represent positive long-term effects for communities. Little research has been undertaken in balancing advantages of disaster-prone locations (e.g. houses built next to rivers) and possible natural impacts.

3.2.6 Urbanisation

Since 2007 more people live in cities than in rural areas (Figure 3.7).

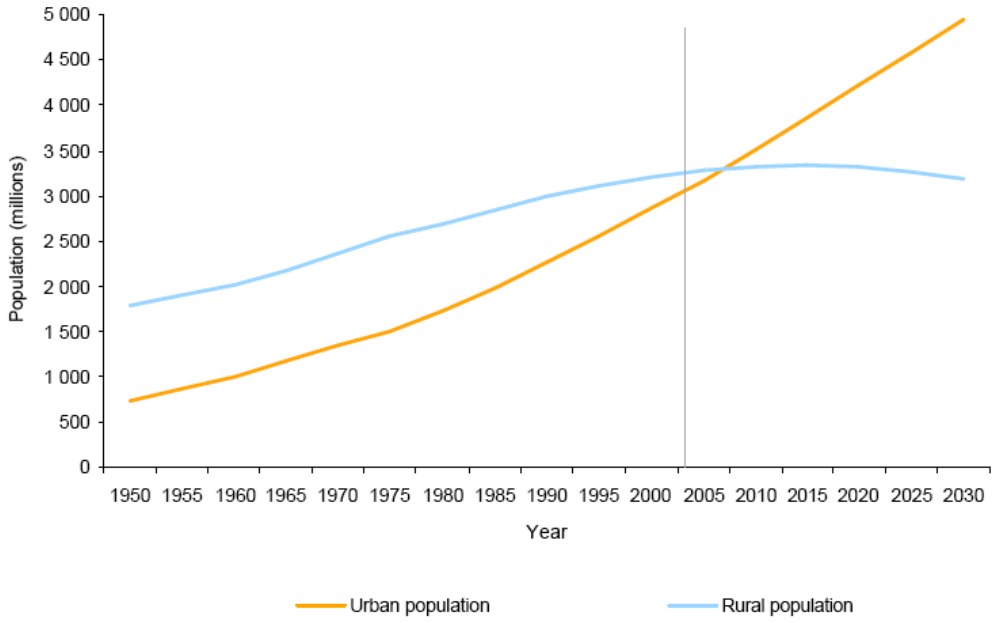


Figure 3.7: Global Development of urban and rural Population (UNITED NATIONS, 2004)

Especially in developing and threshold countries the dynamics of development are accelerating, which leads to cumulated risks and chances for sustainable development (Chart 3-1).

Chart 3-1: Urbanisation is both Risk and Chance for sustainable Development (adapted from KRAAS and NITSCHKE, 2006)

Risks	Chances
Degradation of air and soil	Lower land consumption
Soil sealing	Closed energy and material cycles
Water pollution	Management of urban biodiversity

Untreated waste and waste water	Holistic monitoring and management of the human being-nature-interaction
Deficits in hygiene	Concentration of environmental laws
Epidemics	Better social services
Higher disaster potential (floods, earthquakes, etc.)	Increasing productivity and innovation
Uncontrolled use of resources	Interaction of economic sectors
Ignorance of land use planning	Shorter transport distances
Instable housing structure	Higher density of education- and health institutions
Unemployment, exploitation of cheap workforce, low income levels	Decreasing birth rates
Broad spectre of illegal activities	Decreasing endogenous population pressure
Increase of socio-economic disparities	Intercultural diversity
Overcharged infrastructure	Gender equation
Rising vulnerability of marginalised population groups	Self-determination
Social inequity, abuse of social power	

3.3 The Role of Climate Change

This diploma thesis' objective is not to investigate if climate change is naturally occurring or if mankind is fully responsible for the emission of greenhouse-gases that impede infrared-radiation from reflecting towards our atmosphere. Nevertheless, the topic deserves a clear statement. IPCC-results are thereby taken as granted.

According to the fourth IPCC-Assessment Report (IPCC, 2007), the concentration of the most wide-spread greenhouse-gas, carbon dioxide, has increased from a pre-industrial value of about 280 ppm to 379 ppm in 2005. As ice core analyses proofed that this value of carbon dioxide in the atmosphere exceeds the natural range of the last 650 000 years, which had been 180-300 ppm.

In the worst case (A1FI scenario) a sea level rise of 59 cm can be expected by 2100. Furthermore, it is likely that tropical cyclones (typhoons and hurricanes) will get more intense by rising sea temperatures, although there is no clear trend evident in the global annual number of tropical thunderstorms to date. Heavy rainfall and hot extreme temperatures are both likely to keep increasing (IPCC, 2007).

As regards disaster management, both direct and indirect effects of climate change result in severe consequences. Direct effects are increasing mean temperatures, higher frequency and magnitude of extreme weather events. Ecosystem degradation, unplanned urbanisation, water and food availability are examples for indirect effects. It is a matter of fact that the number of

people suffering from consequences of climate change is growing, as demonstrated in the following sub-chapters.

IPCC (2007, cited in UNITED NATIONS INTERNATIONAL STRATEGY FOR THE DISASTER REDUCTION, 2008) states that the agricultural sector of some mid- and high-latitude areas might benefit from more precipitation. Tropical regions or areas that are seasonally dry in lower attitudes might in contrast suffer from a higher frequency of droughts and floods. This process might easily affect crop production and cause displacement and migration.

Figure 3.8 illustrates that developing countries will be more affected (WORLD BANK, 2007). Droughts mainly concern Sub-Saharan African countries, which simultaneously suffer from the most severe negative impacts on agricultural productivity (WORLD BANK/IDA, 2007; DEVELOPMENT AND PEACE FOUNDATION, 2010). In comparison to 2080, developing countries will have to face a projected loss in agricultural production potential of eight to ten percent (DGVN, 2007)

Flood risk is concentrated in South- and Southeast Asia and countries close to the hurricane belt of the Pacific and Indian Oceans are threatened by thunderstorms (WORLD BANK/IDA, 2007; DEVELOPMENT AND PEACE FOUNDATION, 2010).

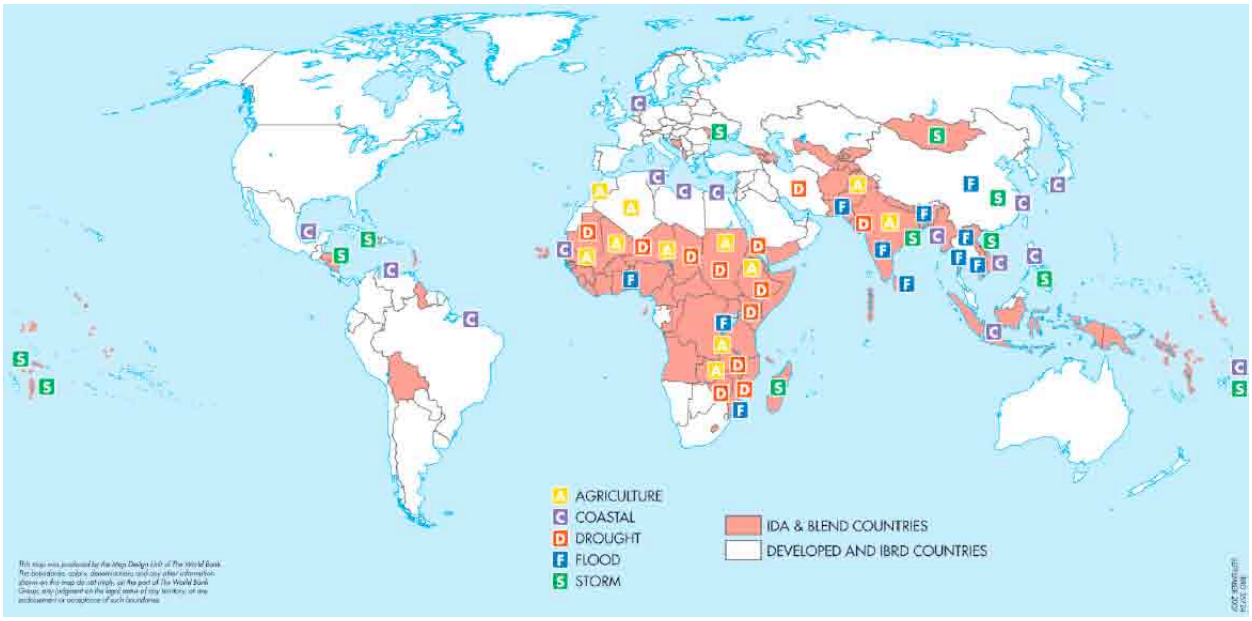


Figure 3.8: Global Climate change-related Vulnerabilities (WORLD BANK, 2007)

Especially industries and societies in coastal areas and river flood plains are vulnerable to climatic changes. The same applies for economies that deal with climate-sensitive resources and for regions that are quickly urbanised. People's vulnerabilities are collaterally increased by more frequent occurrence of malnutrition, diarrhoea and malaria (UNITED NATIONS INTERNATIONAL STRATEGY FOR THE DISASTER REDUCTION, 2008).

According to BAUMERT et al. (2005), developing countries will be emitting more green house gases (respectively green house gas equivalents) than their industrialised counterparts by 2025. Figure 3.9 shows emissions on global scale, in developed and developing countries in comparison to projected emissions.

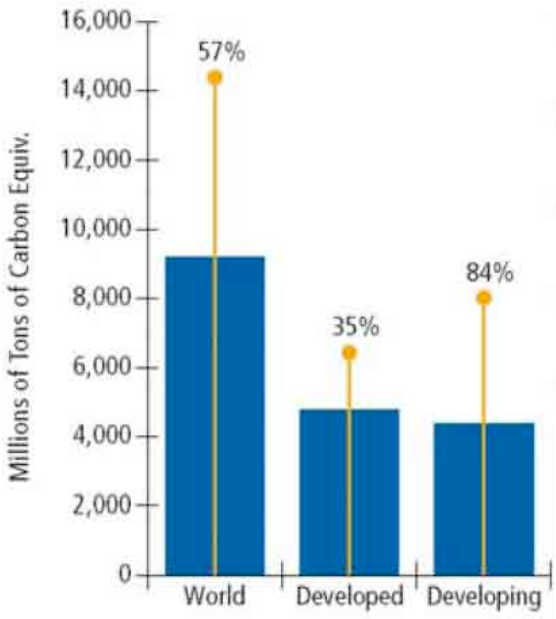


Figure 3.9: Comparison of Emissions in 2000 and 2025 on global Scale, for developing and developed Countries (BAUMERT et al., 2005)

The UNITED NATIONS INTERNATIONAL STRATEGY FOR THE DISASTER REDUCTION (2008) mentions “endemic poverty, weak institutions, complex disasters and associated conflicts” as main causes for low adaptive capacities. Since the 1970s, the Sahel and Southern Africa are becoming drier. By 2020, some countries will have to cope with 50% of their current yields.

One major resource problem in Asia will be the availability of adequate fresh water. Within the next decades people living in the Himalayan region will have to adapt to more frequent flooding and rock avalanches. At the mid of the century this could turn into a concern for more than a billion people. Asia’s coastal areas will be affected from two directions – rising sea levels and river flooding (UNITED NATIONS INTERNATIONAL STRATEGY FOR THE DISASTER REDUCTION, 2008).

3.3.1 Climate Vulnerability Index

Progress in computer performance has made climate models at scales below 50 km^2 possible. Linking outputs of global climate change models to parameters of the “Climate Vulnerability Index” (CVI) make conclusions about vulnerability of water resources and related livelihoods or the generation of ecosystem services possible (SULLIVAN and HUNTINGFORD, 2009).

The CVI assesses anthropocentric vulnerability to impacts of global change on water resources and includes bio-physical and socio-political drivers. Values range between 1 and 100, whereas high values represent higher vulnerabilities.

The Global Impact Factors (GIFs) that the CVI is based on are (SULLIVAN and HUNTINGFORD, 2009):

- Geospatial variability (e.g. rise of sea levels)
- Resource quantification
- Accessibility and property rights
- Utilisation and economic efficiency
- Capacity of people and institutions
- Ecological integrity maintenance

The impact factors are combined with a composite index and corresponding sub-components. Each of the sub-components can be weighted to express its relative importance. The process of weighting needs to be carried out in cooperation with affected inhabitants to consider local conditions. Figure 3.10 shows the global CVI with country-specific weights that were derived from national level data.

One example how GIF can be calculated: Ideally, the factor (water)-“Resource” should be based on availability, quality and variability caused by meteorological fluctuations. Due to lack of data and means to compare water quality on a global scale, rainfall variability was combined with the FAO measure of “total renewable resources” (FAO, 2004; cited in SULLIVAN and HUNTINGFORD, 2009).

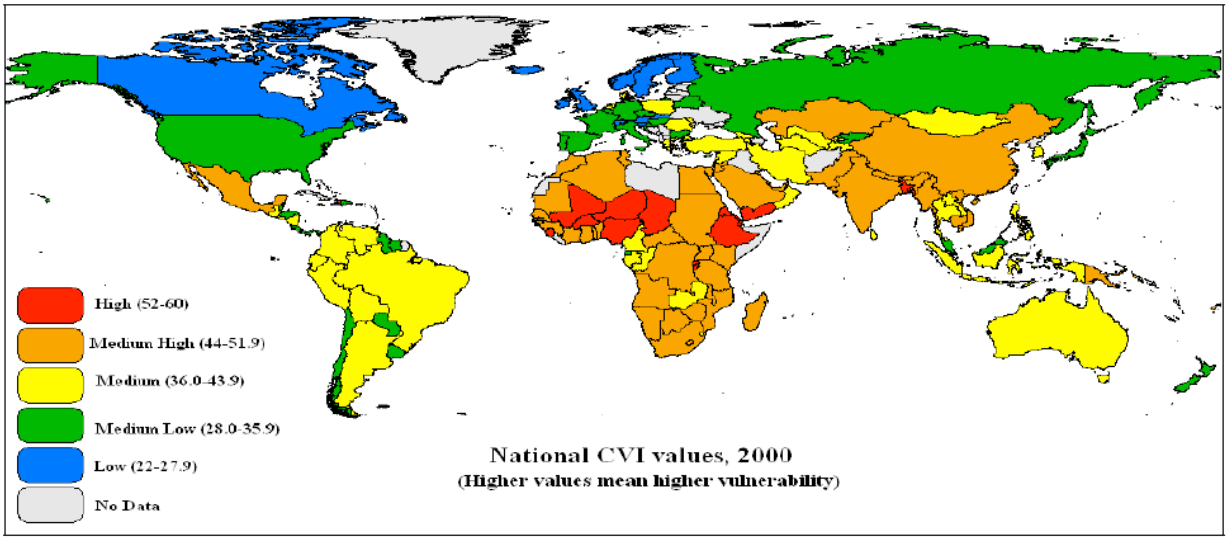
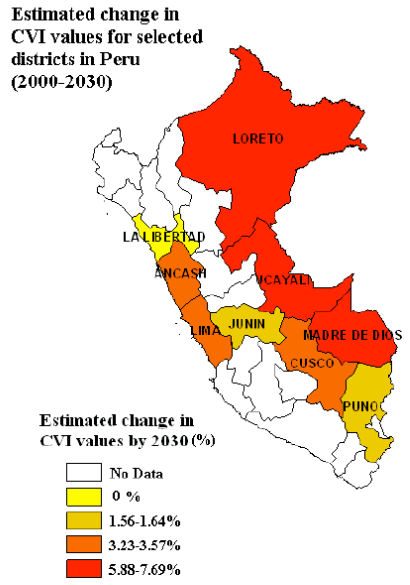


Figure 3.10: Illustration of global Climate Change related Vulnerabilities; neutral Weights are used to represent the Risk Factor (SULLIVAN and HUNTINGFORD, 2009)

Calculations on national scale are more complex, but enable the illustration of regional diversities. Chart 3-2 summarises the predicted development of CVI component values for Peru. Values range between 1 and 100, whereas high values represent higher vulnerabilities. Component values of every region are compared for two years – assessed data for 1993 and calculated values for 2030. Results show a general rise of the CVI-value (although several component values are likely to decrease until 2030). Regions, which are marked in red in the north and northeast of Peru, are characterised by higher CVI values and therefore more susceptible to natural disasters.

Chart 3-2: Local CVI for Peru (SULLIVAN and HUNTINGFORD, 2009)

Change in CVI values



Source: Sullivan, Huntingford and O'Regan (2009)

Summary of component and CVI values, districts in Peru

Department	Year	Component Values						CVI
		Geo-spatial variability	Resource quantification	Accessibility, property rts	Capacity of people and institutions	Utilisation and economic eff	Ecological integrity	
Coastal zone								
Lima	1993	50	66	72	54	58	64	61
	2030	58	65	65	34	62	94	63
Ancash	1993	55	65	74	50	39	56	57
	2030	63	67	68	35	42	74	58
La Libertad	1993	65	67	70	44	41	58	58
	2030	78	53	62	37	44	77	59
Mountain zone								
Junin	1993	77.5	65	81	50	46	48	61
	2030	91	64	77	32	46	63	62
Cusco	1993	77.5	64	85	56	42	50	62
	2030	91	65	81	41	42	64	64
Puno	1993	77.5	89	80	59	42	39	64
	2030	91	89	75	43	42	51	65
Amazonian zone								
Loreto	1993	15	15	88	62	16	9	34
	2030	18	28	85	46	28	13	36
Ucayali	1993	31	31	89	62	14	9	39
	2030	39	43	86	45	27	14	42
Madre de Dios	1993	17.5	17	79	53	18	19	34
	2030	21	31	74	36	31	24	36

3.3.2 Adaptive Capacity

YUSUF and FRANSICO (2009) investigated climate change induced sub-national vulnerability in 530 Southeast Asian regions. Based on IPCC (2007) results, climate hazard, sensitivity and adaptive capacity maps were combined in an illustration of overall vulnerability. After a pre-assessment of exposure by historical records, normalised climate maps on tropical cyclones, floods, landslides, droughts, and sea level rise were obtained. Given the same degree of exposure, areas of high population density, were assumed to be more vulnerable. Surface covered with protected areas of biodiversity was used as a proxy parameter for ecological sensitivity, whereas more protected areas indicated a higher level of vulnerability. At last, an index of adaptive capacity was created as a function of socio-economic factors, technology, and infrastructure (Figure 3.11). The Human Development Index, which covers socio-economics at 50 percent, consists of three factors:

- standard of living (based on Gross Domestic Regional Product (GDRP) per population (per capita)
- longevity (based on the life expectancy at birth index, data were obtained form country reports on the Human Development Index of the UNDP) and
- education (measured using literacy rates).

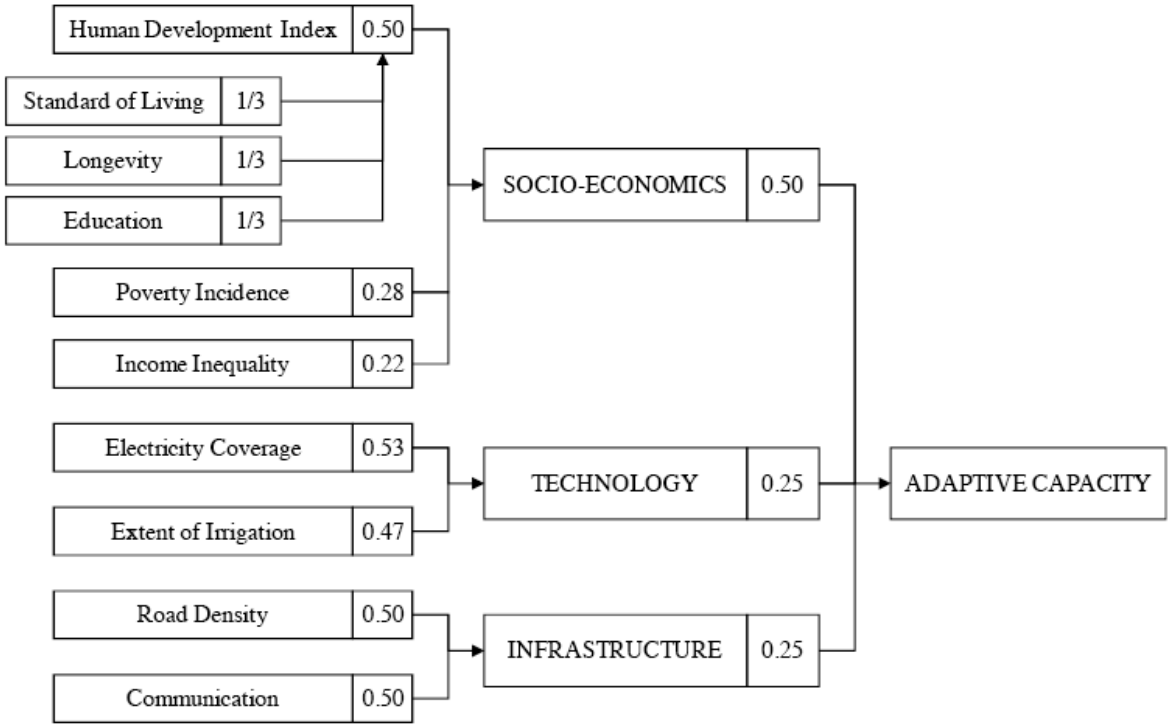


Figure 3.11: Schematic Illustration of Adaptive Capacity (YUSUF and FRANSICO, 2009)

Based on the parameters in Figure 3.11, Figure 3.12 finally illustrates overall-vulnerability of all investigated areas in Southeast Asia. Yellow regions represent low climate change vulnerability; the CVI for red regions is high.

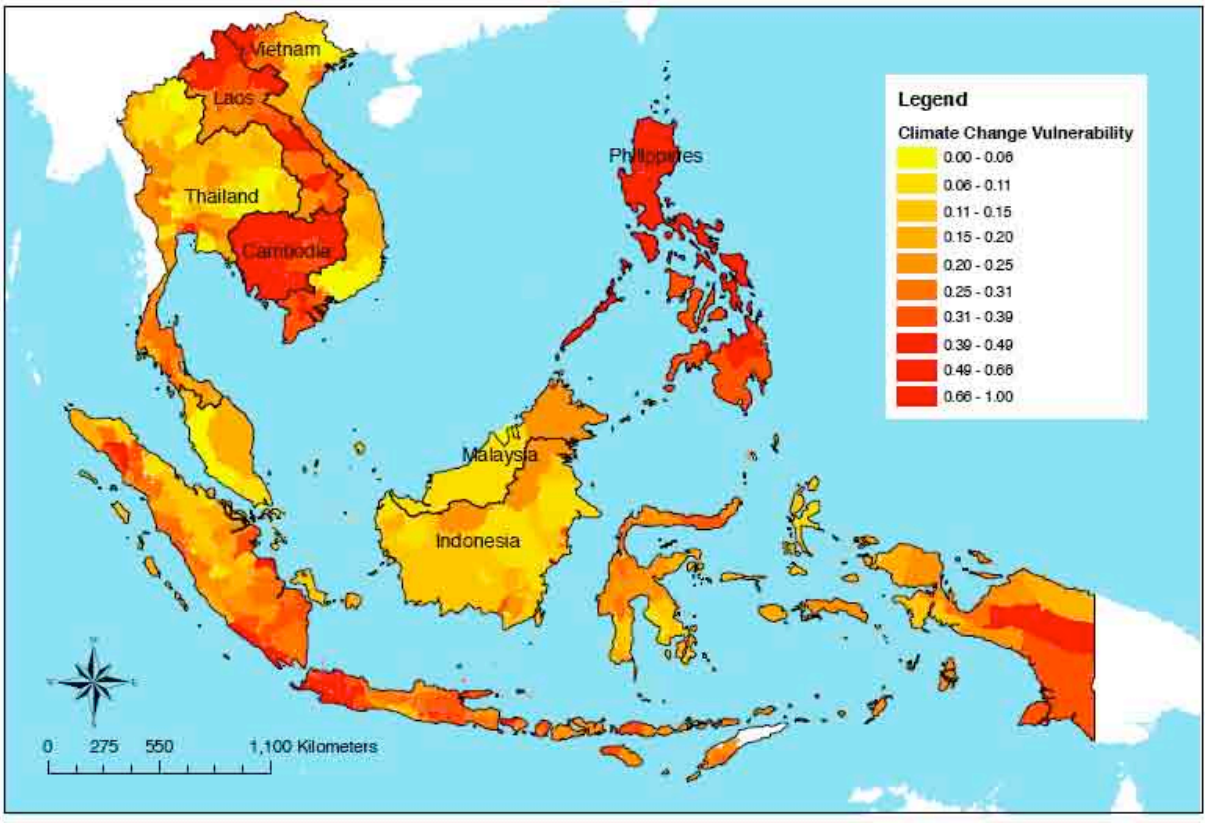


Figure 3.12: Combined Vulnerability Map for Southeast Asia (YUSUF and FRANSICO, 2009)

3.3.3 Proposed Mitigation and Adaptation Activities

First of all, the root cause of climate change, greenhouse gas emissions, have to be addressed by societal reorganisation, focusing on fossil fuel based industry, urban development and use.

Examples for mitigation activities encompass (UNITED NATIONS INTERNATIONAL STRATEGY FOR THE DISASTER REDUCTION, 2008):

- Enhancing greenhouse gas sinks (concerns the management of forests and soils)
- Development of efficient furnace systems
- Development of energy preserving industrial technologies
- Development of energy preserving transport technologies
- Decreased consumption of energy-intensive products
- Promotion of renewable sources of energy (solar, wind power)

Since greenhouse gases would not even disappear from the earth's atmosphere if mankind stopped emitting any kind of emission, the second stage of mitigation is to manage direct impacts of climate change by adaptation (UNITED NATIONS INTERNATIONAL STRATEGY FOR THE DISASTER REDUCTION, 2008).

The IPCC (2007) defines adaptation as "the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities". Under ideal conditions sustainable development and adaptation are linked.

Therefore, the UNITED NATIONS INTERNATIONAL STRATEGY FOR THE DISASTER REDUCTION (2008) proposes the following adaptation activities:

1. Preparing risk assessments
2. Preserving ecosystems
3. Management of water resources
4. Improvement of agricultural methods
5. Improvement of building designs
6. Development of early warning systems
7. Development of social safety nets
8. Better insurance cover
9. Avoidance of uncontrolled settling

The financing demand for adaptation on climate change in developing countries ranges from 4 to 86 billion US $ per year. While the Stern-Report's estimations are 4 and 37 billion US $ per year, UNDP estimates at total demand of 86 billion. US $ per year. Oxfam and the World Bank are in between with 50 and 9-41 billion US $ per year. Possible sources for this financial support could be extended budgets for developing cooperation by tax money, use of international emission trade or carbon tax, compensation fees for maritime and air traffic or compulsory charges for flight tickets. The most realistic solutions are charges on flight tickets and the carbon tax approach. Flight charges are favoured by the Leading Group on Solidarity Levies to Fund Development and could generate up to 10 billion US $ per year. The Norwegian recommendation is to hold back emission rights in an international carbon market. These rights could be auctioned and used for adaptation in a fund. Considering current carbon prices up to 14 billion. US $ per year could be achieved (DEVELOPMENT AND PEACE FOUNDATION, 2010).

3.3.4 Practical examples

Since the proposed mitigation and adaptation activities are only useful, if they are transferred into practical steps, the UNITED NATIONS INTERNATIONAL STRATEGY FOR THE DISASTER REDUCTION (2008) also lists practical examples for different sectors.

Some of them seem feasible (introduction of insurance schemes), others, like desalination, are a utopian, too expensive, solution.

3.3.4.1 Agriculture and Food Security

Besides research on drought-resistant crops like millet and sorghum, which is being carried out for example in Burkina Faso, there are several other adaptation activities:

- Change of planting times and cropping patterns
- Altering of crop strains
- Improvement of water up-take and reduction of wind erosion by changing the topography
- Introduction of insurance schemes
- Combination of livestock, agro-forestry and food crops.

3.3.4.2 Water and Health Sector

Examples for practical adaptation activities in the water sector are:

- Development of flood ponds
- Water harvesting
- Non-water based sanitation
- Improvement of irrigation
- Trans-boundary water resource management
- Desalination

Examples for practical adaptation activities in the health sector are:

- Systematic combat of water-borne and water-based diseases
- Raising public awareness of watershed-protection
- Regulations focusing on safe food- and water handling
- Continuing research

3.3.4.3 Early Warning Systems, Awareness Raising and Education

Besides improvement of existing systems adapting them to climate change, it is crucial to make information available to the affected community. Information has to be provided on time and in an understandable way.

National celebrities can be „used“ to strategically promote the development of curricula in schools. Another function of their or other opinion-former’s leadership can be to supply community groups, journalists, radio and television programmes or other media campaigns with relevant knowledge.

3.3.4.4 Examples for Cost Effectiveness as an Adaptation Measure

STERN (2006) highlights that China’s investment of 3,15 billion US $ on flood control resulted in estimated averted losses of 12 billion US $.

Further examples:

- An evaluation of the Rio de Janeiro flood reconstruction and prevention project showed an internal rate of return that exceeded 50 percent.
- Between 1994 and 2001 a mangrove-planting project, which was carried out in Vietnam to protect coastal regions from thunderstorms yielded an approximate benefit-cost-ratio of 52 percent.
- Several US States installed hurricane protection on nearly 500 locations. A comparison of US Gulf States that had implemented hurricane protection and unprotected States showed that preparedness resulted in eight times less damage. Customer investments of 2,5 Million US $ avoided estimated property losses of 500 Million US $.

3.3.5 Climate Change Case Study - Indian Monsoon Impacts

India's summer monsoon from June-September is responsible for 80-90% of the country's precipitation. It is essential for drinking water supply and India's agricultural sector, which accounts for about one fifth of India's gross domestic product. Average annual losses from 2005-2007 accounted for up to four billion US $ - three to four times more than the average between 1980-2004.

Although the results of individual calculations vary, all of them state a rise in extreme weather events. In case of India that means more severe effects of the Summer Monsoon. Heavy rainfall events (> 100mm/day) have already increased about a third, compared to 1950. Extreme rainfall events (>150mm/day) nearly doubled. Precipitation in total did not change much in this space of time, because drought periods increased simultaneously (Figure 3.13). The most likely explanation is a temperature-increase of the tropical Indian Ocean, whose temperature rose by 0,5°C compared to 1950 (Munich RE GROUP, 2008).

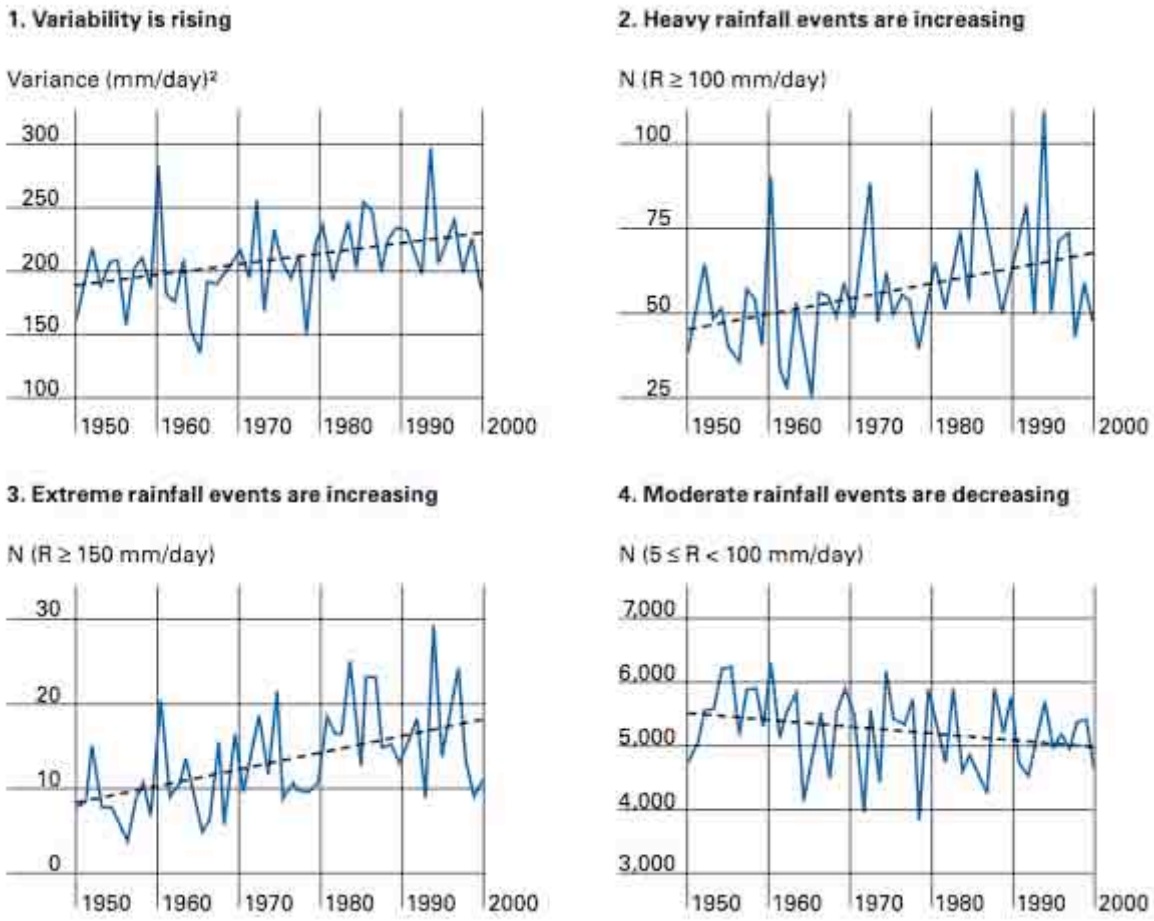


Figure 3.13: Analysis of precipitation in central India - variability, heavy, extreme and moderate precipitation; the broken line stands for the linear trend (GOSWAMI et al., 2006 cited in MUNICH RE GROUP, 2008)

Weather disasters in general (floods, thunderstorms, droughts) caused financial losses of 53 billion US $ from 1980-2007, while floods accounted for 77% of losses, thunderstorms for 19% and extreme temperatures for 4 %. India's insurance market is predicted to increase five times to approximately 100 billion US $ from 2007-2017 (MUNICH RE GROUP, 2008).

3.4 Vulnerability

WILCHES-CHAUX (1992) distinguishes natural, physical, ecological, technical, economic, social, political, institutional, ideological, cultural and educative vulnerability. It is impossible to regard vulnerability, risk and the catastrophe itself as separate factors. As mentioned in the definition of the term „disaster“, a natural event turns into a catastrophe, if negative consequences for human beings are evident. The degree of this threat is an expression for anthropogenic vulnerability and becomes not apparent until there is a direct confrontation.

3.4.1 Constraints of Millennium Development Goals and Developing Cooperation

According to the DEVELOPMENT AND PEACE FOUNDATION (2010) it is hard to evaluate direct and indirect effects of development cooperation beyond the level of single projects. It is suggested that mainly developing countries' own efforts caused positive progress, such as higher school enrolment quota, better supply with clean drinking water or less fatalities due to measles (UNITED NATIONS, 2008, cited in DEVELOPMENT AND PEACE FOUNDATION, 2010). The United States and Japan are still not willing to improve coordination of development cooperation to attack root causes of vulnerability instead of symptoms. Another problem is the absence of perennial financial support.

Until 2010, it has not been possible to implement a multi-stakeholder mechanism to monitor donating and receiving institutions or to establish a global and equitable governance system for further progress in international developing cooperation (INTERNATIONAL CIVIL SOCIETY STEERING GROUP, 2009). The creation of the United Nation's Development Cooperation Forum, which took place for the first time in summer 2008, was an important step towards higher efficiency of developing cooperation. However, neither a binding conclusion, nor a collective statement could be achieved (UNITED NATIONS ECONOMIC AND SOCIAL COUNCIL, sited in DEVELOPMENT AND PEACE FOUNDATION, 2010).

Regarding the millennium development goals, negative developments prevail. It is very unlikely that the number of people suffering from extreme poverty in sub-Saharan Africa can be halved until 2015. Almost 50 percent of all people living in developing countries are confronted with poor hygienic conditions. Still more than 500 000 mothers die every year due to complications while pregnancy or giving birth in the third world. The objective of reducing child mortality has not made better progress. Complications for little or no improvement are manifold – the majority of affected countries face big-scale corruption, war-like conflicts or dependencies on subsidies, which undermine personal responsibilities for improvement (DEVELOPMENT AND PEACE FOUNDATION, 2010).

The global number of undernourished people rose by 75 million people to a total number of 923 million until 2007, thereof 907 million in the developing world. FAO estimations for 2003-2005 result in 848 million undernourished people. Figure 3.14 depicts the impact of rising world market prices on the number of people suffering from starvation in Latin America, Asia, Sub-Saharan Africa and North/North-East-Africa (FAO, 2008)

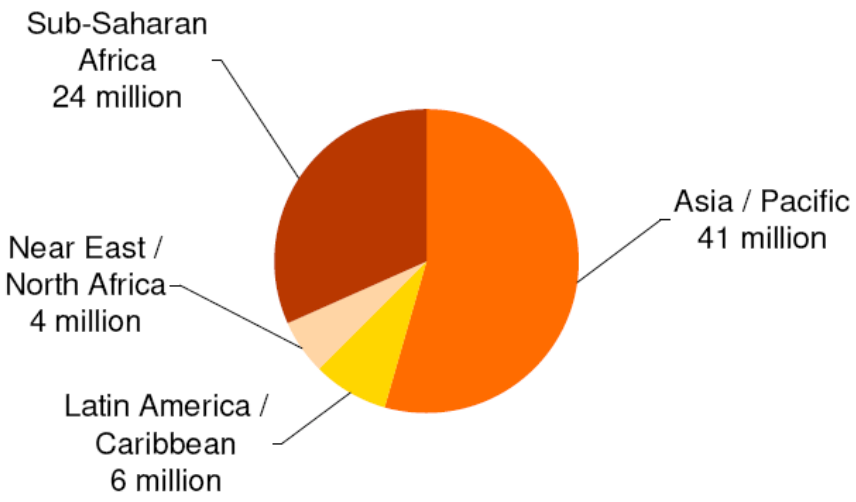


Figure 3.14: Estimations for the additional number of undernourished people in 2007 caused by rising World Market Prices (FAO, 2008)

It is suggested that growing demand will aggravate rising food prices. There is a chance that rural areas might benefit from a “moderate rise”. In combination with adequate investments higher incomes for farmers are possible. At the same, their agricultural land is threatened by speculative investors (DEVELOPMENT AND PEACE FOUNDATION, 2010).

3.4.2 Water Pollution

Water pollution is a complex vulnerability factor, which can easily cause further systemic weaknesses. Since this thesis is focused on preparedness activities in the water sector, this subchapter summarizes some crucial facts in this regard.

As per the World Health Organisation (WHO), approximately 1,1 billion people were affected by polluted water in 2002. Nearly two thirds live in Asia, whereas the lowest levels of drinking water coverage are found in Sub-Saharan Africa and Oceania (WORLD HEALTH ORGANISATION AND UNITED NATIONS CHILDREN’S FUND, 2004). Water-borne diseases, such as diarrhoea, are responsible for about 80 percent of all illnesses. Diarrhoea is worldwide the number one cause of childhood death (UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION, 2005).

3.4.3 Statistical Analysis of Natural Disasters

It is estimated that 97 percent of natural disaster related deaths occur in developing countries. (World BANK, 2000) Compared to industrial countries the financial loss is smaller in absolute figures due to assets of lower value. In relation to their gross national product (GNP) these figures are alarmingly high and demonstrate the importance of natural disasters as an impediment for sustainable development (UNITED NATIONS INTERNATIONAL STRATEGY FOR DISASTER REDUCTION, 2002).

While industrial countries tend to prepare for disasters by expensive technical structures and awareness building, catastrophes can trigger a negative feedback loop in the economic development of both developing and industrialised countries.

Even countries like Japan, which are renowned for high class technology, suffered from indirect negative consequences of natural disasters in the long-run. The Great Hanshin earthquake in Kobe destroyed one of Japan’s major ports in 1995. Seven years later the structures were completely rebuilt, but revenues had dropped by 15 percent, compared to pre-disaster earnings (UNITED NATIONS INTERNATIONAL STRATEGY FOR DISASTER REDUCTION, 2002).

PROSKE (2004) examined the 50 biggest natural catastrophes of 2000. While the disasters made up only three percent of the gross national product in industrial countries, they accounted for 13 percent of the less developed countries' gross national product in average.

Results of the WORLD WATER FORUM (2006) for the period between 1985 and 1999 are similar. The Least Developed Countries (LDC) suffered an average decrease in GDP of 13,4 percent due to natural disasters. Developed countries lost approximately four percent of their GDP.

Especially for small island developing states (SIDS) this situation has become severe. 24 of the 49 least developed countries have to face a high disaster risk situation; at least six of them were confronted with two to eight large scale disaster annually around the 1990s (UNITED NATIONS INTERNATIONAL STRATEGY FOR DISASTER REDUCTION, 2002).

According to the MUNICH RE GROUP (2009) the number of geophysical events was rather constant between 1980 and 2008, while the number of atmospheric events increased significantly. In combination with rising vulnerabilities more severe impacts of natural disasters can be expected.

Figure 3., Figure 3. and Figure 3.17 oppose number of catastrophes, financial losses and number of casualties between 1991 and 2000.

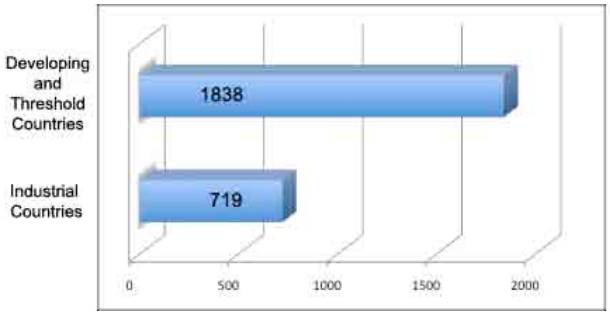


Figure 3.15: Number of Natural Catastrophes in developing, threshold and industrial, countries from 1991-2000 (adapted from IFRC, 2001)

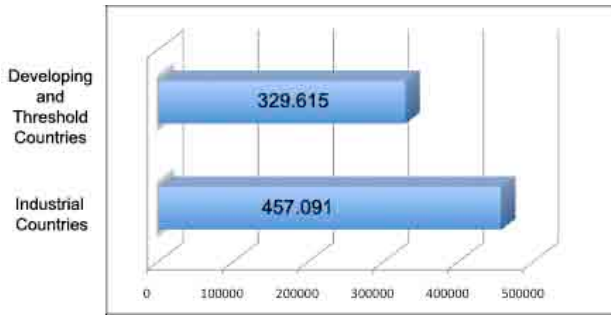


Figure 3.16: Financial losses (in Million US $) in developing, threshold and industrial countries from 1991-2000 (adapted from IFRC, 2001)

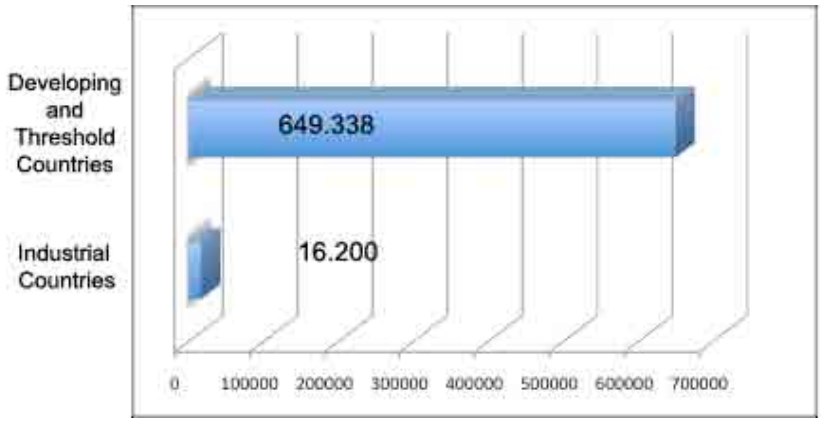


Figure 3.17: Number of casualties caused by natural disasters in developing, threshold and industrial countries from 1991-2000 (adapted from IFRC, 2001)

The EU-strategy for Disaster Risk Reduction in Developing Countries (EUROPEAN COMMISSION, 2008) states that the number of natural disasters increased from 75 in 1975 to more than 400 in 2008. According to this paper, hydro-meteorological disasters increased more than 100% from approximately 100 in 2004 to about 200 in 2006.

Floods are of significant importance for developing countries. On one hand climate change paves the way for extreme weather events, on the other hand insurance companies have difficulties to assess flood damages in a transparent way. Thus they venture this field of insurance very carefully. (WORLD WATER FORUM, 2006)

The following figures illustrate:

- The development of great catastrophes (more than 100 casualties and/or overall loss of more than 200 Mio. US$) from 1950-2000 (Figure 3.18)
- The total number of catastrophes from 1980-2004 (Figure 3.19)
- Disaster classification with an illustration of the years 2006 and 2007 (Figure 3.20)
- The analysis of a typical year - 2007 (Figure 3.21) and
- The comparison of covered and uncovered losses form 1950-2005 (Figure 3.22).

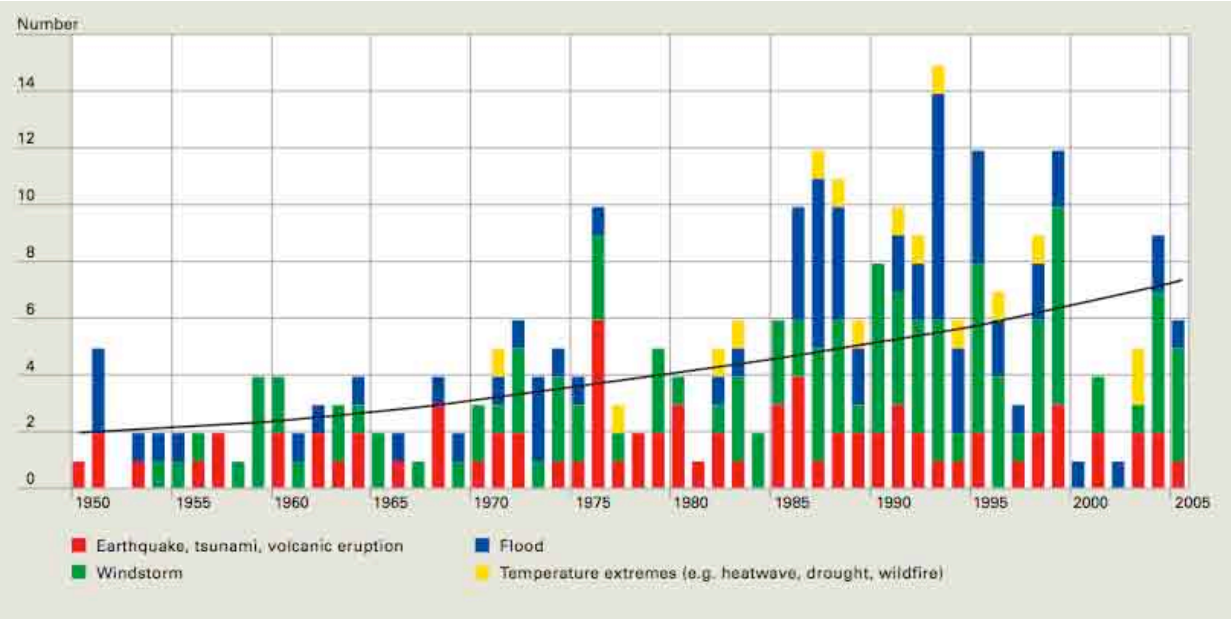


Figure 3.18: Numbers of Great Natural Catastrophes from 1950-2005 (Munich RE GROUP, 2008)

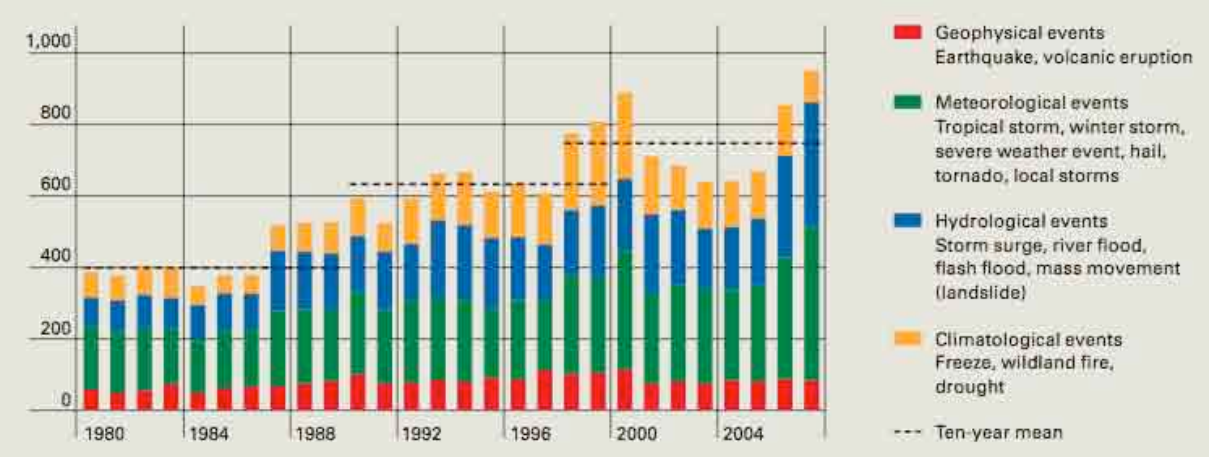


Figure 3.19: Total Number of Natural Disasters from 1980-2004 (MUNICH RE GROUP 2008)

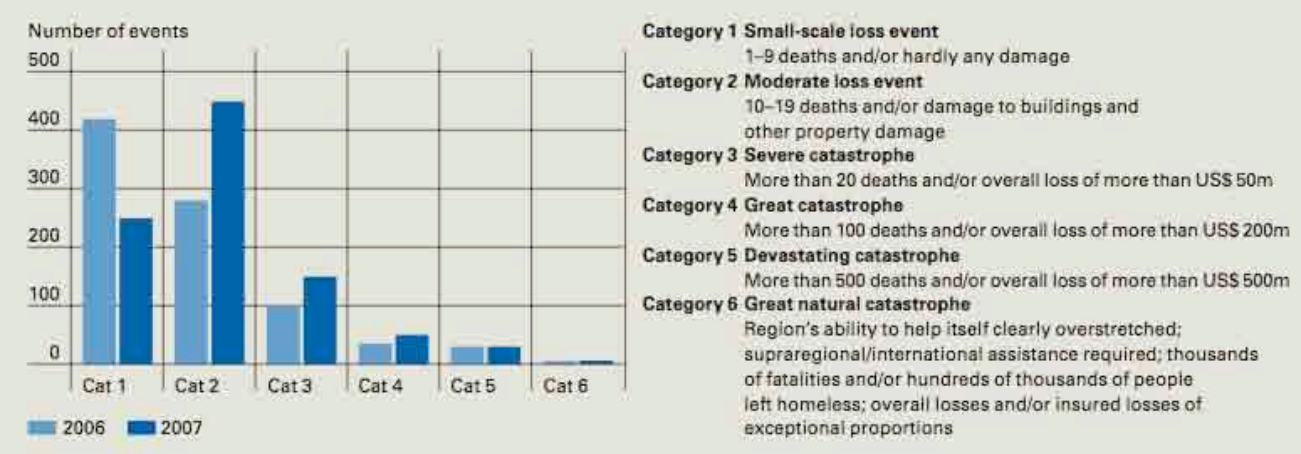


Figure 3.20: Classification of Disaster and Comparison of 2006/2007 (MUNICH RE GROUP, 2008)

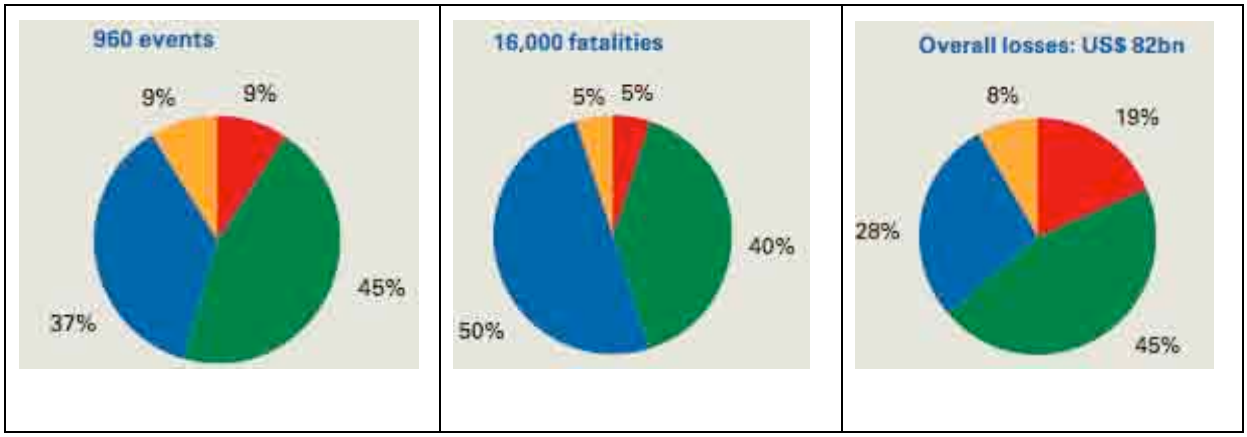


Figure 3.21: Analysis of 2007 - Comparison of Number of Events, Fatalities and overall Losses according to Legend in Figure 9.6 (MUNICH RE GROUP, 2008)

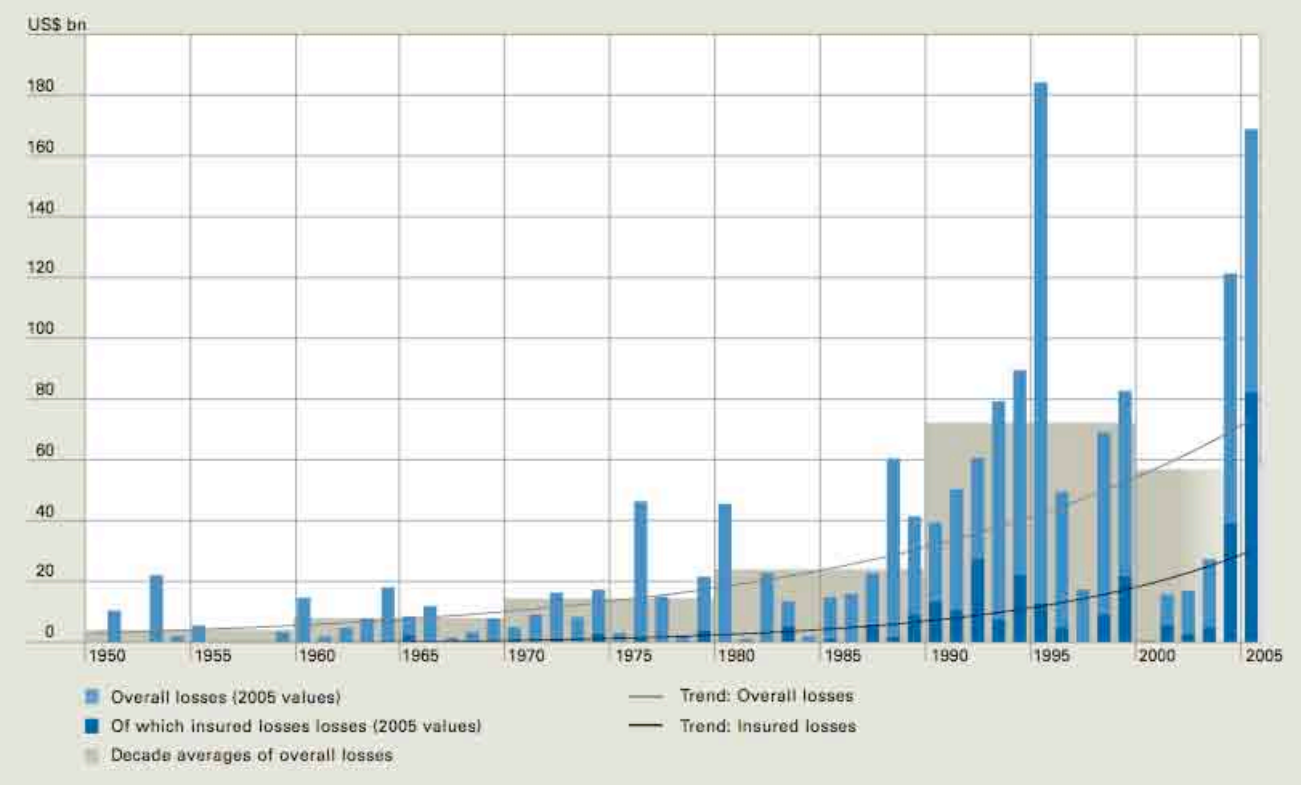


Figure 3.22: Economic Losses caused by Catastrophes from 1950-2005 in US $. Covered losses are depicted in dark blue, uncovered losses in light blue (MUNICH RE GROUP, 2008)

Especially high-tech industries react extremely sensitive, if the supply chain is interrupted or if power stations are affected. An earthquake in Japan in 2007 (16th of July) had its epicentre close to the coastal city of Kashiwazaki and damaged the world's largest nuclear power plant. A transformer caught fire, but large-scale radioactive contamination could be avoided. Railway tracks were impaired, about 4000 houses collapsed and 2000 people died. Structural improvements to make the power plant earthquake-resistant took more than one year and meant billion-dollar business interruption losses that were not insured. Total losses added up to approximately 12,5 billion US $ and Japan's main automobile industry temporarily stopped. An engine manufacturer was no able to deliver on time and caused a loss of 120 000 cars in production (MUNICH RE GROUP, 2008).

The curiosity in this case it the accumulation of earthquake-events in this region. In 2004 seismic activities had caused losses of 30 billion US $ 50 kilometres south. In March 2007 an earthquake let the earth tremble 140 kilometres west (MUNICH RE GROUP, 2008).

3.4.4 The Pressure and Release Model

WISNER et al. (2004) developed the pressure and release model to consider vulnerability as a situation that worsens gradually in phases. These phases reinforce mutually from one, root causes, to three, unsafe conditions (Figure 3.23). The development of a disaster can be depicted, although there is no differentiation between natural and partly-manmade hazards on in the „hazards"-section.

Dynamic pressures assign root causes a spatial and temporal dimension as an economic, social and/or political manifestation. Unsafe conditions represent specific kinds of vulnerability, which interact with the impact of hazards in a disaster.

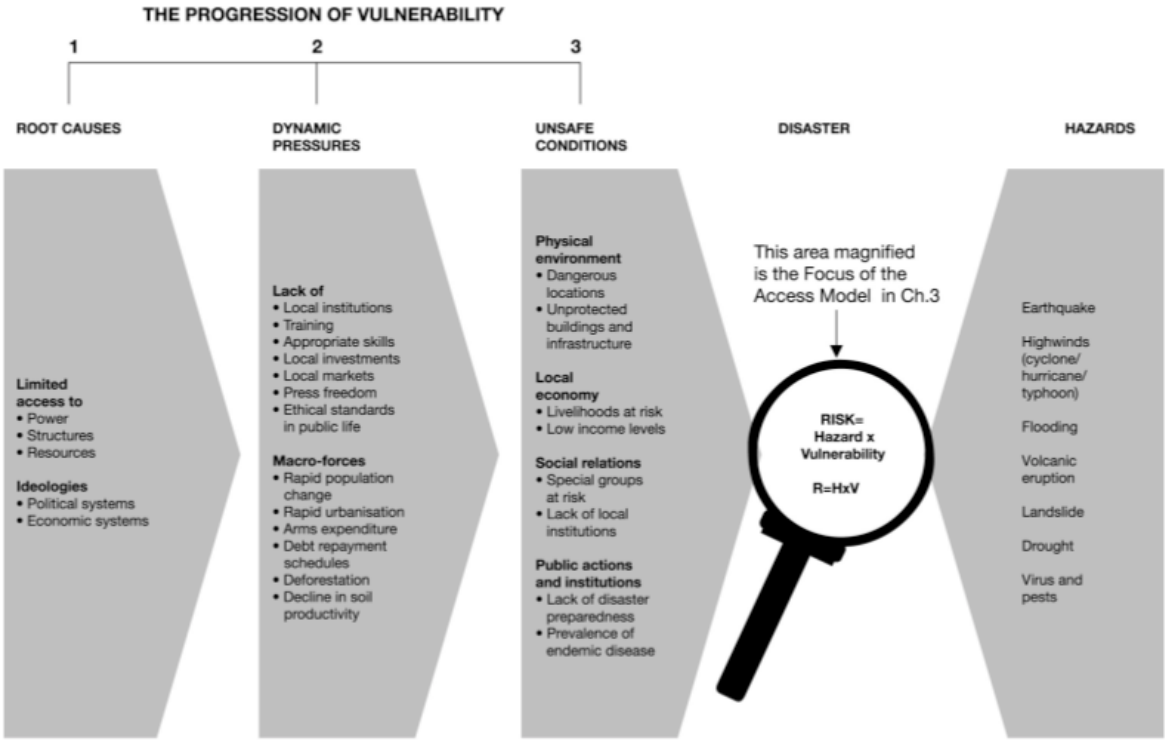


Figure 3.23: The Progression of Vulnerability (WISNER et al, 2004)

3.4.4.1 Overpopulation and Settlements

Since more than 37 percent of all people worldwide live in a distance of less than 100 kilometres away from the sea, the rising sea level is becoming a growing risk and will force people to leave their homes (DFG, 2001).

Estimations of the United Nations Centre for Human Settlements (UNCHS, 2001, cited in UNITED NATIONS INTERNATIONAL STRATEGY FOR DISASTER REDUCTION, 2002). showed that during the 1990s 60-70 percent of urban areas were created in an uncontrolled way, often close to industrial zones that are highly seismic or flood prone. Inaccurate drainage systems and/or artificial sealing with concrete or asphalt lower soil-infiltration capacities and make the towns vulnerable to flash floods. The urban population of developing countries has tripled during the past three decades to 1,3 billion and this development is unlikely to change (UNITED NATIONS INTERNATIONAL STRATEGY FOR DISASTER REDUCTION, 2002). Additionally, natural sealing, caused by ongoing rainfall after soil saturation, means minimised infiltration capacities – a process, which favours flood events (MUNICH RE GROUP, 2008).

3.4.4.2 A possible Scenario for the Progression of Vulnerability

Increasing vulnerability stands in conflict with sustainable development. Negative feedback-loops have weaken the ability to resist impacts of natural disasters. KÖNGETER and PLATE (DFG, 2001) depicted a standard development-scenario as follows:

Overpopulation leads to overexploitation, infertility and/or salinisation of soils, while decreasing world market prices for agricultural products additionally threaten people's livelihoods. Large-scale clear-cuts result in soils, which are exposed to precipitation. Lower retention and faster discharge lead to floods and erosion. Especially in hilly landscapes erosion makes agriculture difficult or impossible. Eroded material accumulates in rivers and clogs them. As a consequence, the risk of floods in lower reagions increases. Finally, droughts become a threat in dry seasons due to the fast discharge. This chain reaction forces indigent people to move into towns, where uncontrolled overpopulation takes place.

3.4.5 Expert Opinions on Vulnerability

An interview of Helmut Jung (University of Natural Resources and Applied Live Sciences, Vienna), Juergen Hoegl and Martin Janda (both Autrian Red Cross) resulted in the conclusion, that preparative measures are most effective in the post-disaster-phase, where vulnerability and perception of natural threats are on the highest level. The Red Cross objective must be to develop practical, interdisciplinary solutions that are accepted by the affected society. In the long run, these solutions have to strengthen the systems ability to resist impacts of natural events, to keep the damage as low as possible and to recover in a fast and controlled way.

In highly vulnerable areas, where the same kind of natural events are recurring, the post-disaster-phase can be considered as a pre-disaster-phase. The United Nations International Decade for Natural Disaster Reduction (IDNDR) from 1990 to 1999 had a clear output, even before its work was continued by the United Nations International Strategy for Disaster Reduction (ISDR): Preliminary measures cannot avert negative consequences of disasters, but there is a high potential for mitigation (DFG, 2001).

During a catastrophe helpers mostly have to cope with a high degree of uncertainty in decision-making, with paralysed people in a chaotic system and a high degree of vulnerability. Individual, preliminary measures could ease that situation both for helpers and victims. Awareness-Building and training alleviate organisation directly after the disaster, they build a trustful relationship and give victims the opportunity to refuse unwanted or inappropriate help. All preliminary efforts have to consider that women are responsible for water supply in developing countries and therefore need to be integrated in major decisions.

3.4.6 Vulnerability and Development

As demanded by the Hyogo Framework for Action (Chapter 3.5.3), concepts aiming at lower vulnerabilities have to turn into a culture of prevention as a "part of day-to-day management" (LEWIS, 1999 and UNITED NATIONS INTERNATIONAL STRATEGY FOR DISASTER REDUCTION, 2005). Reducing vulnerability means "access to social and material resources" and linking social participation to cultural core values. The sole reliance on technological resistance to environmental extremes excludes human ecological adjustments and hardly contributes to building up resilience in communities (LEWIS, 1999).

Already nearly three decades ago disasters were described as "the actualisation of social vulnerability". PELANDA (1981) concludes that all kinds of destructive effects were symptoms of what we do not know, what we cannot or do not want to organize. Hence, organisational weaknesses generate the preconditions for natural and man-made disasters. LEWIS (1999) depicts natural disasters as the "manifest failure of development" or an "indicator of local vulnerability".

The rising complexity of global natural disasters hides the fact that "simple disasters" on smaller scale have not disappeared (LEWIS, 1999). According to STUMMER (2009), who worked as

team leader of the water and sanitation ERUs until 2008, this is one reason for the development of WatSan-Kits. They are a lot cheaper and easy to operate than ERU-equipment. Prepositioned at disaster-prone places and run by National Societies they have three advantages:

- Vulnerability is decreased in the whole region, because the kits can be moved and reconstructed fast and relatively simple.
- They cast a positive light on National Societies regarding preparedness in an emergency situation, which is a necessary prerequisite for preserving their and the government's dignity.
- People are encouraged not to leave rural areas to move into towns, where the accumulation leads to further vulnerabilities.

Delegates from other National Societies can be requested anytime to answer technical question or support the management level. This way preparedness activities and development are coupled to reduce vulnerabilities strategically. The request of ERUs is still possible, if decentralised WatSan-Kits are not able to cope with a certain disaster's magnitude.

3.4.6.1 Practical International Examples for Resilience-promoting Activities

The concept of resilience is closely linked to vulnerability. Based on the assumption that even small perturbations can shift systemic stability irreversibly, it was originally developed to examine non-linear change of ecosystems. Consequently it "can be measured as the magnitude of disturbance that can be absorbed before the system redefines its structure by changing the variables and processes that control behaviour" (IIASA, 2008).

This sub-chapter deals with resilience-policies that were elaborated at the WORLD WATER FORUM (2006). They aim at building up societal resilience towards natural hazards by participatory risk-assessment and linking capacity building to proactive communal planning.

Besides long-term measures like the creation of ground and surface water storages, integrated basin planning or inter-basin water transfers, several specific medium-term actions were recommended for implementation on local level:

- Rainwater harvesting and watershed management
- Artificial groundwater recharge
- Agro-climatic regional planning (e.g. the use of traditional crops with higher drought resistance)
- Optimisation of cropping patterns
- Use of lower water quality for agricultural uses
- Comprehensive water saving schemes (deficit-, sprinkler- and micro-irrigation)
- Minimisation of reservoir losses through evaporation
- Development of consciousness about water scarcity

The UNDP (2007) published a collection of resilience-promoting activities by international non-governmental organisations. Its purpose is to teach disaster managers which approaches were successful at the grassroot-level. A water-related case study from Malawi was chosen to illustrate processes that finally led to more stable conditions.

A Christian charity (Tearfund) initiated multi-stakeholder flood management initiative at small and medium-scale to control river flow in southern Malawi. The Mthumba River was responsible for massive disruption in agricultural production (and therefore food security), loss of lives and

infrastructure. As a consequence, a negative feedback loop led to increased poverty and low impact of development activities.

Similar to the IFRC vulnerability and capacity analysis (VCA, chapter 3.7.3), disaster risk was participatory assessed with five villages in 2003, whereas main hazards, root causes and community capacities were identified. This approach lead to small-scale constructions, such as a storm-drain and tree-plantations. In 2005/2006 another 11 villages and local governments were consulted and it became evident that a multi-stakeholder approach was necessary. The villagers had been motivated by awareness-campaigns for two years and finally formed communal task forces. Locals were for instance made aware of the consequences of overgrazing and tree felling. Finally, their confidence to communicate with authorities, the willingness to take over responsibility and the ability to organize improved.

Together with local authorities (District Protection Committee, District Executive Committee, Committee of the District Assembly), experts, the local sugar company, churches and traditional elders they constructed an earthen dike to rebuild the original course of the Mthumba River, which aimed at decreasing the impact of floods. Especially traditional elders played an important role, because they knew the original riverbed and maintained the initiative's momentum.

The solution proofed to be efficient in the same year's rainy season. The storm-drain diverted excess run-off, while rainfall run-off was decreased by the tree lot and the dike remained stable.

Further long-term effects of the initiative were:

- Advocacy for a bye-law to avoid planting seeds within 20 metres of rivers or streams,
- A decrease in water-borne illnesses during the rainy season,
- Increased school attendance and
- Increased yield, respectively food safety.

3.4.6.2 The Invalidity of the Arrow-Lind-Theorem

According to the ARROW and LIND (1970), the public sector's financial planning for infrequently appearing huge-scale disasters can be regarded as risk neutral. Governmental expenses for post-disaster activities are carried by a number of taxpayers. Subsequently, public authorities are described as "not risk averse" and encouraged to refuse insurances for disaster-related losses.

MECHLER (2004) states that the Arrow-Lind theorem does not hold for disaster-prone developing countries under two circumstances:

1. If the developing country's tax base is not strong enough to spread the risk.
2. If sufficient spread of risks is not possible due to the narrow pool of public goods.

These facts play a crucial role when it comes to insurance of losses.

3.4.7 Small Island Developing States (SIDS) and Disaster Vulnerability

Small Island Developing States (SIDS) are characterised by land area, population, environmental and economic factors. Nine of them are on the list of the ten most vulnerable countries worldwide (BRIUGLIO, 1993). As per PELLING and UITTO (2001) disproportionally high vulnerability is caused by:

- Insularity
- Export dependence
- Tendency to rely on import
- High transport costs
- Small internal market
- Highly specialised production
- Reliance on WTO-protected single markets
- Environmental degradation
- Fragile economic basis (e.g. dependency on tourist behaviour)
- Limited hazard forecasting ability
- Limited insurance cover
- Limited human resource base
- Population concentrated on a large coastal zone
- Rapid population changes
- High susceptibility to atmospheric and oceanic circulations (especially during El Niño)
- Etc.

As 36 SIDS formed the Association of Small Island States (AOSIS) in 1990, it became easier to gain recognition in the United Nations organisations and a collective position for positive change could be formulated. They are still oppressed by political/economic big players and unequal frameworks. The United States, for instance, passed the Helms-Burton Law on Caribbean States in 1996. It made international trade with Cuba illegal. At the same time Puerto Rico was offered duty free access to US-American markets (PELLING and UITTO, 2001).

The Caribbean Planning for Adaptation to Global Climate Change project can be seen as a positive development. Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Jamaica, Saint Kitts and Nevis, Saint Lucia, and Trinidad and Tobago participate. Funded by the Global Environment Facility the projects objective is to implement coping strategies for adverse effects of climate change (mainly sea-level rise) by vulnerability assessment and the combination of adaptation planning and capacity building (PELLING and UITTO, 2001).

3.5 Political Background and Principles of International Disaster Relief

Already in 1995, Red Cross and Red Crescent relief programmes (26th INTERNATIONAL CONFERENCE OF THE RED CROSS AND RED CRESCENT, 1995) explicitly tried to avoid leaving people more vulnerable to future disasters. Key principles included building programmes upon local capacities, involvement of locals in management and implementation and accountability towards beneficiaries. Red Cross and Red Crescent assistance is given to victims independent from "sex, nationality, race, religion, social condition or political opinion".

This chapter summarizes international strategies with regard to disaster preparedness and the reduction of vulnerability. It tries to illustrate the high-level decision making, in which the approach of WatSan-Kits is embedded.

3.5.1 The International Humanitarian System

Both International Humanitarian Law and the framework of principles of the International Committee of the Red Cross name the same four humanitarian principles that actions are rooted in:

- Humanity (centrality of saving human lives)
- Neutrality
- Independence (neutrality from political, economic or any other objectives) and
- Impartiality (implementation on the basis of need, no discrimination between or within affected societies)

There is only one exception, in which case humanitarian action does not depend on the consent of local authorities – interventions authorised by the UN Security Council (HUMANITARIAN POLICY GROUP, 2006).

In practice, international humanitarian financing is far away from fulfilling the principle of impartiality. One example is the calculation of the British Department for International Development in 2003. It showed that since 1997 the per capita level of humanitarian assistance that had been provided in European emergencies was five times higher than for emergencies on the African continent. Clear criteria for the allocation of resources are missing. According to the Humanitarian Policy Group the starting point could be to improve assessment and evaluation of impacts by directing resources towards the "diagnostic aspect" (HUMANITARIAN POLICY GROUP, 2006).

UN-agencies and the Red Cross Movement can be named as the most powerful institutions with regard to international disaster relief. The International Red Cross and Red Crescent Movement do not have the status of a regular non-governmental organisation. It consists of the International Committee of the Red Cross (ICRC), the International Federation of the Red Cross (IFRC) and 183 National Societies. The organisation has a permanent mandate under international law to help victims of armed violence, the wounded and sick and civilians affected by conflict independently (HUMANITARIAN POLICY GROUP, 2006).

The United Nations humanitarian system mainly consists of the UN Office for the Coordination of Humanitarian Affairs (OCHA) and the Inter-Agency Standing Committee (IASC). OCHA and IASC are chaired by the same Emergency Relief Coordinator. OCHA is responsible for the coordination of international humanitarian response, the Consolidated Appeals Process (CAP) and the Common Humanitarian Action Plan (CHAP), a tool for planning and prioritising humanitarian interventions. In case of sudden onset emergencies, flash appeals can be launched in addition to the Consolidated Appeal (HUMANITARIAN POLICY GROUP, 2006).

While donor governments tend to channel humanitarian funds through NGOs, the Red Cross Movement and UN-agencies often deploy their own military for relieve activities after natural disasters. Logistics, transportation and security can be listed as comparative advantages (HUMANITARIAN POLICY GROUP, 2006).

3.5.1.1 Institutional Preparedness of Red Cross National Societies

Results of the 26th INTERNATIONAL CONFERENCE OF THE RED CROSS AND RED CRESCENT (1995) clearly state that each country is encouraged to develop an individual national relief plan. This plan should include "public services, Red Cross and Red Crescent, voluntary agencies, social welfare organizations and qualified persons". National relief plans have to encompass disaster prevention, relief and reconstruction. Additionally, National Societies must prepare themselves for natural disasters by establishing plans of action, which have to be reviewed regularly. Necessary personnel have to be recruited, instructed and trained. Governmental exemption from taxes and customs duties is essential to ease the entry into and transit through the country in an emergency situation. Quick granting of visas for disaster organisations and travel facilities are crucial preconditions for fast support.

Red Cross and Red Crescent relief programmes are adapted to:

- The disaster's magnitude
- Tasks taken over by other organisations
- Responsibilities, which are imposed on National Societies by their governments or
- National relief plans.

One important step that is often neglected in the actual situation is the National Society's preparation for receiving and managing international assistance (26th International Conference of the Red Cross and Red Crescent, 1995).

The GERMAN COMMITTEE FOR DISASTER REDUCTION (2000) goes even one step further. They quote a leading employee of the Pan American Health Organisation after the earthquake of Izmit (Turkey) in August 1999 to destroy the myth of helpless victims and god-like helpers. Of course, people did not wait inactively for international emergency agencies. It is a fact that normally only a few survivors owe their lives to these rescue teams. Local capacities are far more important, because time matters. In this context it has to be mentioned that there are other catastrophes, which overcharge local capacities, even after financial investment has been used for preparedness activities. The flood catastrophe of Mozambique in 2000 serves as one counter-example for a disaster, where the majority of people were rescued by international agencies.

3.5.1.2 Relief Support by the Red Cross and Red Crescent Federation

The Red Cross and Red Crescent Federation (26th INTERNATIONAL CONFERENCE OF THE RED CROSS AND RED CRESCENT, 1995) supports National Societies' preparedness efforts by providing technically qualified delegates and by supporting instruction and training of personnel. The Head of Delegation is responsible for the team's judicious and effective utilization. However, socio-economic and ecological approaches had obviously not reached the level of practical implementation in 1995 – one possible explanation for this mainly technical approach. Even information exchange between societies and the encouragement of investments in disaster preparedness activities seems to be purely technically oriented.

Representatives are sometimes sent into disaster areas without the emergency appeal of a National Society. Especially in case of large-scale international media interest delegates assist National Societies in coping with media requirements and public information needs.

Unused goods or funds remaining untouched can be used for/transferred to:

1. Successive rehabilitation activities
2. Society disaster preparedness activities
3. Other urgent programmes
4. The participating society

It is advised to create an agreement between National and assisting Society for every kind of transfer (26th INTERNATIONAL CONFERENCE OF THE RED CROSS AND RED CRESCENT, 1995). Fifteen years later, a non-binding hand-over document is still to be prepared (HOEGL, 2009).

3.5.1.3 Red Cross Post-emergency rehabilitation policy

The Red Cross Disaster Preparedness and Response Department (IFRC, s.a.E) realised that people usually face higher vulnerabilities directly after the impact of a natural disaster. That holds good for normal citizens and people in relief organisations on local, regional and national level. The Federation's post-emergency rehabilitation policy was adopted by the General Assembly in 1999 to replace previously established post-disaster rehabilitation policies. It addresses all National Society and Federation activities that aim at reducing immediate vulnerability and its root causes. Lost capacities are rebuilt and strengthened, while governments' and National Societies' responsibilities for rehabilitation are clarified.

The statement includes the following key aspects:

1. Rehabilitation measures are undertaken with active participation of the affected society in planning and implementation phase. Assessing unmet needs and available response activities is therefore a crucial prerequisite. Support is focused on the most vulnerable groups and does not try to substitute government services.
2. Active dialogue with local authorities has to clarify concerns, priorities and responsibilities.
3. Community services have to be prioritized. The rehabilitation of shelter, health care support systems and public health infrastructure, the safeguarding of food security and access to potable water are of outstanding concern.
4. Rehabilitation programs have to consider gender and environment factors. Disaster mitigation measures should assist to develop more resilient communities. Rehabilitation programs have to fulfil the task of compensating environmental damages that emerge during relief operations.
5. Ultimately, every National Society is responsible for the effective coordination of rehabilitation activities. Federation planning, implementation and rehabilitation activities have to respect policies, standards and actions of local authorities and other agencies.
6. Transfer of information, strategies, opinions and activities has to take place between representatives of the Federation and local/national authorities to lower disaster vulnerability.
7. An exit strategy has to ensure that involvement in rehabilitation is maintained as long lives and livelihoods of victims deserve protection. Rehabilitation measures aim at handing back or adapting services and activities to/for governments, National Societies or other authorities.

3.5.2 EU-Strategy for Disaster Risk Reduction in Developing Countries

In form of a Commission Communication to the Council and the European Parliament the EUROPEAN COMMISSION (2008) elaborated a strategy on disaster risk reduction in developing countries. Main drivers were the negative effects that natural disasters have on

sustainable development, the eradication of poverty and the achievement of the Millennium Development Goals.

The link between disaster risk reduction and climate change efforts could have numerous advantages, above all the “non-duplication of efforts, cost-effectiveness, better inter-ministerial coordination, exchange of best practices and building on existing structures instead of creating new ones”.

The strategy highlights that a natural hazard does not necessarily have to develop into a disaster. Its potential for destruction depends on people’s vulnerability, the degree of exposure of infrastructures and economic activities.

EU-member states and the European Community are the world’s largest donor in Humanitarian Aid and Official Development Assistance (ODA). Good development policies and practice stand for efficient integration of disaster risk reduction in development programmes. In detail, the strategy describes the necessity of approaches, which not only improve the socio-economic situation in a developing country, but also support the minimisation of vulnerability in a feasible way.

The objective was to create a multi-hazard approach on geophysical or climatic, but not man-made disasters like war. The term resilience represents the capacity of a potentially exposed system, community or society, to reach or maintain an acceptable level of functioning and structure. Learning from past disasters for better future protection plays a key role. Strengthened resilience is regarded as the long-term objective of the strategy.

Three strategic objectives serve as foundation pillars (EUROPEAN COMMISSION, 2008):

- The development from natural hazards into disasters must be averted.
- Developing countries’ and societies’ preparedness must be improved.
- Risks have to be mitigated, impacts of disasters on developing countries and societies have to be decreased.

The principles to reach these objectives are (EUROPEAN COMMISSION, 2008):

- The implementation of disaster risk reduction into humanitarian and development policies and strategies; into Poverty Reduction Strategy Papers (PRSPs), response and recovery
- Partner countries should take the lead in integrating disaster risk reduction into development efforts – the primacy of national ownership of development strategies and processes is emphasized
- The principle of subsidiarity (responsibilities are implemented by specialised agencies on all levels from local to global)
- Guaranteed linkage to relevant interdisciplinary issues like gender and climate change
- Strengthening risk capacity analysis, upgrading data monitoring and early warning systems
- Strengthening institutions, mechanisms and capacities at every level, supporting community-based preparedness activities
- Increase public awareness of disaster risk reduction and root causes of disasters, such as “poverty, land-use planning, poor governance, lack of social and financial safety-nets, environmental degradation, gender inequalities and climate change”.
- Guaranteed participation of stakeholders and vulnerable groups, especially on community level

According to DE VEER (s.a.) the last principle cannot be applied to every level of disaster risk reduction. Preparedness activities are condemned to be ineffective in the long run, if locals are not consulted and integrated in both management and implementation. Directly after the impact of a flood, thunderstorm or earthquake, participation by beneficiaries and local institutions can be time consuming and therefore less effective.

Furthermore, he states that the decision to integrate locals at that stage should depend on local capacities, conditions and training. Especially in case of water service points and control over water use the participation of beneficiaries is necessary.

Based on the Paris Declaration on Aid Effectiveness, EU-approaches on disaster risk reduction (EUROPEAN COMMISSION, 2008) will go hand in hand with the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR), the Global Risk Initiative Programme (GRIP), other non-EU donors, UN Agencies, NGOs and the Federation of Red Cross and Red Crescent.

3.5.3 The Seville Agreement and the Hyogo Framework for Action 2005-2015

The agreement on the organization of international activities of the components of the International Committee of the Red Cross (ICRC), the Seville Agreement, specifies which organization within the Movement would take the lead in certain field operations. Even National Societies can become the leading agency themselves, if both the ICRC and the Federation agree (IFRC, 1997).

It assigns the Red Cross and Red Crescent movement as leading agency in case of persons caught in armed conflict, possibly linked natural disasters or refugees during the conflict.

Specific tasks of the Federation in development of National Societies activities include:

- Technical and legal assistance on establishing or restoring National Societies
- Involvement of National Societies in the promotion and implementation of international humanitarian law and
- Preparation of National Societies for relieve and rehabilitation activities.

The Hyogo Framework for Action (UNITED NATIONS INTERNATIONAL STRATEGY FOR DISASTER REDUCTION, 2005) tried to elaborate a proactive and systematic approach to build resilience of nations and communities to disasters by reducing vulnerabilities and controlling risks. Its outcome can be regarded as the summary of most theoretical state-of-the-art concepts. The framework promotes the integration of multi-sectoral concepts into development cooperation.

Five key sectors are distinguished as a basis for concrete adaptation activities:

- Identification, assessment and monitoring of disaster risk
- The need for a strong institutional base for disaster reduction, which has to become a local and regional priority
- Building a culture of safety and resilience by promoting knowledge and innovation transfer
- Strengthening disaster preparedness to facilitate effective response
- Decreasing vulnerabilities by risk transfer mechanisms, social safety nets, engineering practices, etc.

Besides highlighting that every policy-level and every stage of the disaster management cycle (from preparation to post-disaster reconstruction) have to be addressed, the framework focuses on the following activities:

- Assurance of food security

- Efficient resource management
- Land use planning
- Construction and building codes
- Capacity and awareness building
- Rural development planning and
- Building multi stakeholder public private partnerships.

Further demands are permanent monitoring and the constant updating of databases and risk maps. Gender perspectives have to be integrated in the decision-making process of disaster risk management. The necessity to create a culture of safety and resilience is mentioned explicitly, whereas climate related disaster risks are focused on (UNITED NATIONS INTERNATIONAL STRATEGY FOR DISASTER REDUCTION, 2005).

As the name “framework” suggests, this declaration does not offer practical solutions. Nevertheless, its view is holistic and future oriented, but financial feasibility is not given enough attention.

3.5.4 The Sphere Project

Launched in 1997 by a group of over 400 humanitarian NGOs in 80 countries (Care, Caritas, Oxfam, World Vision International, etc) and the Red Cross and Red Crescent movement, THE SPHERE PROJECT’s (2004) two core objectives are:

- Improved provision of assistance for victims of disasters and consideration of individual vulnerabilities and
- Enhanced accountability of the humanitarian system in case of disasters.

The international project promotes that all possible activities should be undertaken to minimize human suffering caused by (armed) conflicts or natural disasters and that all affected individuals have to get a chance to spend their lives in dignity. This context makes multilateral assistance under the principles of the Humanitarian Charta obligatory.

Based on an official handbook, multi-level collaboration, guaranteed accountability and quality of interventions, the SPHERE PROJECT tries to improve the co-operative performance of agencies involved in disaster response and preparedness.

The Sphere Pilot Project can be regarded as the institutionalization of the “Humanitarian Charta and Standards for Disaster Response”. It focuses on slow and rapid onset disasters in rural or urban areas of developing or industrial nations, but is not suitable for technological disasters such as those involving chemical or nuclear hazards.

Each technical chapter (water supply, sanitation and hygiene promotion; food security, nutrition and food aid, shelter, settlement and non-food items; health services) has a separate set of indicators and standards. Additional guidance notes and corresponding key indicators specify individual activities for certain situations. The handbook does not provide detailed strategies or mechanisms for agencies, but a fundamental framework. The affected population is “involved in the management and maintenance of hygiene facilities where appropriate”.

3.5.4.1 Minimum Standards in Water Supply, Sanitation and Hygiene Promotion

Each chapter of the Sphere handbook (Hygiene Promotion, Water Supply, Excreta Disposal, Vector Control, Solid Waste Management and Drainage) contains a set of minimum standards, key indicators and guidance notes (Figure 3.24).

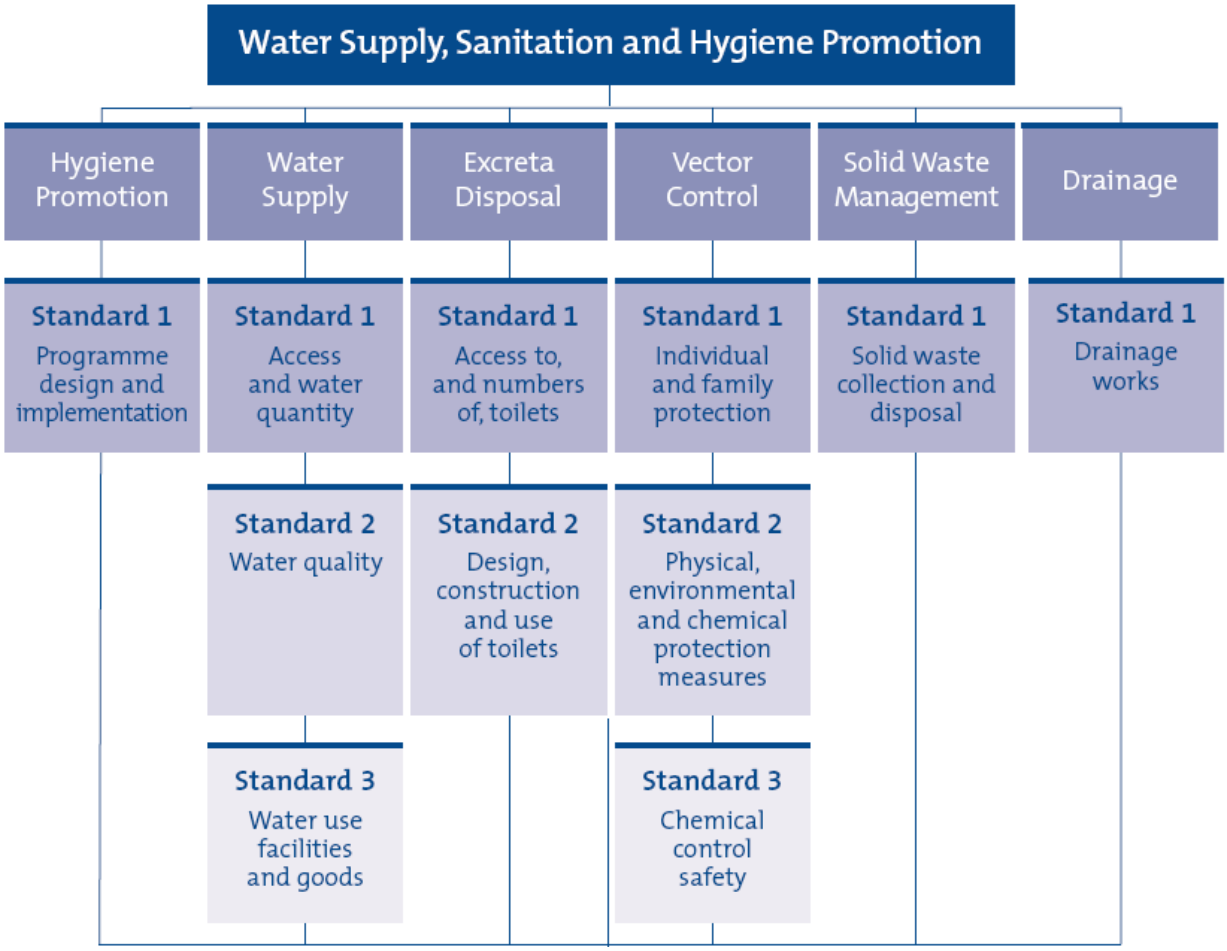


Figure 3.24: Illustration of Water, Sanitation and Hygiene Spheres including Standards on three Levels (THE SPHERE PROJECT, 2004)

Every (sub-)chapter consists of key indicators and corresponding guidance notes. Some examples for water supply and hygiene promotion standard one are illustrated in Chart 3-3 and Chart 3-4.

Chart 3-3: Exemplary Water Supply Key Indicators for Standard 1 and corresponding Guidance Notes (THE SPHERE PROJECT, 2004)

Key Indicator	Corresponding Guidance Notes
Average daily water supply for drinking, cooking and personal hygiene is at least 15 litres/person/day	Guidance Notes 1-8: • Consideration of individual water needs (depending on climate, physiology, practices, etc.) • Sustainable water source selection • Household surveys, observations, discussions instead of simply measuring water extraction times • Better provide adequate quantity of water of intermediate quality than inadequate quantity that meets the minimum quality standard. Consider extra supply HIV/AIDS infected people, livestock and crops

	• Plan programmes to raise water supply directly after the disaster to avoid animosity • Rough guidelines for number of people/water source in case of constantly available water (250 people per tap, based on a flow of 7,5 litres/min.; 400 people per handpump, based on a flow of 16,6 litres/min.; 500 people per single user open well, based on a flow of 12,5 litres/min.) • Decrease queuing time at water points to limit consumption from unprotected surface sources, etc. • Facilitate equitable access
Maximum queuing time at water point is 15 minutes	Guidance Note 7

Chart 3-4: Exemplary Hygiene Promotion Key Indicators for Standard 1 and corresponding Guidance Notes (THE SPHERE PROJECT, 2004)

Key Indicator	Corresponding Guidance Notes
Identification of major public hygiene risks	Guidance Note 1: assessment needed to identify cultural hygiene practices and chance of promotional activities; key risks are likely to concern excreta disposal, toilet maintenance and use, unhygienic water collection and storage, unhygienic food storage and preparation, lack of hand washing with detergent; special consideration of vulnerable groups when carrying out the assessment; report and address possible problems with consultation of certain vulnerable groups
Guaranteed equitable access to all facilities provided and practices promoted	Guidance Note 3: all members of the community should be integrated, e.g. by materials suitable for illiterate people; participatory approaches have to be culturally appropriate to plan and monitor the community's own development in hygiene practices; about 2 hygiene promoters should be available per 1000 affected people in a camp scenario

3.5.4.2 Comparison of SPHERE- and DE VEER-Guidelines for Water Supply

DE VEER (s.a.) lists a similar set of criteria for emergency water supply than the SPHERE PROJECT (2004). He distinguishes emergency (ES), longer term (LTS) and development supply (DS). Additionally, DE VEER highlights the importance of radio equipment to vulnerable communities and a simple protocol to clarify response and communication in case of disaster situations. Chart 3-5 compares both standards.

Chart 3-5: Comparison of SPHERE PROJECT- and DE VEER-Water Supply Guidelines (adapted from the SPHERE PROJECT, 2004 and DE VEER, s.a.)

Criterion	The SPHERE PROJECT	DE VEER
Water Availability per	2,5-3 l	3-5 l (ES)

Person/Day	7,5 – 15 l (total basic water needs incl. basic hygiene practices and cooking needs)	15 l (LTS) 20-50 l (DS)
Number of Water collection Points	1 per 250 Persons (tap) 1 per 400 (single user open well) 1 per 500 (handpump)	1 per 500-750 Persons (ES) 1 per 250-500 Persons (LTS) 1 per 200-300 Persons (DS)
Distance from Water Collection Points	500 metres	1 km (ES) 500-700 m (LTS) 100-400 m (DS)
Maximum Waiting Time at Water Source	15 minutes	2 hours (ES) 20 min. (LTS) no guideline for DS
Turbidity in NTU	< 5	< 20 (ES) < 10 (LTS) < 5 (DS)
Conductivity	X	< 3000 µS/cm(ES) < 2000 µS/cm (LTS) < 1400 µS/cm (DS)
pH	X	No Restriction (ES) 6-8 for coagulation with aluminium sulphate; < 8 for disinfection (LTS) < 8 for effective chlorine disinfection
Residual free Chlorine at Water Collection Point in mg/l	0,5	0,3-1 (ES) 0,2-0,5 (LTS) 0,2 for chlorinated water (DS)
Faecal Coliforms (E. Coli)	No faecal Coliforms per 100 ml	Aim to disinfect Supplies; if not possible use best available Source and solar Disinfection (ES) Apply Supply-Disinfection; if not possible: <10 /100 ml (LTS) Apply solar Disinfection; No faecal Coliforms/100 ml (DS)

Small-scale irrigation	3-6 mm/m^2/day	Mentioned, but no specific Value
Livestock	20-30 litres/day (large animal) 5 litres/day (small animal)	Mentioned, but no specific Value

3.6 Red Cross Interventions in the Water Sector

Based on WHO Drinking Water Guidelines (WHO, 2008) and Sphere standards (THE SPHERE PROJECT, 2004) there are three modules for disaster prevention and relief available. They vary in size, weight, content and capacity (Figure 3.25; IFRC, 1997). The Austrian National Society owns all three types of preparation and relief modules.

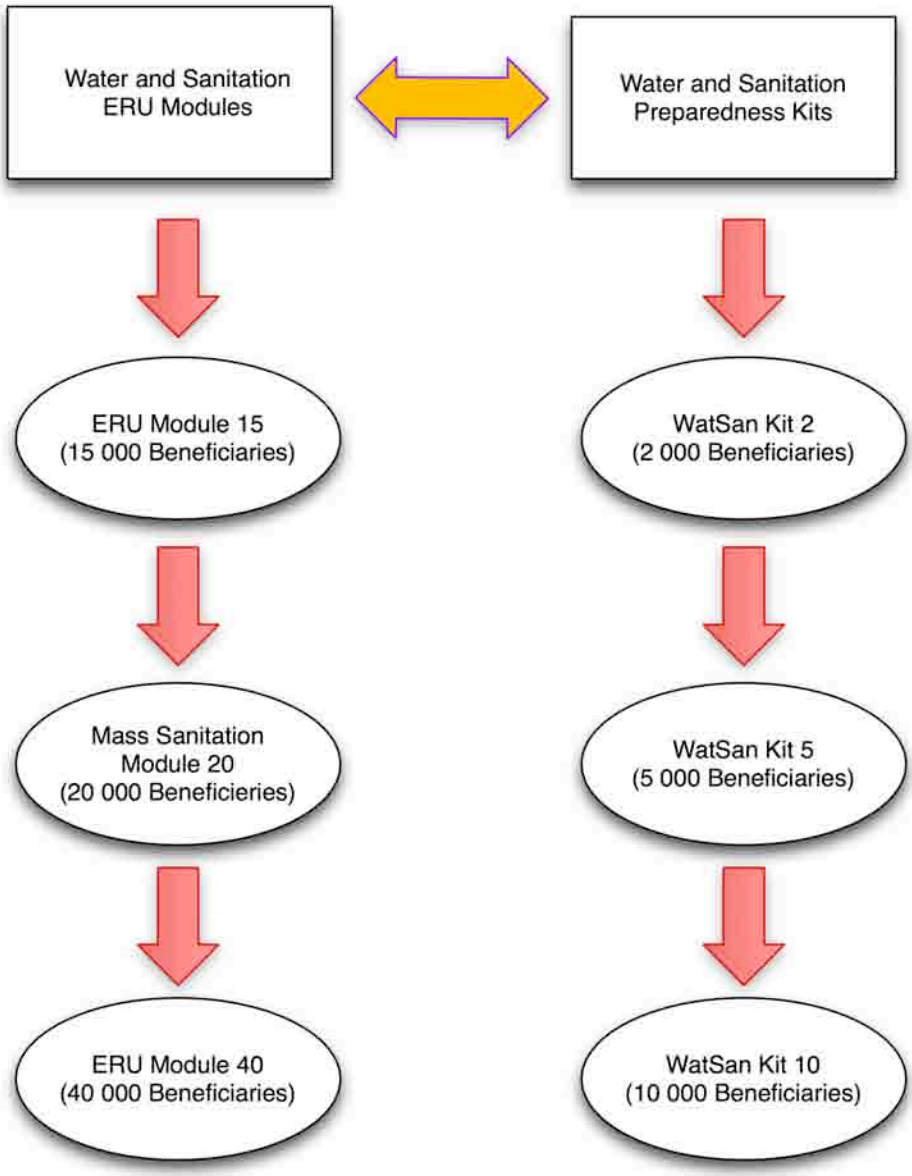


Figure 3.25: Comparison of capacity: ERU-module for acute intervention and WatSan-Kits as disaster preparation (ENENKEL, 2009, adapted from IFRC, s.a.)

3.6.1 Red Cross Emergency Response (ERU) Equipment

According to the IFRC (s.a.) the emergency response modules' water treatment capacities vary between 225 000 and 600 000 litres/day.

3.6.1.1 Water and Sanitation Module 15 and Module 40 (M15 and M40) and MSM20

Maximum volume water treatment and distribution: 225 000/600 000 litres/day

Supply for: 15 000/40 000 people

Basic sanitation for: 5 000 people

Distribution and trucking capacity: 75 000 litres/day

M15 is used for scattered populations due to a number of smaller treatment units, which can be operated independently (stand-alone). Nine different storage and distribution points can be set up. A local water source is required.

A suitable local surface water supply is crucial for the operation of the M40-unit. Nine different storage and distribution points can be set up, whereas the availability of flat-bed trucks, fuel and road access are prerequisites.

The Mass Sanitation Module MSM20 is focused on basic sanitation facilities, such as latrines, vector control and solid waste disposal. Another objective is to initiate health and hygiene promotion programmes.

3.6.2 Sequence of ERU-Actions

According to standard operation procedures (IFRC, 2008) deployments of emergency response units are usually triggered by a request for international assistance in the form of a Federation Emergency Appeal. Decisions about location and type of ERU are based on assessments that the host National Society carries out with RDRT (regional disaster response teams) and/or FACT (field assessment and coordination teams) and/or relevant sectoral International Federation staff.

The decisive parameters and facts for ERU-deployment are (IFRC, 2008):

1) Magnitude and evolution of the disaster;
2) Number and needs of the affected population;
3) Capacity of the host National Society to respond;
4) Capacity of authorities and/or other organizations;
5) No duplication of services or resources;
6) Availability of Federation and National Society resources (human, financial, material);
7) Suitability of the ERU to the environment (availability of water, sufficient land area, beneficiary caseload);
8) Request by the government for international assistance;
9) Access to country and affected area;
10) Security situation.

The operational manager in the field is responsible to guarantee that the host National Society agrees to both deployment and specific requirements of an ERU-mission. In case of water and sanitation ERUs the permission of local water authorities or ministries may be required. Water and sanitation ERUs are never deployed without a technical WatSan-assessment that is either carried out by:

- FACT
- RDRT
- WatSan delegate/staff or
- another receiving National Society WatSan member.

Additionally, the Secretariat's sectoral officers have to agree upon this assessment (IFRC, 2008).

If an ERU deployment is finally confirmed by the ERU officer in charge of the operation and the Secretariats relevant technical officers, National Societies and the Federation Secretariat ERU officer are informed by SMS and email. Subsequently, National Societies confirm receipt of the message to the ERU officer and send back an "offer" of available units within 24 hours. This offer includes all data from travel and transport schedules, composition of personnel and equipment, estimated total budget, the name and address of a fully authorised contact person, etc (IFRC, 2008).

At the end of the ERU mission, all the emergency response equipment or single parts are handed over. This decision is up to the deploying National Society, the Federation Secretariat and the officer in charge of the operation. It depends on funding requirements or restrictions (IFRC, 2008).

The main options are:

- Donating the equipment to the host National Society
- Donation the equipment to the Federation (country or regional) representation
- Donating the equipment to a NGO or similar organisation in the country of operation
- Donating the equipment to the government or local authorities or
- Return transport of the equipment may be subject to donor restrictions and local laws concerning the re-expert of goods

All 162 ERU-deployments that have taken place since 1996 were carried out according to the same pattern, which is illustrated in Figure 3.26. The maximum length of the emergency operations is four months. Team leaders are exchanged every four to six weeks (HOEGL, 2009).

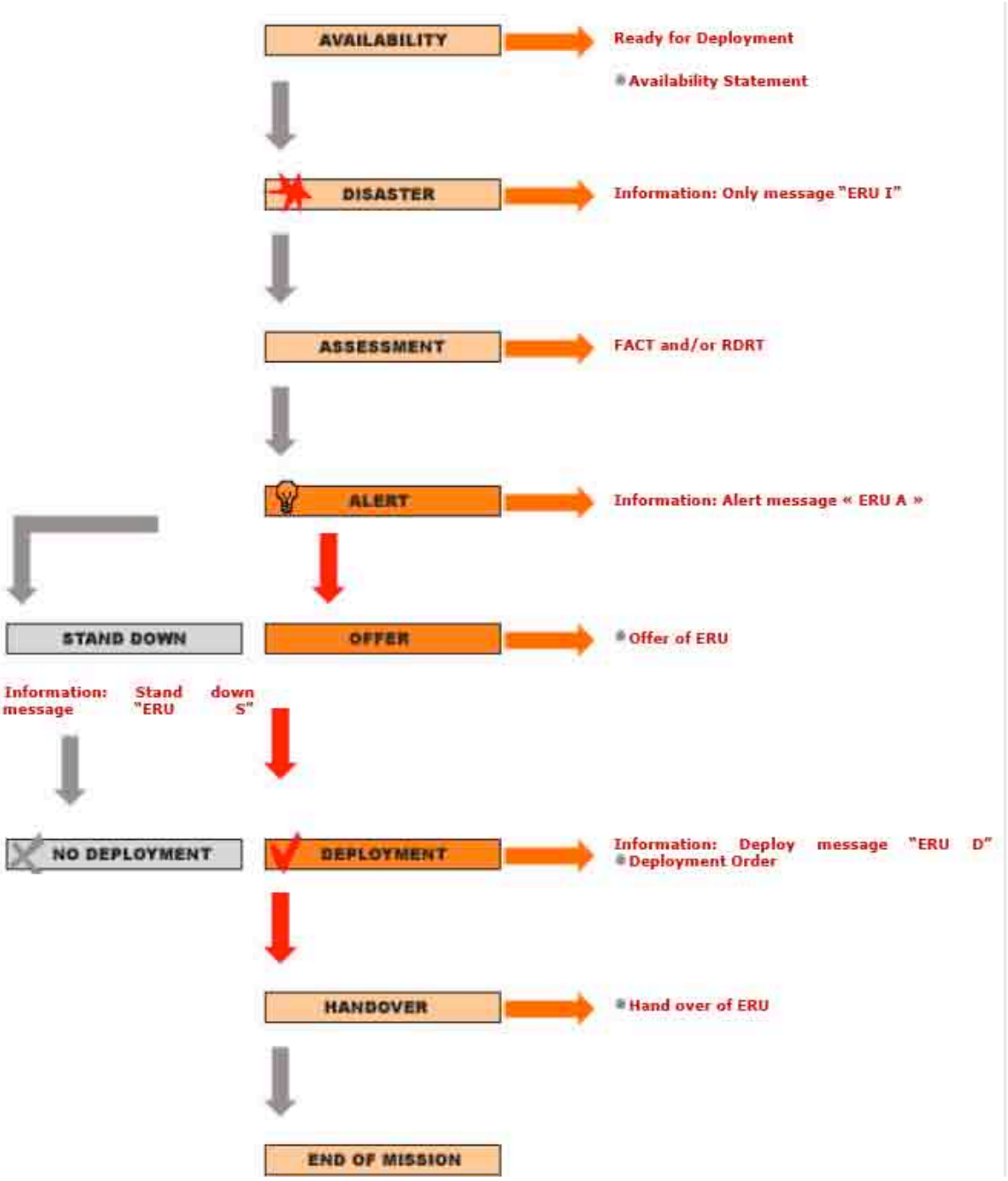


Figure 3.26: Deployment Chart (IFRC, 2008)

3.6.3 Water and Sanitation Emergency Response Kits (WatSan-Kits)

The term Water and Sanitation Emergency Response Kits is misleading. In contrast to the equipment of emergency response units, kits were designed to strengthen local, regional or national capacities in disaster prone and vulnerable areas before a natural disaster takes place.

Depending on which kind of kit is pre-positioned, 2000, 5000 or 10 000 people can be provided with water treatment and distribution, sanitation, hygiene promotion and vector control (Chart 3-6). As first means of intervention the kits are be operated either by regional or national disaster response teams (RDRT, NDRT) (IFRC, 2008).

According to STUMMER (2009) the kits are a lot easier to transport and operate for National Societies than emergency response equipment. Hence, they can replace the request for an ERU or at least serve as a buffer until it arrives. That makes WatSan-Kits an important tool for preserving National Societies' dignity towards their governments.

Chart 3-6: Comparison of WatSan Kit 2, WatSan Kit 5 and WatSan Kit 10 (adapted from IFRC, s.a.B, C and D)

	WatSan-Kit 2 (approx. 13 000€)	**WatSan-Kit 5** (approx. 52 000€)	**WatSan-Kit 10** (approx. 106 000€)
Hygiene promo-box A (Training Kit, Posters, pocket charts for participatory activities, etc.)	**X**	**X**	**X**
Hygiene promo-box B (Digital camera, camcorder, laptop, printer, projector, etc.)			**X**
Rigid water tank (Vol.: 10m^3, ∅ 6,4m EPDM synthetic rubber liner, , PVC coated polyester roof, bolts and nuts zinc coated, etc.)		**X**	**X**
Water Purification Unit (4m^3/h, diesel driven pump, flocculation and coagulation unit, sand filter, active carbon filter, chlorine dosing unit, chemicals for 1200 hours)		**X**	**X**
Diesel pump (incl. fitting and connecting kit: hoses, adapters, compression couplings, etc.)		**X**	**X**
Water Treatment Chemicals		**X**	**X**
Sedimentation/disinfection sachets (1 sachet treats 10 litres of water within 30	**X**		

min.) and household ceramic filter (10 litre storage)			
Flexible water tank (5m^3, bladder type for flat bed trucks, fitted with 50mm polyester straps)		**X**	**X**
Water quality testing equipment (chlorine testing kit, PH and conductivity tester, portable microbio. Laboratory)	**only chlorine testing kit**	**X**	**X**
Collapsible 10l emergency jerrycans	**X**	**X**	**X**
14l plastic buckets	**X**	**X**	**X**
Low flow water dispenser (2l in 16 min., suitable for scaling up handwashing initiatives, U/V-resistant)	**X**	**X**	**X**
Rapid latrine (last 3-6 months, light weight, easy to erect and clean)		**X**	**X**
Latrine material	**X**	**X**	**X**
Backpack sprayer, insecticides and protective clothing		**X**	**X**

3.6.3.1 The WatSan-Kits in Detail

The WatSan-Kit 2 includes no central treatment unit or storage capacity, but provides treated water and basic sanitation for scattered households (2 000 people, 400 families). Beneficiaries are trained in the use of materials and tools, when the kit is distributed. Thereby hygiene promotion plays an important role. (IFRC, s.a.)

The WatSan-Kit 5 can treat up to 75 000 litres of water per day to serve 5 000 people in case of an emergency. Limited sanitation and trucking capacity (15 000 litres) are included. A local surface or groundwater supply and flatbed trucks, fuel and roads have to be available.

Training and hygiene promotion is handled similar to WatSan-Kit 2, but local water and sanitation technicians and Red Cross Red Crescent volunteers have to support training and distribution. The kit has a weight of 3,5 tons and a volume of 15 m^3. (IFRC, s.a.)

Designed for medium populations of up to 10 000 people this kit is similar to its smaller counterpart concerning hygiene promotion, training and requirements, but treatment and trucking capacities are 150 000 and 30 000 litres a day. The kit has a weight of 7 tons and a volume of 30 m^3. In contrast to WatSan-Kit 5 it is pre-positioned at zonal, not at country level (IFRC, s.a.).

3.6.3.2 Current Location of WatSan-Kits

The following chart (Chart 3-7) lists all pre-positioned types of WatSan-Kits and their locations. Currently ten WatSan-Kits 2, seven WatSan-Kits 5 and eight WatSan-Kits 10 are prepositioned. In-stock capacity serves approximately 135 000 beneficiaries (CARTER, 2009).

"Old Kit 10" refers to different equipment list not conforming to current Federation standards. Kits will be replaced with new standard Kit 10 after deployment or possibly before.

Chart 3-7: Location of Kit-Types and pre-positioning Status (CARTER, 2009)

Zone	**Kit Type:**	**Location:**	**In-Stock or en-route.**	**Notes:**
Southern Africa	2 x Kits 2 1 x Kit 5	Harare, Zimbabwe.	1 x Kit 2 In Stock Elements of 1 x Kit 2 and Kit 5 awaiting replenishment	Zonal contingency, floods/cholera
	1 x Old Kit 10*	Caprivi Strip, Namibia.	In Stock	With NS.
	1 x Old Kit 10*	Lilongwe, Malawi	In Stock	With NS.
	1 x Old Kit 10*	Beira, Mozambique	In Stock	With NS.
East Africa	1 x Kit 2	Nairobi, Kenya.	In Stock	Zonal contingency stock
	1 x Old Kit 10*		In Stock	Zonal contingency stock
	1 x Kit 2 1 x Kit 5	Juba, Sudan.	In Stock	Floods contingency.
	2x Old Kits 10*	Juba and Tekekera, Sudan.	In Stock	Cholera and Floods contingency.
West Africa	2 x Kits 2 1 x Kit 5	Dakar, Senegal.	In Stock	Floods/Cholera contingency.
	1 x Old Kit 10*		In Stock	Kit used for training
	1 x Kit 2	Yaounde, Cameroon	In Stock	Floods/Cholera contingency
	1 x Old Kit 10*		In Stock	Kit used for training
	1 x Kit 2	Accra, Ghana	In Stock	Floods/Cholera contingency
MENA	1 x Kit 2 1 x Kit 5	Amman, Jordan.	In-Stock.	Kits for training and Zonal contingency
	1 x Kit 5	Libya	Pending	NS purchase

Asia/ Pacific	1 x Kit 2 1 x Kit 5	Kuala Lumpur (RLU)	In Stock	Kits for training and Zonal contingency
	1 x Kit 5		In Stock	Australian Red Cross. Nomad unit
	4 x Kit 5		Pending agreement with Netherlands RC	With Norit membrane filtration unit
	1 x Kit 5	Hanoi, Vietnam	In Stock	With NS. Australian Red Cross. Nomad unit

3.6.4 Water Supply Technology

All WatSan-Kits include a Scanwater-water purification unit that has a maximum discharge of 4 m^3/hour. This self-contained station can be used for pumping, filtering and disinfecting water (STOECKL, 2010).

Key-Content (IFRC, s.a.F):

- Diesel pump
- Coal filter incl. chlorination doser
- Sand filter
- Tool box
- Engine Oil
- Flexible suction hoses in lengths from one to five metres
- Flat hoses
- Draining hose
- Suction hoses
- Two flocculation chambers
- 4 types of flocculants
- Turbidity tube
- Floater
- T-Connector water pressure and release valve
- Geotextile
- Installation and connection kit
- Pillowtanks
- Tapstand

3.6.5 Filtering and Distribution Set-Up

Figure 3.27 illustrates the filtering and distribution process from pumping water into the flocculation chambers, via 60 metres of pipes for flocculation into sand filter and activated carbon unit, where the water is as well chlorinated. Afterwards pillow tanks, which are connected to the activated carbon unit feed tapstands. Both sand filter and the activated carbon unit have a control window. If the valve-pressure inside the filtering units rises above 1 bar the back wash procedure has to be started immediately. The back wash procedure takes five minutes or until the water in the control window is clean. Finally, the system has to be rinsed for at least one minute (IFRC, s.a.F).

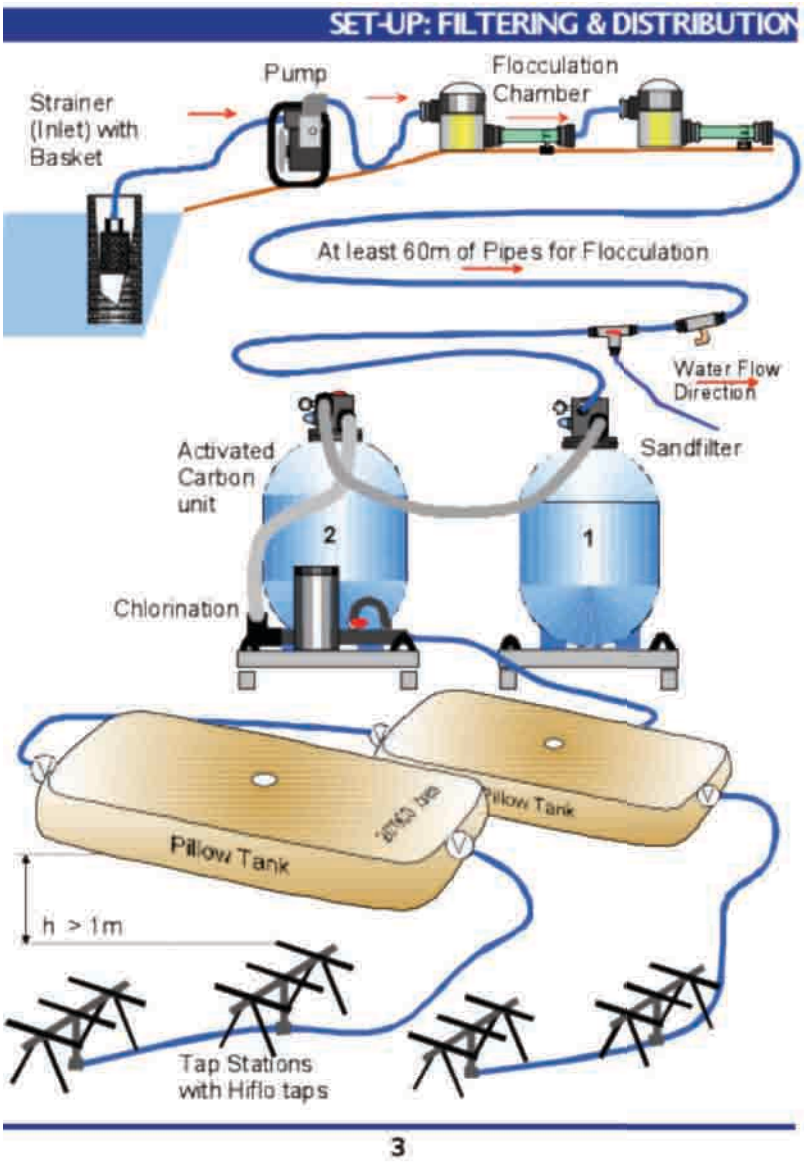


Figure 3.27: Schematic illustration of the filtering and distribution set-up in emergency situations (IFRC, s.a.F)

3.6.6 Flocculation and Chlorination

The pressure-release valve has to be opened before starting the flocculation process. Afterwards the water's turbidity can be tested by turbidity tube. If the treated water shows an NTU above 15, one of the four flocculants has to be used (try and error). In this case three to

five tablets have to be inserted into the flocculation chamber. Regular water sampling and monitoring of the turbidity is advised (IFRC, s.a.F).

The pressure-release valve has to be opened before chlorinating. Chlorination works efficiently if the NTU is below a value of 15 after filtration (IFRC, s.a.F).

Procedure according to field manual:

- Fill the chlorine doser with 3 dissolving hyperchlorite tablets
- Set the doser control position between 4 and 15 ppm
- Treat 2-3 m^3 of water
- Collect water from the tapstand
- Analyse the water for residual chlorine (after 30 minutes the value should be around 0,5 ppm
- If the residual chlorine after 30 minutes is zero the chlorine concentration has to be increased

3.6.7 Emergency Sanitation Planning

Even in emergency situations it is possible to plan the collection and disposal of human excreta as a preparedness measure to protect the health of all involved persons. In case of contingent immediate spread of diseases or death quick response and planning procedures run simultaneously (Figure 3.28). Public participation is crucial for the planning process (WHO, 2005).

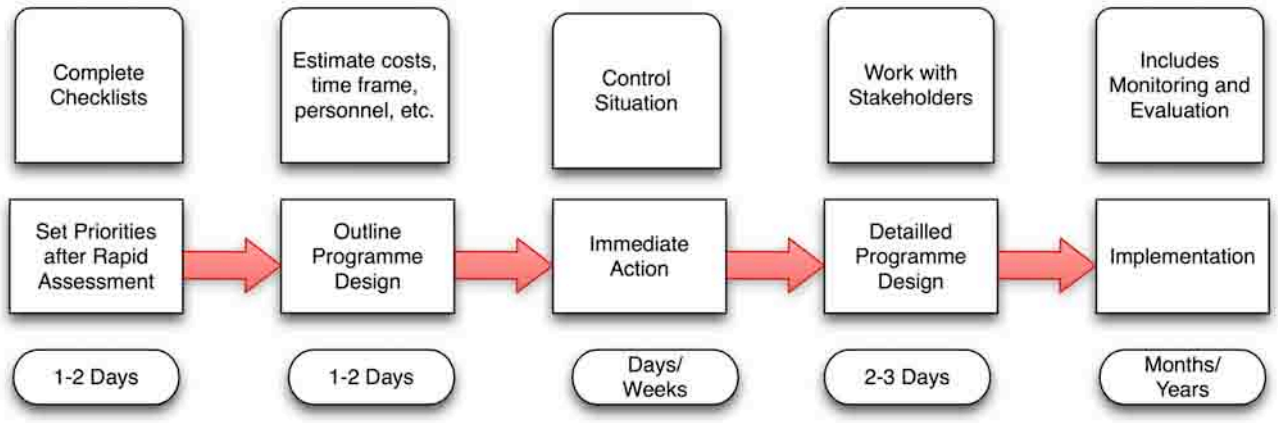


Figure 3.28: Schematic Illustration of Emergency Sanitation Planning (adapted from WHO, 2005)

3.6.7.1 Planning Checklists for Emergency Sanitation

Planning checklists include the following key data:

1) A holistic description of the emergency, including relevant information from the socio-political, institutional, demographic and geographic sphere. Additional information about hygienic practices and the construction of facilities are needed.
2) General information (description of assessing organisation, identity of assessors, available logistics and resource, nature and history of the disaster, conflicts and possible resolutions, climatic implications, existing and potential donors, cooperations, etc.)
3) Demographic data (estimations about the number of victims and the socio-demographic constitution of the affected population, average family size, estimations about population increase within one month)
4) Sketch map about the disasters geographic setting (location and distribution of sanitation facilities, location of random disposal of excreta, medical and solid waste, groundwater levels, water sources, water storage, slope directions and drainage, etc.)
5) Quality (appropriateness of sanitation facilities, potential hazards for disease transmission or contamination of food and water sources, possible breeding sites for vectors or pests, etc.)
6) Quantity (ratio of sanitation facilities to population, need for facilities in organisations or public places, maximum walking distance to sanitation facilities, etc.)
7) Usage of sanitation (frequency, hygienic maintenance)

3.6.7.2 Recommended minimum Sanitation Objectives

Expert interviews showed that sanitation as an objective in disaster situations is often inferior to water supply activities. One crucial consideration is that that every-day needs do not stop after the impact of a natural disaster.

The following minimum objectives for sanitation, more precisely safe excreta disposal, list key criteria in three time-scales – immediate, short-term and long-term. Quality, quantity and usage criteria are distinguished, ratios for access and supply are established (Chart 3-8)

Chart 3-8: Recommended minimum Sanitation Objectives for immediate needs, short and long term (WHO, 2005)

Criteria	Immediate	Short-term	Long-term
Quality	• Technically basic • Barely socially and culturally acceptable • Basic health protection measures in place • Technology sustainable for one month	• Technically appropriate • Socially and culturally acceptable • Minimal health hazard • Technology sustainable for six months	• Technically very appropriate • Very socially and culturally acceptable • No health hazard • Technology sustainable for three years
Quantity	• Ratio of one space/cubicle to 100 persons accessible to all population or immediate responses only • Maximum walking distance 70m (one way) • Availability of sufficient numbers of facilities at: 1. Medical centres (one latrine space to 50 beds or 100 outpatients) 2. Schools (one to 50 girls and one to 100 boys) 3. Market areas (one to 100 adults and one to 50 children) 4. Feeding centres (one to 100 adults and one to 50 children)	• Ratio of one space/cubicle to 50 persons accessible to all population • Maximum walking distance 50m (one way) • Availability of sufficient numbers of facilities at: 1. Medical centres (one latrine space to 20 beds or 50 outpatients) 2. Schools (one to 30 girls and one to 60 boys) 3. Market areas (one to 50 stalls) 4. Feeding centres (one to 50 adults and one to 20 children)	• Ratio of one space/cubicle to 20 persons accessible to all population • Maximum walking distance 25m (one way) • Availability of facilities at: 1. Medical centres (one latrine space to 10 beds or 20 outpatients) 2. Schools (one to 15 girls and one to 30 boys) 3. Feeding centres (one to 20 adults and one to 10 children) 4. Market areas (one to 20 stalls) 5. Offices (one to 20 staff)
Usage	• 50% of affected population has access to domestic facilities (100% in medical and feeding centres) • 50% using facilities correctly on a regular basis	• 75% of affected population has access to domestic facilities (100% in medical and feeding centres • 75% using facilities correctly on a regular basis	• 95% of affected population has access to domestic facilities (100% in medical and feeding centres) • 95% using facilities correctly on a regular basis

3.6.8 Hygiene Promotion

The IFRC WATER AND SANITATION MISSION ASSISSTANT-CD of the Red Cross Federation's Health and Care Department (2006) contains 14 fact-sheets concerning hygiene promotion, which can be applied for the WatSan-Kit-system. The following sub-chapters deal with its core information.

3.6.8.1 Data Collection and Objectives

The process starts with qualitative and quantitative data collection about current hygiene practices (excreta disposal, storage and collection of water and food, hand washing, etc.). Data collection has to be based on more than one method or source of information. Questioned people should represent the society in terms of age, sex, education, income, etc. Furthermore, people have to be informed about the reason why the information provided is useful. Besides personal interviews, published sources, focused group discussions or observation can be a valuable source of information. It has to be kept in mind that personal contact automatically helps to build trust in aid organisations.

Objectives of hygiene promotion have to be measurable, comprehensible and transparent. Intermediate objectives can help to maintain motivation.

The following parameters have to be specified:

- Intended change (should be measurable; e.g. develop an ability to make decisions or learn a practical skill)
- Recipients
- Intended amount of improvement (e.g. rise of people with access to clean drinking water from 10 to 30 percent)
- Time scale

3.6.8.2 Selection of appropriate Communication Methods

Reaching a common understanding is based on participatory learning, (entertaining) demonstrations, training of field staff and appropriate techniques. As a starting point it has to be clear which information has to be conveyed, whereas the collected data serve as a guideline.

The primary objective is to trigger discussions, to provide observable real-life demonstrations in the given time, such as latrines, and to emphasize immediate benefits. In case of latrines more comfort and the absence of smell or flies can be mentioned as such.

Accurate, easily understandable pictures without distracting background or ambiguous symbols are easy means to convey messages. Pre-testing the images on smaller groups is advised.

Only if already existing practices are adapted instead of implementing a completely new approach, recipients can be satisfied and willing to adjust their behaviour. Messages received through different channels are more likely to be remembered and implemented.

3.6.8.3 Education Programmes and Cholera Prevention

The decision to plan an education programme has to consider both continuums – current base-line level and operational target. Besides questions like how to reach to target it is crucial to find out when the objective has been achieved.

Getting to know the community has to be the first step to start capacity building, which could include the establishment of new structures, action committees or selection of community members for specific tasks (e.g. pump caretaker or water minder)

Effective management requires clear responsibilities (e.g. in a diagram) and regular monitoring. If the community is already well organised, field visits can increase the number of poorly represented marginal groups and to evaluate the process (e.g. the continuity of participation).

In terms of implementation, training workshops are mostly ideal to provide information for all persons involved. A regular schedule of visits can help to maintain the programmes momentum.

Attacking all transmission routes for cholera simultaneously is impossible. Therefore, the disease pattern and environment have to be studied to implement a working hygiene promotion programme.

Core questions are:

- What is the evidence for cholera-enhancing behaviour in the community?
- Which changes in behaviour can have the biggest impact in health improvement?
- Which behaviour concerning water supply and sanitation is being promoted?
- Which hygiene practices are easy to change?
- What are the community's needs and priorities?

Prevention of cholera has to consider the status of water sources, treatment, collection, storage, use and disposal. The prevention of building septic tanks next to wells has to be a priority and communicated to the community. In terms of water storage vessels have to be covered and regularly cleaned. Taking water out for drinking should be done with a dipper or ladle. Wastewater has to be disposed or reused to avoid the creation of breeding places for mosquitoes (or other disease transmission vectors) and the contamination of clean water sources.

3.6.8.4 Evaluation

Assessing the degree of achievement of pre-determined objectives requires a systematic approach, based on effectiveness and efficiency. Formative evaluation (monitoring during the programme and o intermediate targets) and summative evaluation (assessment of change at the end of the programme) have to be distinguished.

The evaluation has to proof if change has taken place, if this change was the result of the programme and if the effort was worthwhile. Applied evaluation techniques have to be clarified at the beginning. Questions on active communication, behaviour of recipients, changes in health status, etc. can visualize change in comparison to evaluation before the beginning of the programme. Additionally, comparison with control groups that did not receive any education can help to evaluate improvement.

3.7 Assessment of Performance, Vulnerability and Risk

The IFRC (2008A) has already begun to evaluate water and sanitation emergency response units. WatSan-ERUs work with almost standardized packages in different sizes, but the working environment on site varies widely. Flexible approaches have worked often, but by far not always.

3.7.1 Assessment of Water and Sanitation Emergency Response Operations

The 2008 review (IFRC, 2008A) criticises that ERUs were often confronted with initial assessments from the disaster area, which were of “low quality” and sometimes had to be double checked by the deploying National Society. As a consequence, several deployments included large units, which worked at a fraction of their capacity, local, possibly quicker and more effective capacities had been ignored or the deployments had not even been necessary. Obviously, independent verifications of FACT results are increasing and so the Federation is trying to have at least one qualified WatSan technical delegate on the assessment team. Austria and Germany have started to integrate WatSan ERU-staff in FACT trainings and deployments. Especially in the case of floods, time management often seems to fail and ERU get fully operational when the flood has receded.

On one hand, political pressure seems to be a trigger for blindfold deployment. On the other hand, deployment of FACT to carry out the initial assessment and finally of ERUs had been delayed with negative consequences in Sri Lanka 2004, Pakistan 2005, Indonesia 2006, Peru & Bangladesh 2007 or China 2008.

The review points out that the sanitation equipment of M15 and M40 units may be needless because of two reasons: the ERU focus on water production and/or distribution and lack of personnel. Many host National Societies are not able to provide enough staff for the purpose of sanitation in the chaotic situation after a natural disaster. (IFRC, 2008)

Further criticism on the current ERU concept:

- There is no handover-strategy, which guarantees wise long-term use of the equipment.
- Deployed ERU equipment is often not kept ready for another deployment, adequate staffing and volunteer lists are not updated, storage and maintenance are often unsuitable. Donor National Societies slowly realize that technical support and training were evaluated to be more efficient than the deployment of more equipment.
- The training approach of WatSan-ERU staff is often too technically oriented for locals. The closed circle of procedures has to be understood. Even when working to full capacity, host staff have to be prepared for a sustainable use of the remaining equipment. One option would be to leave a qualified WatSan officer on site for three months after the official end of the ERU mission to guarantee specific training.
- WatSan ERU members are not flexible enough due to their technical orientation.
- Sometimes labour force has to be recruited from the local market and trained on-the-job. Some host National Societies do not have a separate WatSan branch. In this case it is difficult to maintain people’s motivation for future deployment.
- Kits might be a very effective tool, but major questions about ownership and operation remain unknown. “The decision to use the Kits should be taken by someone with water and sanitation experience…” – but no paper published by the Federation explains who “someone” should be.

Recommendations:

- Competent WatSan delegates or staff members have to become regular emergency assessment team members. Their additional task must be to carry out a separate WatSan assessment prior to future deployments.
- The number of available M15 and M40 units should be know by decision makers in Geneva at any time. The development of more mobile units has to be thought over.
- Collapsible jerrycans or covered buckets could be used for household level distribution before more appropriate solutions are discovered and installed.
- Experienced WatSan delegates should assist in installing WatSan Emergency Kits and early phases of operation or whenever host National Societies need support for the mobilisation of already existing equipment.
- Handovers have to become more than a negligibility prior to departure. Detailed knowledge about the equipment, such as critical processes to monitor, spare parts, possibilities to deconstruct it, etc. have to be communicated systematically. Furthermore, it has to be clear if volunteers are available, how and by whom they will be trained.
- Lists about the condition of donated equipment, which are updated every six months. Combinations with the Disaster Management Information System (DMIS) are possible.
- Workshops for host National Societies to ensure ability and readiness to operate the equipment in case of regional disasters.
- The integration of RDRT-members into deploying teams could strengthen regional capacity building.

3.7.2 Integrated Assessment

Miththapala (INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES, 2008) points out that the success of post-disaster measures fully depends on pre-disaster management. Based on the example of the tsunami-catastrophe of December 2004 in Asia, she criticises that many organisations worked isolated, which lead to “omissions, duplications in research and implementation, piecemeal results and a lack of accountability“.

Therefore, it is suggested to apply an integrated approach that includes biodiversity and ecosystems, as well as livelihood and economic valuation. Over-exploitation, further environmental damage or disposal of unsustainable supplies, such as non-degradable packing out of plastic, are common side effects of emergency operations.

In case of the Asian tsunami the extent of created debris had been underestimated. The disposal of more than 500 000 tons of waste became a huge problem for Sri Lanka’s authorities and international helpers in terms of volume and costs. Emergency measures resulted in deposition on playgrounds, roads or in sensitive ecosystems. Large garbage dumps were created, because previously identified landfills were not available. In the Maldives approximately 290 000 m^3 of debris contaminated both groundwater and coastal environment. Emergency measures often worsened environmental conditions. Somalia served as another negative example. Hazardous materials, such as asbestos, and non-toxic waste were burned or dumped inappropriately. For decades the coastline had served as an unofficial landfill for other countries’ nuclear and hazardous wastes, which were moved inland by the tsunami, where they caused health problems, such as acute respiratory infections, mouth bleeds and skin conditions, and affected local fisheries negatively (INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES, 2008).

Environmental collateral damages were accepted in exchange for rapid help and often hidden by cosmetic work to fulfil environmental standards. In some tsunami-affected countries excessive deforestation for building housing units destroyed habitats of elephants. That resulted in crop damages and deaths of citizens and elephants. Intense sand mining degraded coast-morphology conditions and the over-supply of boats and fine-meshed nets by NGOs or small donors threatens the fisheries sector by over-exploitations (INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES, 2008). According to Integrated Regional Information Networks, 50% of all people, who received fishing gear and boats had not worked in that industry before the tsunami (IRIN, 2007).

3.7.2.1 Preparatory work for disaster-risk-mapping

In the early pre-disaster phase, mapping all natural and socio-economic resources is crucial to assess the importance of and dependency on each resource. This process allows comparisons of resource levels across time and facilitates decision-making, but requires highly trained personnel from different fields of science (INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES, 2008). The assessment itself is highly focused on environment and livelihoods - possible social or political instabilities are neglected.

Based on the United Nations Millennium Ecosystem Assessment, which involved more than 1360 international experts, KALLESØE et al. (2008) developed a framework for integrated assessment (Figure 3.29). The quality of an ecosystem is just one parameter that affects vulnerability, but the concept is interdisciplinary enough to consider economic, livelihood and service assessment as well.

Provisioning services represent the flow of goods and covers natural resources and products originating ecosystems. Regulation and supporting services are determined by the size and quality of the ecosystem. These services stand for actual life-support functions. Cultural services are non-material benefits. The strongest relation exists between “fresh water” and “security”, respectively “basic material for a good life” (KALLESØE et al., 2008).

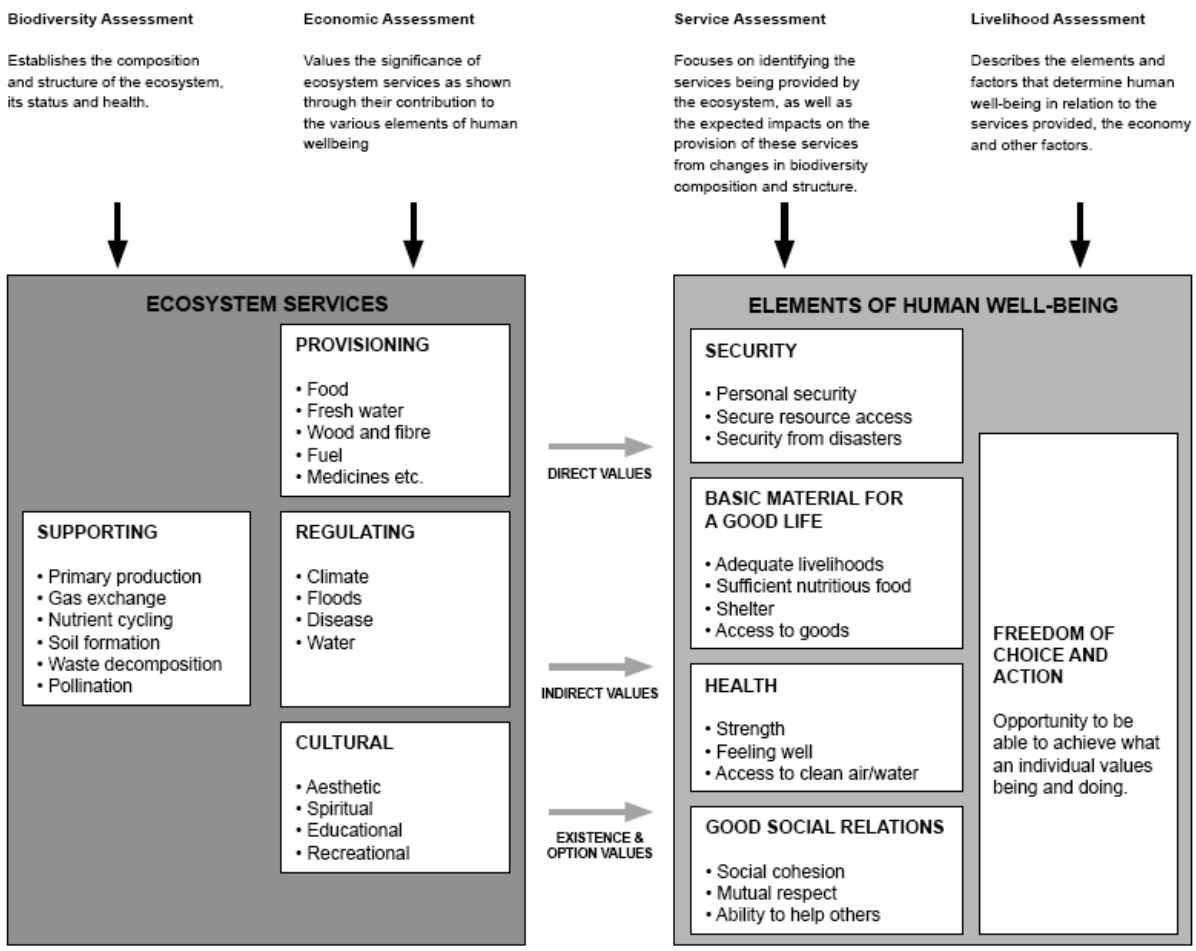


Figure 3.29: Framework for Integrated Assessment (adapted from KALLESØE et al., 2008)

The following steps of assessment can be regarded as a chronological guidebook. Gender sensitivity affects every step.

Biodiversity Assessment identifies the ecosystem's composition, structure, status and health. Core questions are:

- What is the type of ecosystem?
- Distribution and extent of habitats in these ecosystems?
- How many different species of plants/animals are there?
- How many individuals are there per species of plant/animal?

Ecosystem Service Assessment investigates both services provided by the ecosystem and impacts that can be expected, if changes in biodiversity composition or structure occur. At first, ecosystem services have to be identified.

Possible questions:

- How many individuals or households depend on goods provided by the ecosystem, such as water, fuel wood, medicine, timber, non timber forest products (NTFP), etc.?
- How much primary production/yield is there?
- Does the ecosystem provide protection from natural hazards?
- Is the ecosystem used for cultural activities, such as tourism, education or recreation?

Afterwards, indicators are used to assess them (examples):

The extent of the ecosystem's provisioning services is characterized by quality and quantity of fish, vegetables, fruits, etc. Species diversity represents the ecosystem's supporting services. Regulating services can be expressed by assessing the tree cover or vegetation that protects infrastructure. The extent of traditional knowledge and the demand for recreation and education indicate the degree of cultural services. One possible indicator would be the extent of tourist-related built infrastructure.

Now, direct drivers of ecosystem loss can be assessed (examples):

- Is the system over-exploited?
- Is the habitat being destroyed?
- Do invasive species spread?
- Has accumulation of waste or increased pollution of water, soil or air been observed?

Socio-economic assessment provides information about elements and factors that determine human well-being of a specific community in relation to services provided by the ecosystem, economy and other factors. Economic assessment values the contribution of ecosystem services to all elements of human well-being (INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES, 2008).

Recommended questions:

Does the household profit from any provisioning, supporting, regulating or cultural service? If so, which?

- Identification of livelihood dependencies on provisioning services.
- How much cash and non-cash income can one household obtain from provisioning services?
- What are alternative livelihoods to provisioning services to obtain cash and non-cash income?
- What is the proportion of cash and non-cash income from provisioning services compared services that are not related to natural resources?
- What is the percentage of used to sold/traded natural resources?
- Can seasonal variations be observed? If so, when?

Assessment of impacts that ecosystem loss has on human well-being:

- Which impacts do ecosystem losses have on the livelihood of individuals, households or communities?
- Would ecosystem loss affect safety, health, social relations, freedom of choice and actions or basic materials for good life?
- Would the government act as a buffer and increase expenditures in case of increased loss of environmental services?

After an integrated assessment has been carried out, ranking procedures can start. In the disaster situation the importance of assets increases with uniqueness, economic value pre-existing threats (resources that are already threatened in the pre-disaster phase are give higher priority).

Ranking should focus on the species or ecosystem that:

- show the most number of uses
- are the most economically valuable

- are the most over-exploited
- are the biggest threat to the ecosystem and
- affect the highest number of people

Furthermore, it is crucial to detect the community's sector which is most affected by these parameters. If this phase is finished, the focus shifts towards policy and legislation that protect ecosystems and services.

The next steps are hazard mapping and risk analysis to show where hazards are likely to occur and to specify their intensity of occurrence. Maps can include all kinds of relevant information from GIS-based to already existing socio-demographic, environmental or economic data.

3.7.2.2 Disaster Risk Mapping – Case Study Sri Lanka

The INTERNATIONAL RESEARCH INSTITUTE FOR CLIMATE AND SOCIETY (2004) carried out a risk study about Global Natural Disaster Hotspots in to deepen the understanding of risks caused by multiple hazards and vulnerabilities, mitigation-potentials and emergency response approaches. The seasonality of disasters was investigated from a climatic perspective. Outputs were high-resolution hazard, vulnerability and natural disaster risk maps (Figure 3.30) that compared information on local and global scale. The landslide risk map combines data on population distribution, average annual rainfall and former landslide areas. There is a significant correlation between risk distribution and precipitation, but not between risk distribution and population density.

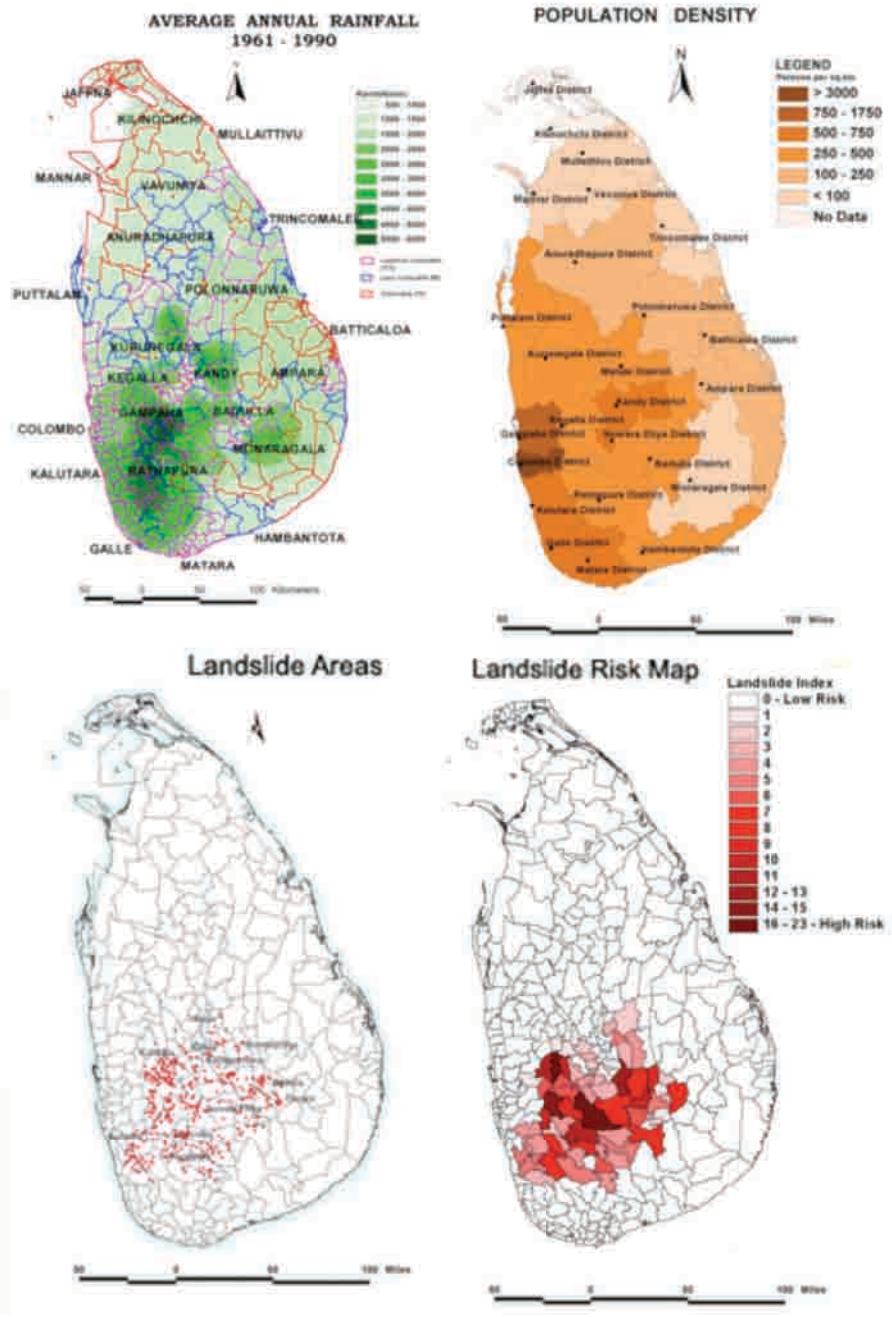


Figure 3.30: Vulnerability and Landslide-Risk Analysis Sri Lanka. The Images show population density, food insecurity vs. precipitation, occurrence of landslides from 1947-1996 (red dots) and finally the landslide risk map (INTERNATIONAL RESEARCH INSTITUTE FOR CLIMATE AND SOCIETY, 2004)

3.7.3 Red Cross Vulnerability and Capacity Assessment

Vulnerability and Capacity Assessment (VCA) was developed by the IFRC (2007) to extend the traditional role as service provider. Its main purpose is to allow national societies to support communities in understanding the background of natural disasters and in mitigating possible impacts. Hence, the preparedness-approach of VCA is based on rural and urban communities' skills, knowledge and actions. It tries to steer people's perception from the paralyzing feeling of being a "victim" to the active perception of being "affected by a disaster". In general, VCA is a participative way of gathering information to increase risk awareness and capacities before an extreme natural event can cause severe damage.

VCA appears to be a powerful tool for identifying local vulnerabilities and capacities, but it is time-consuming and hardly allows for conclusions on bigger scale.

The degree and kind of participation, as well as consequences for the overall process, have to be defined in the beginning. The gathering of information during the field visit includes methods, such as:

- Questionnaires
- Interviews (unstructured, semi-structured or structured; individual or group interviews, which allow interaction)
- Sampling
- Seasonal charts
- Direct observation
- Transect walks
- Focus groups
- The creation of historical timelines by interviews
- Daily or seasonal calendars
- Mapping or
- Analysis of secondary/external sources.

Sampling methods can be random in case of similar livelihoods, household or conditions. If these characteristics differ significantly, sampling methods can be purposive. The composition of the assessing team should consider language skills, gender balance, balanced biases and representation of locals.

Daily or seasonal calendars are created by direct interviews about daily or seasonal routine. 18 months are the ideal space of time to create a seasonal calendar and should include:

1. Rainfall patterns
2. Stockbreeding practices
3. Animal and agricultural production
4. The calendar of secondary production activities according to type of activity, location, operator and contribution to the household's economy
5. Required work intensity and attribution for children, women and men
6. Problems (hazards, water shortage, diseases, accidents, drop in income, etc.)

3.7.3.1 VCA Management

VCA (IFRC, 2007) promotes the reduction of vulnerability by planning ahead. It can contribute to the creation of community-based disaster preparedness programmes at the rural and urban grass-roots level. Local priorities can be identified to finally enhance public participation. That leads to involvement and the design of actions, which account for disaster impact reduction. Within the context of national risk reduction and capacity building, high-risk communities have to be identified by risk analysis and hazard mapping.

The VCA-Handbook lists five categories of vulnerability. Once the link between VCA and the particular category is made and understood, it becomes more obvious, which capacities need to be strengthened. Afterwards, even the integration of programmes whose focus is not on disaster management can be useful, in case the VCA-output demonstrates needs outside Red Cross fields of action.

- Livelihoods
- Well-being
- Self-protection
- Social-protection
- Governance

The VCA management structure, starting with the National Society's Board as a representative for the "political" level, is illustrated in Figure 3.31. Its purpose is to approve and overview the process. One of the leaders has to be trained in VCA to guarantee the advance of the process on the "driving-force"-level. Finally, the "implementing body" consists of people at the National Society's headquarter and branches, who implement the VCA. Management committee and task force ensure that the process runs smoothly by supporting day-to-day decisions. They can include members of other stages, external partners or governments.

Before the actual process starts, the phases of preparation and implementation are linked by field testing to adapt, evaluate and improve skills or methods. Afterwards, the VCA process can start. Systematisation and interpretation of the gained data to produce recommendations is the hardest part. At least three sources (e.g. transect walk, community hazard/risk map and seasonal charts) should be used to increase the credibility of recommendations (IFRC, 2007).

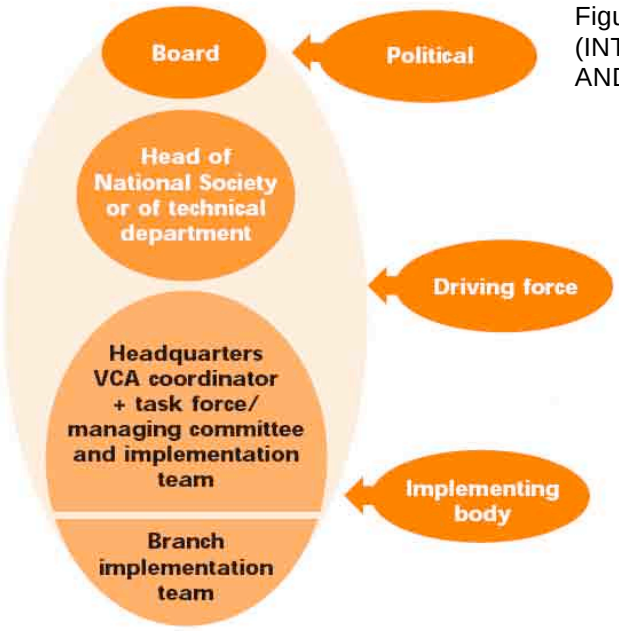


Figure 3.31: VCA Management Structure (INTERNATIONAL FEDERATION OF RED CROSS AND RED CRESCENT SOCIETIES, 2007)

The idealised VCA process in three levels and 12 steps is demonstrated in Figure 3.32. Both VCA potential and limitations have to be clear for initiators and communities.

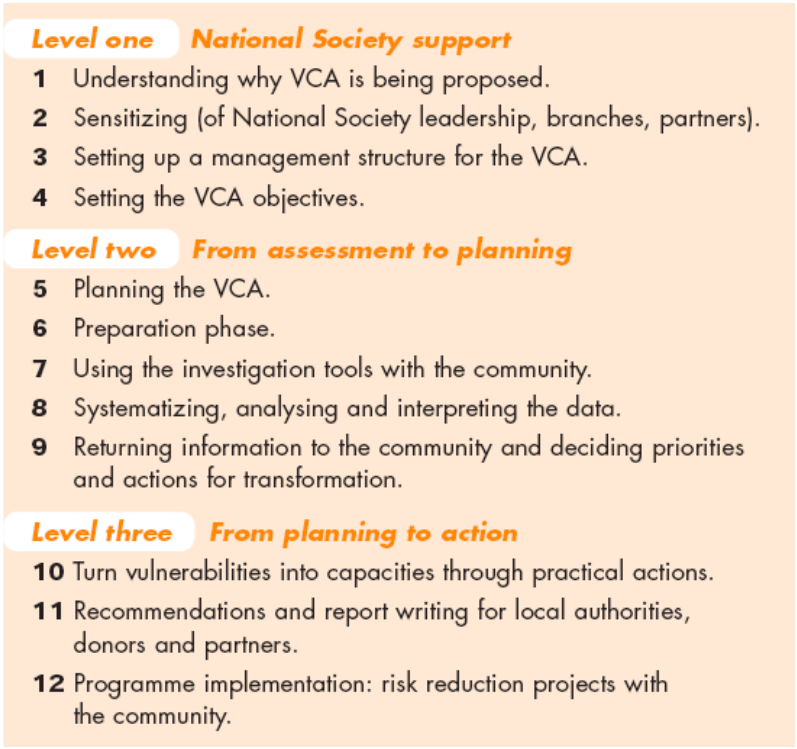


Figure 3.32: The 12 steps of the VCA-process (International Red Cross and Red Crescent Societies, 2007, p. 21)

There has to be a balance between communities' perceptions of risk and the National Society's larger-scale risk assessment and mapping, when VCA-outputs are returned to the communities. Therefore, the presentation has to be adapted e.g. for people who cannot read. The overall process has to be monitored by focus groups or questionnaires to measure and document the changes caused by VCA.

3.7.3.2 Transfer of Vulnerabilities into Capacities

In the end, hazards or issues need to be prioritized. Vulnerabilities, potential risks, capacities and immediate needs have to be clear for everyone. Subsequently, mitigation measures can be elaborated together with the community. The focus lies on transforming vulnerabilities into capacities by supporting locals in undertaking transformative measures – a process that has to be based on existing capacities. A management timeline is useful to avoid losing overview and assigning responsibilities (Figure 3.33).

	Week 1	Week 2	Week 3	Week 4
National Society Secretary General.	Write to Ministry of Health, Civil Defence and local authorities.		Courtesy meeting with counterparts from Civil Defence, Ministry of Health and local authorities.	
VCA coordinator.	Sensitize National Society management and branch officials.	Contact Ministry of Health, Civil Defence and local authorities to make appointments.	Set up sensitization sessions for following week.	Sensitize representatives from Ministry of Health, Civil Defence and local authorities.
Branch leaders.	Participate in sensitization.	Sensitize local staff and volunteers.	Sensitize local community groups.	
Local staff and volunteers.		Participate in sensitzation.	Assist in sensitizing local communities and selecting community focus groups. Clarifying expectations.	

Figure 3.33: Sample-Management Timeline (IFRC, 2007)

For each measure some questions have to be clarified in advance:

- Can it be undertaken instantly?
- Are certain resources needed?
- Can these resources be organized without external help? How?
- Is technical support needed? Where do we get it?
- Are strategic partnerships useful for this measure?

Figure 3.34 gives a practical example of flood risk in the Caribbean:

Problem/ issue/ hazard	Potential risk	Vulnerabi-lities	Capacities	Immediate needs	Mitiga-tion actions
Flood	■ The river floods over the banks affecting homes in the vicinity. ■ Homes become water-logged at ground level. ■ Household equipment is damaged. ■ Most vulnerable people (elderly and very young) lost their lives. ■ More mosquitoes can breed in the area where river is blocked, increasing risk of malaria. ■ Flooding in homes results in drinking-water sources becoming contaminated. ■ Drinking contaminated water results in diarrhoea in young children.	■ Poor infrastruc-ture ■ Poor agricultural practices ■ Poor drainage ■ Poor sanitation ■ Lack of agricultural supplies	■ Training ■ Skilled personnel ■ Storage facilities ■ Evacuation plan	■ Food ■ Housing ■ Sanitation facilities	■ Retention walls ■ Cleaning up rubbish

Figure 3.34: VCA for Flood Risk in the Caribbean (IFRC, 2007)

Finally, planned activities have to be conciliated with indicators and evidence (Figure 3.35)

Activity	Indicator	Evidence
Creation of an evacuation plan.	The village's evacuation plan results in a reduction of mortality.	Impact after disaster can be measured by identifying how many people were killed in the previous year before the evacuation plan was implemented.
Clearing blocked drains.	The clearing and cleaning of blocked drains results in less flooding in homes.	The number of homes flooded in the flood season after the drains have been cleaned and cleared can be compared with the number of households affected the year before.
Health awareness campaign.	There is a reduction in the number of cases of diarrhoea in children.	The local clinic can compare the number of cases of children with diarrhoea who have attended the clinic.
Mosquito spraying programme initiated with municipality.	The reduction in mosquito breeding grounds results in a reduction of malaria cases.	The local clinic can compare the number of cases of malaria seen in the clinic.

Figure 3.35: VCA - Activities, Indicators and Evidence for Flood Risk in the Caribbean (IFRC, 2007)

3.7.3.3 Documentation

The last step of VCA-activities is to write a report about the entire process (preparation-, implementation-, analysis- and action-phase), including activity plans, maps and conclusions. The report should be composed together with the community and, once approved, shared with relevant stakeholders and donors (IFRC, 2007).

The guidelines for assessments in emergencies of the Red Cross Federation, which refer to the VCA-framework clearly divide the evaluation process in three phases: before, during and after the field visit. Phase one is based on the question if an assessment is needed, its possible preparation and preliminary review of secondary information, such as:

- Field assessment reports
- Media reports
- Maps
- Data provided by NGOs, UN-agencies, governments, research groups
- Technical surveys
- Eyewitness accounts
- Government census data

Phases two and three consist of field observations, analyses recommendations and reports.

3.7.3.4 VCA Case Study – Syrian Arab Red Crescent Movement

A practical example for the potential of VCA was the Syrian Arab Red Crescent movement in 2000. After the earthquake of 1999 the National Society was afraid of disastrous impacts in the north-western part of the country. At the beginning, further vulnerabilities, such as lack of water, pollution and different health issues, were identified by interviewing Red Cross staff, management and volunteers. That was surprising, because high sensitivity towards earthquakes had been expected.

In co-operation with the Ministry of Health and Civil Defence volunteers were trained both in disaster preparedness and integrated, every-day health activities. As a consequence, Syrian Arab Red Crescent volunteers cleaned up the river in Damascus or initiated local awareness campaigns for garbage collection. In 2001, the Zaizon dam collapsed and disaster management worked fine. Affected people were provided with basic needs like first aid or health car, a rapid assessment was carried out and a temporary camp could be managed (IFRC, 2007).

4. Materials and Methods

The methodology mainly consisted of broad literature research and expert interviews to

- identify a core question that is of practical use for the Red Cross and Red Crescent Movement and
- deal with the problem of communal vulnerability in a holistic, not purely technical way by considering all possible root-causes
- evaluate the performance of water and sanitation kits via questionnaire
- fortify the necessity of preparedness measures by creating a scientific and political basis

4.1 Expert Opinions and internal Information

The majority of information was provided by Helmut Jung, Juergen Hoegl, Guenter Stummer and William Carter. Magdy Mohssen added relevant information from his point of view.

Without their experience it would have been impossible to shape a precise research question. Discussions about practical relevance and feasibility finally led to its formulation. Additionally, some internal Red Cross papers were drafts, others were stored in the real-time disaster management information system (DMIS), which requires log-in by active members of the Red Cross community.

4.2 Literature Research

On one hand, literature research consisted of common search engines like Google Scholar or meta search engines like Metacrawler. On the other hand, water and sanitation-, disaster- and development-cooperation- related online-portals and databases were searched for up-to-date approved information. Further relevant publications were provided by Helmut Jung.

4.2.1 Search Engines and Online Portals

Mainly two search engines (Google Scholar, Metacrawler) and the “best-match”-method were used for specific literature survey. “Best-search” means that as many topic-related terms as possible are entered to specify search results. Google Scholar (scholar.google.com) offers an advanced search method, which works according to parameters like the author’s name and date of publication. Metacrawler (www.metacrawler.com) is a meta search engine, which combines search results of several search engines. Of course it is still impossible to access information from sites that require log-in.

A lot of information on preparedness, communal vulnerability and the correlation between climate change and disaster risk is available online from international development agencies, governmental and non-governmental organisations. Many documents that cannot even be viewed or downloaded free of charge by www.eldis.com can be obtained through the online Boku-literature search system.

The following online-portals were searched for up-to-date information about processes, strategies and equipment:

- www.ifrc.org (International Federation of Red Cross and Red Crescent Societies)
- www.reliefweb.int
- www.worldwatercouncil.org
- http://www.sandec.ch/ (Department Water and Sanitation in Developing Countries)
- www.wateraid.org

- http://www.who.int/water_sanitation_health/en/ (World Health Organisation)
- http://wedc.lboro.ac.uk/ (Water, Engineering and Developing Centre)
- http://www.dkkv.org/ (German Committee for Disaster Prevention)

Additionally, online databases were searches for specific contents. Some are free of charge, others can be accesses through the Boku-online literature search system:

- IRCDOC, library database of the IRC International Water and Sanitation Centre
  http://www.irc.nl/ircdoc
- Water, Engineering and Development Centre
  http://wedc.lboro.ac.uk/knowledge/well_pubs.html
- Natural Hazards and Earth System Sciences
  http://www.nat-hazards-earth-syst-sci.net/volumes_and_issues.html
- Sciencedirect:
  http://www.sciencedirect.com/science/search
- Ingenta
  http://www.ingentaconnect.com/search
- Scirus
  http://www.scirus.com/

4.3 The WatSan-Questionnaire

A questionnaire was developed to address the performance of water and sanitation kits (WatSan-Kits) that are currently used in Africa by Red Cross National Societies. The last version was both English and French. By serving as a buffer before international assistance has to be demanded, the kits aim at strengthening preparedness and lowering vulnerability on local and regional levels.

The questionnaire focuses on receiving as much information as possible by posing simple questions on the kits' location, condition, actual performance in disaster situations and National Societies' capacities for training, maintenance and operation. The United Republic of Tanzania serves as the case study, because the kit system has just been used in a major flood catastrophe for the first time.

4.4 Water Preparedness Training and SWOT-Analysis

The Red Cross water training in Steyr (Austria) was an ideal opportunity to compare the technology of WatSan-Kits with current emergency water supply in Austria. Close to the river Enns, all supply units were installed and fed with contaminated water to practice operation and maintenance. Additionally, the performance was assessed for one week of continuous operation.

Results of literature review, interviews and the WatSan-questionnaire are finally illustrated in a SWOT analysis – opposing strengths, weaknesses, opportunities and threats.

5. Water and Sanitation Questionnaire

The bilingual questionnaire (English, French) was elaborated to address the actual performance of water and sanitation kits (WatSan-Kits) that are currently used by Red Cross National Societies. By serving as a buffer before international assistance has to be demanded, the kits aim at strengthening preparedness on different levels. The questionnaire focuses on receiving as much information as possible by posing simple questions on the kits' location, condition, actual performance in disaster situations and National Societies' capacities for training, maintenance and operation.

Discussions with William Carter from the IFRC headquarter in Geneva resulted in a focus on the location of the kits, training, barriers and performance. The original plan to send the questionnaire to all National Societies had to be adapted because of time pressure that was caused by the earthquake in Haiti in January 2010. After the event, it became nearly impossible to communicate with Red Cross staff during the reconstruction phase. Thus it was decided to take the only country that actually had the chance to test the kits' performance after a natural disaster, the United Republic of Tanzania, as a case study. Following interviews are likely to follow in a related dissertation.

5.1 Objective and Structure

The WatSan-questionnaire's objective was to answer the following questions:

- The appropriateness of the WatSan-Kits' location (in consideration of past incidents, local capacities and conditions)
- Possible suggestions for better locations
- The WatSan-Kit's condition - qualitative evaluation from very good (fully functional) to very bad (not functional)
- The frequency of practice
- A qualitative assessment of the system's performance (from very good to very bad) in case they have been used in a disaster situation
- Possible barriers for the use of WatSan-Kits (lack of personal for training, maintenance or operation, lack of spare parts, insufficient support from the Federation, complications concerning operation or transport, etc.)
- Possible local emergency approaches that are more efficient than the WatSan-concept
- The last question tried to evaluate if WatSan-Kits contribute to a subjective feeling of preparedness

Wherever possible, people were given enough space to add further comments. The original English and French version of the WatSan-questionnaire can be found in the appendix.

5.2 Interpretation Key

Although all questions were elaborated to allow clear understanding of the questions and interpretation of the results, an interpretation key was prepared (Chart 5-1). Its objective is to consider possible dependencies and interactions of questions. An essential assumption is that interviewees take the questionnaire's completion serious, that they answer honestly and consult other members of staff in case of uncertainty.

Chart 5-1: Interpretation Key for the WatSan-Questionnaire

Question	Interpretation Key

1. Is your WatSan-Kit located in a disaster prone area? (Please consider past incidents, local capacities and conditions)	Since there is not scientific basis for the location, where WatSan-Kits are prepositioned, Interviewees are asked to judge the adequacy of their kit's location. Interpretation has to consider which kit is used (Kit 2, 5 or 10)
2. If the answer is NO, why is the location not appropriate?	In case the National Society ticked NO it is crucial to investigate why the location is inappropriate to draw conclusions for further positioning of WatSan-Kits.
3. If the answer is NO, which location would be appropriate?	National Societies know local vulnerabilities and interacting risks best. This questions aims at giving them a chance to explain, which location would be more appropriate and why.
4. Your kit's condition is very good (fully functional), good (little damage, operation possible), bad (severe damage, operation hardly possible or very bad (not functional)	This question is closely related to the next one. It can be expected that kits, which are used every day, show a worse condition than their hardly used counterparts.
5. How often do you practice? (Answers: every week, every 1-3 months, every 4-6 months, every year)	On one hand, the frequency of training correlates with the kit's location. On the other hand, National Societies will practice less often, if they have to cope with lack of personnel, spare parts, knowledge or high frequencies of emergencies.
6. Is that sufficient? If not, why?	An explanation of the training-behaviour can facilitate adaptations of knowledge transfer, other kinds of support or kit-technology.
7. Was the kit already used in a disaster situation?	The answer to this question shifts the understanding of the WatSan-Kit-system towards a more practical dimension in the chaotic system of a natural disaster. It has to be considered that a "NO" does not necessary mean that there has not been any kind of disaster.
8. If the answer is YES, how did the system perform? (Answers: very good, good, bad, very bad)	In case the National Society had the chance to use their kit in the field, an assessment of its performance could lead to conclusions about its "buffering capacity" before international emergency response units arrive.
9. What are barriers for using WatSan-Kits?	Interviewees are asked to tick one or more possible barriers for efficient use of WatSan-Kits. They are given the chance to list further reasons that are not in the list.
10. Are there more efficient approaches than WatSan-Kits used in an emergency situation?	This questions is crucial for identifying National Societies' perception of the kit-concept. It is closely linked to the frequency of training and

	barriers for efficient use. Furthermore, it might enable adaptations.
11. Do the kits contribute to a feeling of preparedness?	In combination with additional comments, the answer to this question is expected to correlate with the appropriateness of the kits' location and condition, frequency of training, actual use in disaster situations and performance in the field and all kinds of barriers.

6. Case Study - United Republic of Tanzania

The United Republic of Tanzania was chosen for a case study, because it is the first country that had an opportunity to gain practical experience with WatSan-Kits in a flood catastrophe on the 6th of January 2010.

6.1 Country Profile

With a surface of 945,000 km2, including mainland, Zanzibar and marine water surface, the United Republic of Tanzania is the biggest East African country and a multi party democracy. Administration is formed by the Union Government and the Zanzibar Revolutionary Government. The country was formed in 1964, after Tanganyika and Zanzibar had become independent in 1961 and 1963 (OFFICIAL ONLINE GATEWAY OF THE UNITED REPUBLIC OF TANZANIA, s.a.).

Between 1950 and 2009, the population increased from 7,7 to 43,7 million people (DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS POPULATION DIVISION, 2009). 80 percent of the population live in rural areas. There are 26 administrative regions. Dodoma is the capital, whereas Dar es Salaam can be regarded as the political capital. Geographical structures encompass islands in the east, the inland plateau and the highlands (OFFICIAL ONLINE GATEWAY OF THE UNITED REPUBLIC OF TANZANIA, s.a.).

Main natural resources encompass minerals (gold, diamonds, natural gas, iron ore, salt, etc.), fisheries, forestry and 12 national parks. The latest estimation of per capita GDP in 2001 resulted in 251 US $ per year. 50 percent of all inhabitants live below the poverty line (OFFICIAL ONLINE GATEWAY OF THE UNITED REPUBLIC OF TANZANIA, s.a.). WATER AID (2010) list a percentage of 35,7.

Further relevant information from the WORLD DEVELOPMENT REPORT 2006/09, UNICEF STATE OF THE WORLD'S CHILDREN and WHO WORLD HEALTH STATISTICS (cited in WATER AID, 2010):

- Average life expectancy is 55 years
- 23 900 children die of diarrhoeal diseases every year
- Adult literacy rate: 72,3 percent
- Water supply coverage: 55 percent
- Average water collection time: 2 hours

6.2 Water Resources and Climate Change

Freshwater resources are expected to decrease by 50 percent until 2025, compared to the level of 1990 (SHARMA et al, 1996). According to McSWEENEY, NEW and LIZCANO (2008), the main driver for seasonal precipitation is the Inter-Tropical Convergence Zone (ITCZ). The position of the ITCZ varies throughout the year. Reasons are variations in the Indian Ocean sea-surface temperature and El Niño's Southern Oscillation (ENSO), which causes higher average rainfall in the short rainfall season. La Niña is responsible for more intense dry seasons. The CVI (climate vulnerability index) is "medium-high", as illustrated in chapter 3.3.1.

Tanzania's climatic vulnerability showed for instance in 1997/1998, when El Niño caused severe floods and droughts. Results were food shortages, skyrocketing food prices and enormous losses in cattle and cash crops. People had to walk up to 50 kilometres to receive emergency aid rations (EHRHART and TWENA, 2006). Floods destroyed settlements, infrastructures and livelihoods. Malaria, Cholera and Diarrhoea were favoured (Initial National Communication, 2003, cited in EHRHART and TWENA, 2006).

The ITCZ moves south from October to December and reaches the country's most southern regions between January and February. Subsequently, it returns northwards from March to May. This process makes a clear differentiation between north and east of Tanzania and southern, western and central areas possible. North and east face a short rainy season from October to December and a long rainy season from March to May. South, west and the central regions are confronted with only one wet season that starts in October to end in April or May. Precipitation maxima vary widely, but can reach 300 mm/month in the wettest regions (McSWEENEY, NEW and LIZCANO, 2008).

In contrast, the INITIAL NATIONAL COMMUNICATION (2003, cited in EHRHART and TWENA, 2006) stated a decrease in the annual flow of three key Tanzanian rivers (Pangani, Ruvu and Rufiji) between 5 and 11 percent within the next decades. Regions with long periods of little precipitation will additionally be confronted with falling water tables, slow aquifer recharge rates, higher rates of evapo-transipiration and reduced soil moisture.

These circumstances are enhancing power shortages in hydropower regions and uncertain water supply for agriculture in dry regions. Areas with higher rates of precipitation are facing increasing flood risks. Although water scarcity is more severe in some neighbouring countries, such as Kenya, Rwanda or Malawi, social and political tensions could easily have a border crossing effect like in Uganda or Ethiopia (EHRHARD and TWENA, 2006).

Sea-level rise is as well predicted to result in severe consequences for regions on the 800 km coastline, which serves as the livelihood for 16 percent of the population. Damages in Dar es Salaam only are likely to reach 48-82 million US$ by 2100 (based on 50 and 100 cm sea-level rise) (INITIAL NATIONAL COMMUNICATION, 2003, cited in EHRHART and TWENA, 2006).

Further likely consequences of sea level are (EHRHART and TWENA, 2006):

- Loss of land, marine and coastal ecosystems
- Erosion
- Salt water intrusion in fresh water bodies and
- Inundation of low-lying coastal areas.

6.3 The Flood Event of January 2010

Heavy precipitation, which had started on 24th of December 2009, lead to a major flood event in the Eastern parts of the country between the districts Kilosa and Kongwa. The Kilosa region was mostly threatened by inundations of the river Mkondoa. Affected regions are highlighted in Figure 6.1.

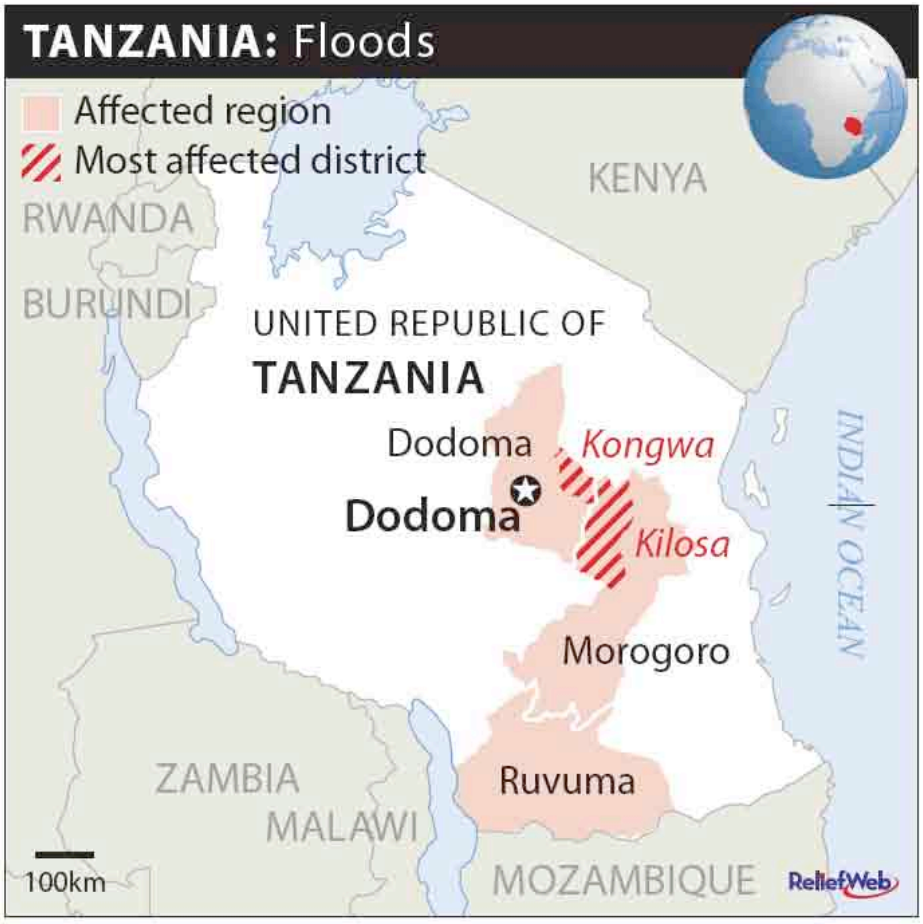


Figure 6.1: Location of Tanzanian Floods, January 2010 (RELIEF WEB, 2010)

According to RELIEF WEB (2010), more than one thousand people were displaced and approximately 25 000 affected. Infrastructure suffered enormous losses. Roads, bridges and rails were swept away. Around 1000 houses were completely destroyed in Kilosa. Similar to the floods in 1997/1998, crops and wells, which served as main water supply, were flooded. As a consequence, cases of cholera and acute watery diarrhoea were reported.

The Tanzanian Red Cross recruited 50 volunteers for search, rescue and relocation. More than 200 families were provided with relief equipment like blankets, water guard tablet and buckets. Shelter turned out to be the biggest problem. 216 000 Euros were taken from the Disaster Relief Emergency Fund to assist 5000 families for three months (RELIEF WEB, 2010).

According to IFRC documents (IFRC, 2010), an emergency appeal was launched on the 20th of January 2010. 1,14 million Euros were calculated to support 23 000 beneficiaries for four months. The operation's update from the 15th of February speaks of 50 000 people affected and of 28 000 people, who had to leave their homes because of further heavy precipitation and a thunderstorm. The report highlights the vulnerability of tens of thousands of people after the water and sanitation infrastructure had collapsed.

6.4 Relief Operations

Red Cross, UNICEF, the ministry of health and the Tanzania People's Defence Force (TPDF) co-operated to provide hygiene promotion, non-food items and 36 cubic meters of treated water (12,6 litres/person/day) in the displacement camps of Mazulia and Kimamba (Kilosa District). People were brought to these camps after having been accommodated in 23 makeshift camps directly after the flood. The TPDF constructed 124 latrines and 21 bathing stations, the ministry

of health supported the camps with health clinics. In the Districts Kongwa and the Mpwapwa the flood caused less damage. Water infrastructure was damaged or destroyed and 439 households had to be provided with shelter. About 5100 hectares of farmland were flooded.

International support was provided by the International Federation's Eastern Africa Regional office in Nairobi (Kenya) with WatSan-Kits 10. Three Austrian delegates, two Regional Disaster Response Team delegates and three WatSan officers of the Tanzanian National Society supervised the kit's operation and maintenance. Two 10 000 litre and one 2 000 litre tanks with 13 taps were installed in the camp of Mazulia. Kimamba provided with one 10 000 litre and one 2 000 litre tank and 8 taps. Low flow water dispensers were installed close to latrines for hygiene promotion. Additionally, the Mpwapwa and Kongwa Districts received three WatSan 2 kits on the 16th of February.

The International Federation Regional Disaster Operations Manager supported the National Society's management process. Delegates from Uganda, Rwanda, Burundi and Malawi Red Cross joined the Regional Disaster Response Team (IFRC, 2010).

6.5 Results of the Questionnaire

The questionnaire was completed by Abdala Bunga, WatSan engineer of the Tanzanian Red Cross National Society, and Adam Karia, WatSan Coordinator for the Tanzanian Red Cross Society. Important additional information on the results was received by email. While the operation update mentions the use of WatSan kits 2 and 10, Abdala Bunga, a WatSan-engineer in Zanzibar, confirmed that the use of all three kinds of kits. Relevant results of the questionnaire are listed in Chart 6-1 and discussed in chapter eight.

Chart 6-1: Relevant Results of the Questionnaire and Interpretation

Question	Result	Interpretation
Was the location appropriate?	YES	The location of all kits used was described as appropriate, although they were not located in Tanzania, but in neighbouring countries.
Condition of the kit?	GOOD (little damage, operation possible)	As expected, new kits that have not been used in a disaster before or kits that are not used frequently are in good state.
Training frequency?	Every 4-6 months	This answer does not mean that the Tanzanian National Society used WatSan-Kits for training purposes every 4-6 months. Since the kits were received from other National Societies after the flood, it related to general disaster training.
Is the training frequency sufficient?	YES	See answer above.
Was the kit already used in a disaster situation?	YES	Flood disaster, January 2010.
How did the system perform?	GOOD	The flood disaster served as the first opportunity to evaluate the actual

		performance of the kit approach in the field.
Barriers for the use of WatSan kits?	- TOO COMPLICATED - LACK OF SPARE PARTS	The answer to this question explains why the system is not evaluated as VERY GOOD. Adaptations have to consider especially technical complexity and ease of use.
Increased feeling of preparedness?	YES	The answer to this question was YES, although the kits were not located in the country, when the flood started. It is related to the question of appropriate locations. Preparedness and buffering capacity would have been higher if the kits location had been Tanzania from the beginning.
Further comments	Excellent and quick response	

6.5.1 Evaluation of Training

The background for the evaluation of the training component was, that the Red Cross headquarter assumed weaknesses concerning the training of water technicians.

Abdoul Wahabou, a 35-year old water technician from Cameron, who gained practical experience while practicing emergency situations with a WatSan-Kit 5 in Burkina Faso, agreed to participate in an interview about the most crucial factor for efficient preparedness via Skype. Additionally, he offered all his training documents for assessment.

Already at the beginning of the interview with Mr. Wahabou it turned out that training for water technicians of the Red Cross lacks a practical dimension. Preparing staff for actual work with threatened communities in developing or threshold countries requires a more detailed approach than the explanation of technical equipment, operation and maintenance.

Considering technical aspects only, the training material is suitable and schematic illustrations facilitate easy understanding. With regard to all other interdisciplinary issues, such as vulnerability and its background, the training is far too theoretical. Water technicians normally receive three training units within 15 days, before they are deployed. Abdoul Wahabou confirmed that several case studies that show the progress of disasters from root causes over the actual relief phase to preparedness would improve the understanding. Ideally, these case studies would have to illustrate a recent emergency situation in the country to which water technicians are deployed.

7. Results

Figure 7.1 summarises the results in form of a SWOT-analysis (strengths, weaknesses, opportunities, threats) of the system's performance. It is the result of literature review, interviews and the WatSan-Questionnaire (cf. appendix in chapter 14). Amongst others, Figure 7.1 points out that WatSan-Kits require further adaptations with regard to training and technical configuration.

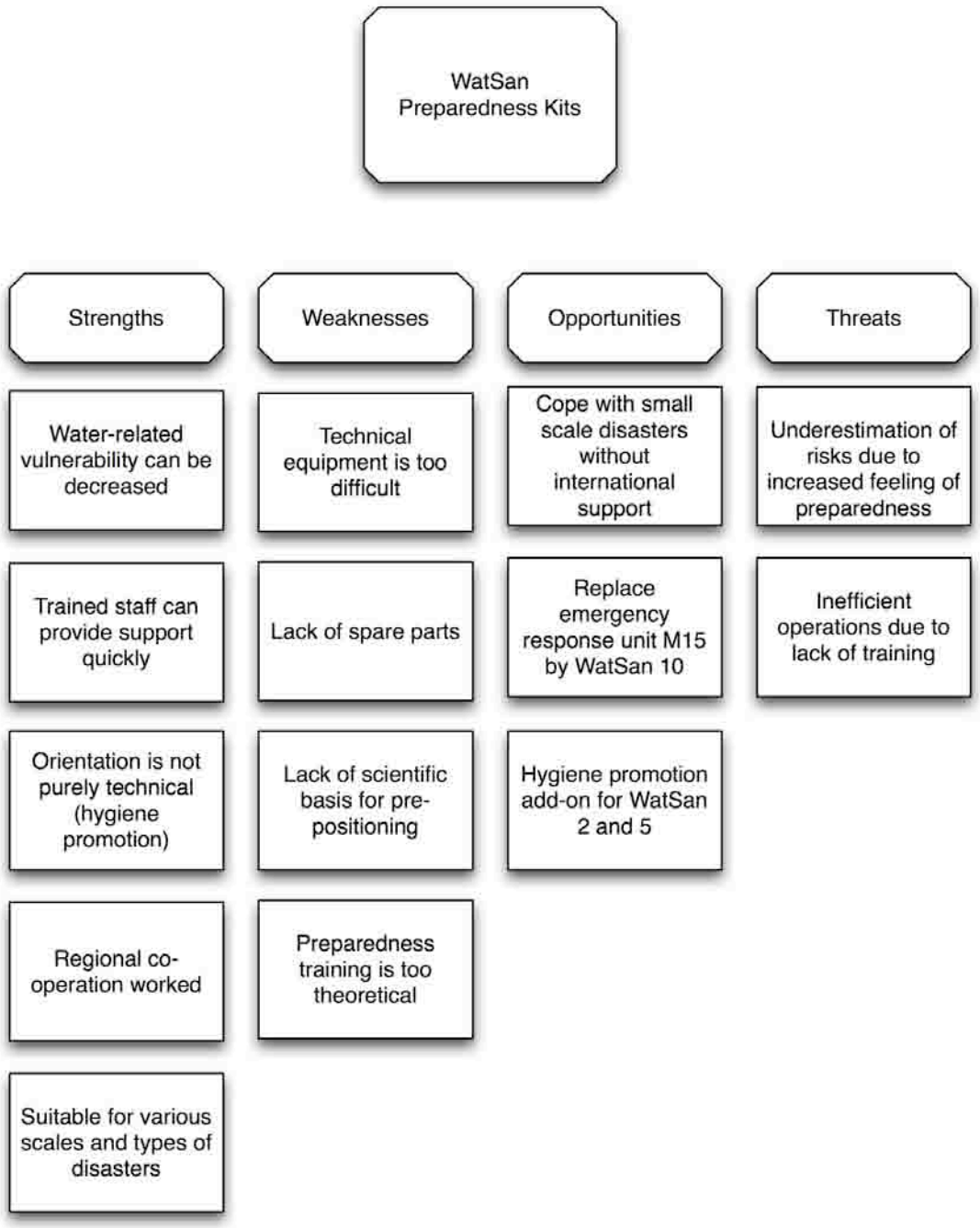


Figure 7.1 Summary of Results

It has to be considered that general comments about the overall performance of WatSan-Kits are assumptions, which were deducted from their performance in the Tanzanian flood disaster of January 2010.

Consequently, these are the answers to the research questions in chapter 1.3:

- **What are barriers for Red Cross National Societies to cope with the WatSan-kit system on site?**

Water technicians of the Tanzanian Red Cross National Society especially highlighted two weaknesses that were discovered during the relief phase after the floods.

Firstly, the system's complexity was criticised. Secondly, lack of spare parts complicated operation and maintenance.

- **Are the kits' locations considered as appropriate by the host National Societies?**

There were no WatSan-Kits pre-positioned in Tanzania when heavy precipitation led to a flood event. Nevertheless, quick emergency response was possible due to support of adjacent countries' Red Cross National Societies, which owned WatSan-Kits.

Surprisingly, the question, if the kits were located on an appropriate location was answered with "yes". One main future objective has to be the pre-positioning of WatSan-Kits or similar approaches according to risk distributions, climate change models and/or time series analysis.

- **What are the kits current conditions?**

All kits current condition was assessed as "good" (operation possible, little damage).

- **How often do National Societies practice with the kits for emergency situations?**

Since the kits were just deployed to Tanzania there is little experience on training. The projected training interval of the Tanzanian National Society is four to six months.

- **If not, are there more efficient, possibly traditional tools used in disaster situations?**

WatSan-Kits were assessed as the most efficient instrument for water-related disaster preparedness.

- **What are potentials to optimise WatSan-Kit training and operation?**

It can be assumed that other National Societies of the International Red Cross will have similar problems with operation and maintenance. While increasing the number of spare parts is unlikely to turn out to be a problem, the situation is different concerning water supply technology. The treatment units were designed to meet the best possible relation of complexity, costs, robustness and performance. Possible adaptation strategies have to be discussed with Red Cross staff.

- **Do the kits efficiently contribute to disaster preparedness on local, regional or national scale?**

In case of the flood disaster in the United Republic of Tanzania it is not possible to answer this question unambiguously. On supranational level it can be stated that preparedness was increased. The relief operations were accelerated through Tanzania's proximity to the International Federation's Eastern Africa Regional office in Nairobi. The cooperation resulted in the deployment of WatSan-Kits 10 in the most affected region, the Kilosa District.

8. Interpretation and Discussion of Results

Although the concept of vulnerability has already been established in the 1980s (e.g. PELANDA, 1981 or JEFFERY, 1982), interdisciplinary approaches emerged almost a decade later. The United Nations International Decade for Natural Disaster Reduction (1990-1999) had one clear output: Preparedness activities cannot avert negative consequences of natural disasters, but there is a high potential for mitigation (DFG, 2001).

Results of the IPCC (2007) are straightforward with regard to effects of rising air and sea temperatures due to greenhouse gas emissions. It will not be possible to reverse climate change immediately – not even, if all greenhouse gas emissions stop today. The process of decreasing CO_2 and other green house effect promoting gases has to be supported by strategies that can cope with a variety of disasters, ranging from thunderstorms to floods or droughts. However, this procedure requires institutional cooperation between organisations dealing with disaster management and others that are specialised on climate change.

Climate change-related Vulnerabilities are predicted to keep affecting developing and threshold countries harder due to lack of adaptation strategies and preparedness (e.g. WORLD BANK, 2007; SULLIVAN and HUNTINGFORD, 2009). WatSan-Kits can be seen as a complementary bottom-up instrument to various general top-down processes, such as the ones proposed by the UNITED NATIONS INTERNATIONAL STRATEGY FOR THE DISASTER REDUCTION (2008): development of early warning systems and social safety nets, better insurance cover, avoidance of uncontrolled settling, etc.

Nevertheless, WatSan-Kits cannot be seen as a common preparedness activity or instrument. It is necessary to distinguish between vulnerabilities that lead to unsafe conditions and others that relate to disaster relief. WatSan-Kits do not affect root causes, which finally pave the way for natural disasters, but they are an efficient tool for quick disaster relief concerning water supply. Sanitation and hygiene promotion are part of the kits' concept, but practically underrepresented. WatSan-Kits 2 and 5 are not even pre-positioned including the hygiene promotion add-on, which would be an easy way of decreasing vulnerabilites. Training is a crucial prerequisite to provide efficient emergency response. However, especially the training component has to be improved with regard to actual conditions in specific target countries. Delegates and affected people need to understand the root causes of hazards and that technical equipment is only one way of mitigating vulnerability.

An internal review of the IFRC (2008A) criticises the purely technical focus of emergency response operations, which sometimes leads to a worse level of preparedness than before the impact of the disaster. WatSan-Kits could be designed far more interdisciplinary. Vulnerability and capacity assessments have been carried out by the IFRC around the world, but obviously there is a lack of interdisciplinary trained personnel. Even the hygiene promotion kit is only part of the biggest and therefore most expensive kit 10. One way of efficiently improving preparedness would be to transfer to kit approach to other fields of specialisation of emergency response units - health care, logistics or telecommunication. Another approach could be the extension of standardised kit equipment with tools that are adapted to local circumstances, such as more material for pit latrines or an opportunity to provide emergency shelter.

Regarding the technical aspects of the kits only, lack of spare parts and processes or equipment, which are too complicated, were mentioned by the Red Cross National Society of the United Republic of Tanzania. However, one major advantage of the kits is that they preserve the dignity of the affected population and National Societies. They are able to cope with small scale disasters on regional scale without having to call for international help or losing face in front of the government. The question of pre-positioning is here important. The Tanzanian National Society was lucky to be supplied with kits and delegates from the

neighbouring countries. If the kits had been positioned in Tanzania from the beginning, the risk of impassable transport routes and delays would have been lower.

WatSan-Kits are already the most efficient preparedness instrument of the IFRC in the water sector. According to HOEGL (2009) they might even replace the smallest emergency response unit (M15). Nevertheless, there is backlog demand concerning hygiene promotion, training, technical complexity and spare parts.

One factor, which is hardly mentioned in literature, is the underestimation of actual hazards and risks due to the existence of preparedness concepts or equipment. A culture of prevention is far from being reality. People need to understand that the sole pre-positioning of technical equipment does not mitigate future consequences of natural disasters. Raising awareness works best when the relief phase turns into a reconstruction phase after a catastrophe. The only way of avoiding this hard lesson is to build trust towards potentially affected communities and explain the need of disaster preparedness and training in a comprehensible, mutual dialogue. One approach might be to create an “awareness-building” add-on for WatSan-Kits.

It will not be possible to divide developing cooperation and disaster management – even if organisations may compete. Frameworks like the EU-Strategy for Disaster Risk Reduction in Developing Countries (EUROPEAN COMMISSION, 2008) are not generally useless. They are simply too theoretical and maladjusted to specific needs of populations that cannot afford the preparedness standard of industrialised nations.

Nevertheless, the existence of a political background for disaster preparedness is crucial for awareness raising. Although technical solutions are still the state-of-the-art-approach, it is possible to link technical equipment to more interdisciplinary concepts. WatSan-Kits fulfil that task partly by providing equipment for hygiene promotion and can be seen as a role model in need of improvement.

9. Summary

As illustrated in chapter 1.2 and 1.3, the major objective of this diploma thesis is to falsify or verify the hypothesis that Water and Sanitation emergency preparedness kits (WatSan-Kits) of the International Red Cross are an efficient instrument for water-related disaster preparedness. Their performance in a recent flood disaster was evaluated with support of the Tanzanian Red Cross National Society and the Red Cross headquarter in Geneva. Additional information on weaknesses of preparedness training were provided by Abdoul Wahabou, a water technician from Cameroon, who trained relief teams in Burkina Faso.

Several reasons led to the development of water supply, sanitation and hygiene promotion preparedness strategies. On one hand, the majority of victims depend on local aid, which has to be provided directly after a catastrophe and before international emergency appeals have an effect. On the other hand, emergency relief equipment often runs at a degree of efficiency below 20 percent and has to be left on site after the mission is over, because costs for return transport exceed the budget.

Preparedness activities have been an integral part of international agreements and frameworks for the last decades. Similar to many strategies on climate change adaptation, agreements on preparedness tend to be too theoretical. WatSan-Kits are among the first standardized approaches that give people, who live in disaster-prone areas, an instrument to bridge the time between a catastrophe and the arrival of international support or to manage it on their own.

Climate change leads to more frequent occurrence of heavy precipitation and droughts. Due to higher vulnerabilities, developing and threshold countries suffer more than their industrialised counterparts. Statistical analysis proofs that natural disasters caused higher financial loss in industrial nations. Compared to the GDP, developing and threshold countries are generally hit harder. Especially in the water sector, preparedness measures have to be able to cope with varying circumstances. WatSan-Kits were designed as a flexible instrument to deal with disasters of different range, types, time horizons, etc. However, this thesis is the first attempt to assess their performance in the field with the help of people, who actually used them.

Considering the disaster management cycle, WatSan-Kits are on the edge between preparedness and relief. Following the pressure and release-model, which directly opposes unsafe conditions and potential hazards, one major advantage of the kits is that they can be used to deal with small-scale disasters, which hardly get any international media attention. The water sector is highly susceptible to disasters. A decrease in systemic vulnerability generally results in better preparedness in case of future catastrophes. Therefore, the flexible approach of WatSan-Kits aims at mitigating risks that are, for instance, caused by uncontrolled urbanisation, lowering ground water levels, degradation of water and soil, deficits in hygiene or epidemics.

The flood disaster in Tanzania required the use of all three sizes of kits – 2, 5 and 10, which are able to serve 2000, 5000 or 10 000 beneficiaries per day. A SWOT analysis of the kits' performance and interviews with water technicians resulted in a positive general assessment, but highlighted several weaknesses. Mainly, the complexity of the system and lack of spare parts were criticised. While understanding can be improved by specific and practical training, the lack of spare parts might lead to a reconsideration of the treatment units. Austrian water supply units are a lot heavier, more rugged and expensive than the ones used in WatSan-Kits, but the majority of locking devices have a standardized diameter, which makes it easy to replace them with bottle caps or similar screw closures.

WatSan-Kits are definitely a step in the right direction and one of the most powerful instruments to increase preparedness, but further adaptations and research will be necessary. On one hand, there is no scientific basis for pre-positioning. On the other hand, training is too theoretical considering the system's complexity and interdisciplinary root causes that enhance vulnerabilities.

10. Outlook and Recommendations

WatSan-Kits are still far from being a flawless preparedness tool. A scientific basis for the kits' prepositioning has not yet been developed. Technical weaknesses, such as lack of spare parts and the complexity of the system, and the training component have to be revised.

One way of improving the kit approach would be dealing with the problem in a dissertation. A concept has already been elaborated.

The main objective is to identify the ideal environment for preparedness activities that are focused on water supply and sanitation. This requires identifying key vulnerabilities on different scales with regard to existing capacities on site (water supply, experience, equipment, know how, etc.). Therefore, essential approaches, on which the dissertation will be based, are the climate vulnerability index (CVI, chapter 3.3.1) and adaptive capacity (chapter 3.3.2.)

Developing this strategy will consider both illustrations of hazards and potential impacts, as well as local coping strategies, training and adaptations of the kits technical composition. As per the headquarter of the International Red Cross, information about these factors is moreover important to establish a scientific basis for the kits' pre-positioning. Relevant contacts to Red Cross National Societies have already been established in this diploma thesis. Latest research concerning effects of climate change on water resources and corresponding strategies for adaptation on sub-national scale will be integrated.

According to HOEGL (2009), relief operations mostly lack long-term benefits for the affected society. Expensive equipment has to be left behind, because expenses for return transport exceed the budget. There are currently no protocols about the equipment's state or their use in case of future disasters that requires similar equipment. Maintenance and operation would require trained staff or at least regular inspection by delegates. Consequently, the second main objective is to strategically increase the sustainability of relief actions in case preparedness activities fail.

10.1 Scientific Innovation

The major innovation is a combination of models on climate change, risk and vulnerability distribution with existing capacities, such as:

- Water quality, quantity and access
- Existence of preparedness activities (e.g. water and sanitation preparedness kits)
- People's experience in disaster management (assessed by VCA)
- Early warning systems
- Evacuation plans, etc.

Instead of solving problems for people living in disaster prone regions, the approach aims at developing strategies with them in a mutually beneficial way.

Most recent papers about vulnerability assessment (e.g. SULLIVAN and HUNTINGFORD, 2009 or United Nations World Water Assessment Programme, 2010) highlight the necessity of linking scientific outcomes with actual opportunities of implementation. Scientific and practical contributions of IFRC and IIASA (International Institute of Applied Systems Analysis, Laxenburg, Austria) will guarantee the consideration of both spheres within this project. Although the approach is theory driven, progress is constantly evaluated with regard to practical relevance in discussions with experts at Red Cross staff and all joining institutes at Boku Vienna.

Four BOKU Institutes of two Departments are involved.

Department of Construction Technique and Natural Hazards:

- Institute of Mountain Risk Engineering
- Institute of Safety and Risk Management

Department of Water, Atmosphere and Environment:

- Institute of Sanitary Engineering and Water Pollution Control
- Institute of Meteorology

Figure 10.1 schematically illustrates the knowledge transfer of the dissertation.

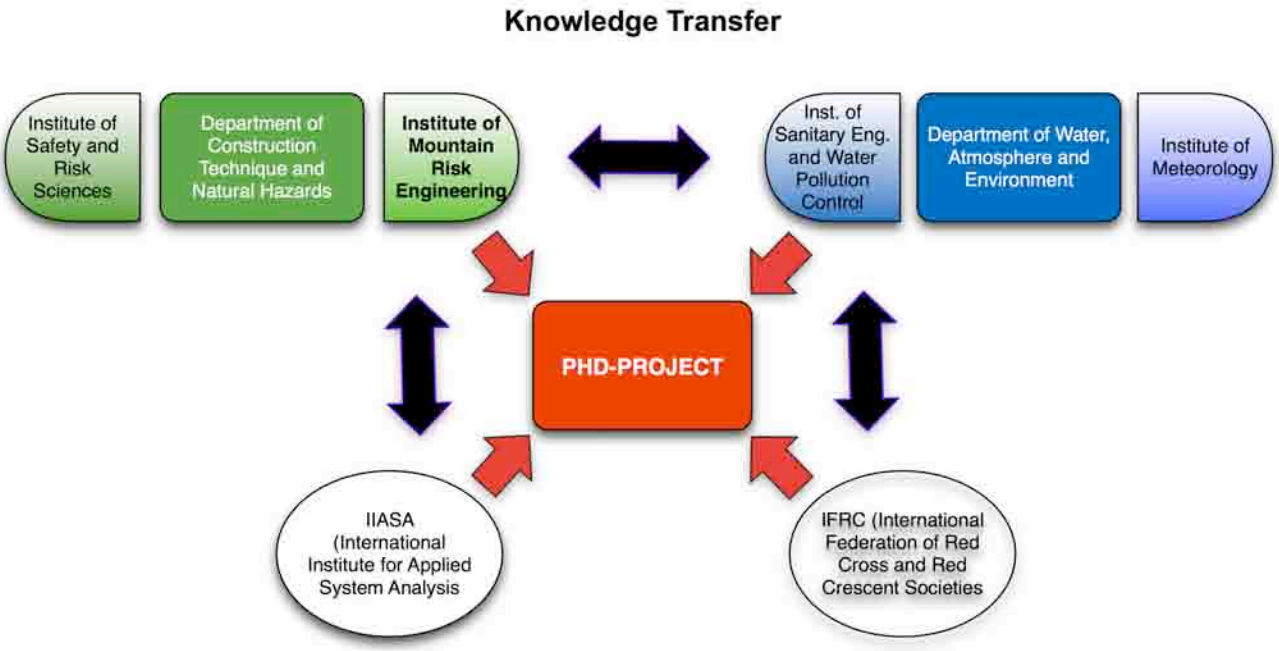


Figure 10.1: Knowledge Transfer of the planned Dissertation

10.2 Direct Influence on Location and Configuration

Results of the dissertation will boost the reconsideration of water and sanitation kit capacities. The biggest preparedness kit can already serve up to 10 000 beneficiaries, while the smallest emergency response kit has a capacity of 15 000 beneficiaries. According to an internal evaluation of the IFRC, the biggest emergency response kits run at an efficiency rate of 15-20 percent. Improving the efficiency of preparedness kits by further adaptations of capacities or technology might supersede emergency response operations or even the smallest response kit.

Cooperation with the IFRC enables direct influence of research output on location and configuration of global water and sanitation kits systems. Results of JOHNSON et al. (2008) about the feasibility of water purification technology in rural areas of developing countries will be useful for adaptations in the supply sector.

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12. List of Figures

13. List of Charts

14. Appendix

Questionnaire for the Optimisation of WatSan-Kits

Please check the corresponding answers in the charts (by inserting an “X”) and answer the open questions. It would be great if you could return the questionnaire to markus.enenkel@gmx.at as soon as possible. All boxes expand as you write in them. You can also add information to boxes that you mark with an “X”. Please do not hesitate to ask if there are any questions.

Cochez s’il vous plaît la case de la réponse correspondante (en insérant un « X ») et répondez aux questions ouvertes. Retournez le questionnaire à markus.enenkel@gmx.at le plus vite possible. Toutes les cases s’agrandissent lorsque vous écrivez vos réponses. Vous pouvez aussi rajoutez des informations dans les cases dans lesquelles vous avez inséré un « X ». En cas de questions n’hésitez pas à me contacter.

	Yes/Oui	No/Non
Is your WatSan-Kit located in a disaster prone area? (Please consider past incidents, local capacities and conditions) Est-ce que votre WatSan-Kit se trouve dans une zone de catastrophe naturelle ? (Considérez SVP des incidents passés, les capacités et conditions sur place)		

If the answer is “NO”: Why is the location not appropriate?

Si la réponse est “NON”: Pourquoi le lieu de montage n’est pas approprié?

If the answer is “NO”: Which location would be better and why?

Si la réponse est “NON”: Quel lieu de montage serait mieux et pourquoi ?

	very good (fully functional) très bon (complètement	good (little damage, operation possible) bon (peu	bad (severe damage, operation hardly possible) mauvais	very bad (not functional) très mauvais

	utilisable)	d'endommagement, manœuvre possible)	(des endommagements sévères, la manœuvre est à peine possible)	(inutilisable)
Your kit's condition is… L'état de votre kit est…				

	every week chaque semaine	every 1 to 3 months tous les 1 à 3 mois	every 4 to 6 months tous les 4 à 6 mois	every year une fois par année
How often do you practice? Combien de fois l'utilisez-vous?				

	Yes/ Oui	No/ Non
Is that sufficient? If not, why? Est-ce que cela est suffisant ? Si non, pourquoi ?		

	Yes/ Oui	No/ Non
Was the kit already used in a disaster situation? Est-ce que le kit a déjà été utilisé dans une situation de catastrophe naturelle ?		

	very good/ très bien	Good/ bien	Bad/ mal	very bad/ très mal
If the answer is "YES", how did the system				

perform? Si la réponse est “oui”, quelle était la performance du système ?				

What are barriers for using WatSan-Kits? (multiple choices possible)

Quelles sont les barrières empêchant l’utilisation de WatSan-Kits? (plusieurs réponses possibles)

Lack of personnel for training Manque de personnel d’entraînement	
Lack of personnel for maintenance Manque de personnel de maintenance	
Lack of personnel for operation Manque de personnel opérationnel	
Insufficient support from the Federation Soutien insuffisant de la fédération	
The kit-system is too complicated Le système du kit est trop compliqué	
The kits are too difficult to transport Les kits sont trop difficiles à transporter	
Lack of spare parts Manque de pièces d’échange	
Other reasons: Autres raisons:	

Are there more efficient approaches than WatSan-Kits used in an emergency situation? If yes, please name them.

Existe-t-il d'autres approches plus éfficaces que les WatSan-Kits utilisés dans une situation de secours ? Si oui, lesquelles ?

	Yes/ Oui	No/ Non
Do the kits contribute to a feeling of preparedness? Est-ce que le kit vous donne un sentiment d'être bien préparé?		

Further comments on the kit's overall performance:

D'autres commentaires sur la performance générale du kit :

Thank you for answering the questionnaire. You will be informed about the results.

Merci beaucoup pour vos réponses. Vous serez informé sur les résultats.

15. Curriculum Vitae

Date of birth:	25.12.1984
Place of birth:	Eisenstadt/Austria
Parents:	Inge and Kurt Enenkel
Education:	1991 – 1995: Elementary School in Neufeld/Leitha
	1995 – 2003: School Leaving Examination at
	BG Babenbergerring in Wiener Neustadt

Actual Educational Status:

October 2009 – June 2010

Advanced Training Course as certified Environmental Consultant

(University of Natural Resources and Applied Life Sciences)

June 2009 – Mai 2010

Work on Diploma Thesis, Temporary Title: “Optimisation of Preparedness Measures towards lower long-term Vulnerability of natural Disaster-affected Communities”

June – November 2008

Joint-Study-Semester at Lincoln University New Zealand

Since October 2007

Joint Study Programme of Natural Resource Management and Ecological Engineering (University of Natural Resources and Applied Life Sciences)

From 2004 - 2007

Bachelor in Environmental- and Bio-Resourcemanagement

(University of Natural Resources and Applied Life Sciences)

Bachelor Thesis on Disaster Management

Work Experience:

Since March 2008	Member of the Task Force “Right to Food”, an informal consulting group of Austrian Ministries, NGOs and Scientists
January 2008- October 2009	Freelancer for “RideOnTime”, Collaboration for the relaunch of the PR-concept of the Viennese Transportation Services. Journalistic Fields: culture and environment
2005 – 2008	Consultant of the Federal Agency for Health and Family
2005 - 2007	Representative for Bio-Resourcemanagement at the University of Natural Resources and Applied Life Sciences Vienna
January 2007-January 2008	Project Management, Multimedia Support for Alchemia Nova, a private research institute (Phyto-Chemistry)
August 2006	Editor for a TV-production on VOX (Bach Film Germany)
Juli 2006	Internship at the Federal Ministry of Agriculture, Forestry, Environment and Water Management - Department of environmental Technologies
March 2006	Course for ECR (Efficient Consumer Response)-Management at the University of Business and Economics
Summer 2004 and 2005	Bilingual (German, English) Tourist Guide at the Viennese Prater
March-September 2005	Callcenter Agent for Picha Communications Vienna
Oktober 2003-September 2004	Civilian Service at Institute Keil in Vienna (Work with heavily disabled children)
Summer 2001, 2002 and 2003	Work Experience at the „Neufelder Seebetriebe“

Languages:

English	fluently – Camebridge Certificate in Advanced English, I spent eight Months in Los Angeles, New Zealand and Australia
French	spoken and written, University Courses in technical language

Wien, 14.05.2010 gez. Univ.-Prof. Dipl.-Ing. Dr.nat.techn. R. Haberl