INTER-AMERICAN DEVELOPMENT BANK
REGIONAL POLICY DIALOGUE
NATURAL DISASTERS NETWORK
III MEETING

COMPREHENSIVE RISK MANAGEMENT BY COMMUNITIES AND LOCAL GOVERNMENTS

COMPONENT III: INDICATORS AND OTHER DISASTER RISK MANAGEMENT INSTRUMENTS FOR COMMUNITIES AND LOCAL GOVERNMENTS

Herwig Hahn

Juan Carlos Villagrán De León

Ria Hidajat

Deutsche Gesellschaft für

Technische Zusammenarbeit (GTZ) GmbH

International Services

Preliminary Draft

Washington, D.C., 6 y 7 de marzo de 2003

Note: This document is part of a series of papers commissioned by the Inter-American Development Bank for the Regional Policy Dialogue. This document is under review, therefore it should not be cited as reference. The opinions expressed herein are solely those of the author and do not necessarily reflect the position of the Bank.

Preface

In the third phase of the Regional Policy Dialogue on disaster risk management, the Inter-American Development Bank (IDB) requested the Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation Agency, GTZ) to conduct a study on "**Comprehensive Risk Management by Communities and Local Government**", with the purpose of suggesting strategies and measures to strengthen local actors for disaster risk management. This analysis is based upon the results of studies carried out in the two previous phases of the Dialogue regarding institutional (Freeman and Martin 2001) and financial mechanisms (Freeman and Martin 2002) at the national level. The present study is divided in four components:

Component I: Institutional Aspects of Local Government Disaster Risk Management

Component II: Capacity Building and Technical Assistance for Disaster Risk Management at a Community Level

Component III: Indicators and other Disaster Risk Management Instruments for Communities and Local Governments

Component IV: Ex-ante and Ex-post Financial Considerations for Local Government Risk Management Capacity

The consultant team combined two approaches to the study: an analysis of existing concepts at the global level with emphasis on Latin America and case studies based on country-specific experiences. Case studies have been prepared by national experts in the countries of Latin America, Europe, and Asia with the goal of analyzing national and local systems and practices in disaster risk management. These approaches have enabled the team to take into account a wealth of contextual and conceptual information, in addition to their practical applications. Appraising strengths and weaknesses of disaster risk management systems through these case studies also facilitated outlining the recommendations and models appropriate for disaster risk management in Latin America and the Caribbean, where local actors play a crucial role.

Although separate reports have been prepared for each component, the consultant team has ensured a conceptual integrity and coherence among the four components through pursuing similar approaches and common concepts.

The aim of this study is strengthening local governments, institutions and communities for undertaking disaster risk management, and establishing their complementarity in the national disaster management system. It is important to recognize the importance of local resources and initiatives in assessing the national capacity for disaster risk management.

With this underlying objective, it is necessary to consider that the effectiveness of local actors depends on the existence of appropriate national frameworks for disaster risk management. Local actors derive their role, authority, and resources from institutional, legal, and financial frameworks established at the national level.

The concept of risk management applied in the study embodies: prevention, mitigation, preparedness, response, rehabilitation, and reconstruction. Within this approach, it considers as essential the analysis of risks as the basis to identify and define appropriate measures for reducing risks. The understanding of these elements, as well as the concept of strengthening of capacities in this area is based on the definitions contained in the preliminary version of the survey of global initiatives in disaster reduction prepared by the International Strategy for Disaster Reduction (ISDR) published in the year 2002 (ISDR 2002).

Table of Contents

Appendices

List of Acronyms

CONRED	Coordinadora Nacional para la Reducción de Desastres
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit German Agency for Technical Cooperation
FEMID	Fortalecimiento de Estructuras Locales parar la Mitigación de Desastres
IDB	Inter-American Development Bank
IDNDR	International Decade for Disaster Reduction
IGN	Instituto Geográfico Nacional.
INSIVUMEH	Instituto Nacional de Sismología, Vulcanología, Meteorología e Hidrología
ISDR	International Strategy for Disaster Reduction
MAGA	Ministerio de Agricultura, Ganadería y Alimentación
SEGEPLAN	Secretaría de Planificación y Programación de la Presidencia.
UNDHA	United Nations Department of Humanitarian Affairs

1 Executive Summary

To improve the capacity of communities and local governments to measure key elements of their current disaster risk, a community based indicator system was developed. Using indicators on community level in this context is a rather new and innovative approach.

The established conceptual framework systemizes the key elements of risk management into the factors of Hazard, Exposure, Vulnerability and Capacity & Measures. The framework helps to understand the driving forces (factors) at work and served to identify appropriate indicators. The resulting indicator system comprises a total of 47 individual indicators arranged according to the identified four factors and are further broken down into factor components.

The indicator selection and formulation was guided by the philosophy of the system to be applicable in data-scarce environments. Consequently, a questionnaire was developed to collect all necessary information for the indicators from knowledgeable people on community level. Scientific survey data can support this information, but is not essential.

The information generated by the indicator system supports decision-makers on local and national level to analyze and understand the disaster risk a community is exposed to. The identified vulnerabilities and deficits in capacities and measures indicate areas of intervention for disaster risk reduction. Regular application of the indicator system will allow to monitor changes over time as a measure of evaluation of initiated policies and interventions.

A case study analysis in two countries was conducted to learn about existing approaches on communal disaster risk management, to test the applicability of the indicator system and to illustrate its feasibility and the usefulness of the results.

Also a proposal is discussed to use the indicator system as the basis for an indexing system that would condense the technical and individual information of the indicators into summary figures of easy to understand scores of Hazard, Exposure, Vulnerability and Capacity & Measures. Such an index would allow to directly compare different communities and would facilitate interpretation of the data.

2 Introduction

In the context of the IDB study "Comprehensive Risk Management by Communities and Local Governments", this report presents the results of Component III: Indicators and other Disaster Risk Management Instruments for Communities and Local Governments.

The report builds on the basic understanding on disaster risk management reached at the "First Natural Disaster Dialog Meeting" on "Managing Economic Exposure of Natural Disasters" of the Inter-American Development Bank (IDB). (see Andersen 2001).

Special attention was given to the UNDP effort to produce a Global Risk Vulnerability Index as part of the forthcoming World Vulnerability Report.

Cooperation was also sought with the IDB project on "Information and Indicators Program for Disaster Risk Management", with component II being executed by the national University of Colombia.

2.1 Objectives

Elaborating on the TORs, the purpose of this study is to propose a methodology on community and local government level, that can guide decision-makers to reduce and manage risk to natural disasters.

Expected benefit of this study is to develop a methodology, based on a set of indicators, that will

- systemize and harmonize the presentation of risk information from community level,
- improve the capacity of decision-makers on local and national level to measure key elements of disaster risk and vulnerabilities towards risk of communities,
- provide comparative parameters to monitor changes in disaster risk, as a measure of evaluation of effects of policies and investments in disaster management, and
- point at the major deficiencies in confronting natural disasters and thus indicate possible areas of intervention.

2.2 General Concepts on Disaster Risk Management and Indicators

There are various approaches to conceptionalize risk in the context of natural disasters with differing and sometimes contradicting definitions. However, there is a convergence towards the understanding of *risk* being the "probability of harmful consequences, or expected loss (of lives, people injured, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between *natural hazards* and *vulnerable/capable conditions*. An actual impact with consequences or losses that exceed the ability of an affected community or society to cope using its own resources, is termed a *disaster*." (ISDR 2002, p. 24).

Disaster risk management is about the development and application of policies, strategies and practices for disaster risk reduction. It aims to minimize prevailing conditions of vulnerability, to avoid (prevention) or to limit (mitigation) adverse impact of hazards, to respond to emergencies and act in the aftermath of disasters (rehabilitation and reconstruction). (see ISDR 2002).

It is only recently that systematic work on indicators on risk management has started. In 2001 UNDP began to develop a vulnerability risk index for least developed countries and is currently preparing a World Vulnerability Report (see ISDR Inter –Agency task Force: Working Group 3; ZENEB 2002). The Global Vulnerability Index will compare countries according to their level of risk over time. The index will identify countries' social and economic vulnerabilities, along with hazards caused by natural conditions and human activities that contribute to risk. Other prominent (inter)national publications are the annual World Disaster Reports of the International Federation of Red Cross and Red Crescent Societies and the annual reports of the internationally active re-insurance company Munich Re Group. However, the presented statistics of both institutions are limited to the impact of past disasters and do not consider vulnerabilities or capacities.

While the UNDP exercise is a purely (inter)national approach there are only some risk assessment models described in literature that appear to be in use by emergency managers and practitioners at commune level. A recent review of those has been undertaken by Pearce (Pearce 2000).

Contrary to national risk assessments that are based on existing highly aggregated statistical data, community based risk and vulnerability assessment approaches are process oriented. They are geared towards specific intervention planning and can stretch over various month with intensive broad-based involvement of the community. They are mostly based on checklists and have neighborhood or even household focus. The employed (subjective) appraisal methods do not allow to use the results for a comparison of different communities nor are they consistent and structured enough serve as a monitoring tool.

The proposed indicator based vulnerability and risk assessment approach on community level, with its intended benefits, can therefore be seen as a truly pioneering exercise. An indicator based system is, however, an analytical and not an implementation tool. It can be seen as an initial step that is followed by a detailed (participatory) intervention planning.

2.3 Approach

A systematic review of literature identified the factors that determine the loss of lives and lead to material damages during hazards in Latin America. These factors were organized into a conceptual framework (see chapter 3.1). In a second step, suitable indicators were chosen to represent the identified factors (see chapter 3.2). This set of indicators allows to measure key elements of disaster risk communes are facing.

There are five criteria that were used to select the indicators for the identified key element. Each one is presented below along with an illustrative question in guise of an explanation:

- Validity - Does it measure the key element under consideration?
- Reliability - Is it a consistent measure over time?
- Sensitivity - When the outcome changes will it be sensitive to those changes?
- Availability - Will it be easy to measure and collect the information?
- Objectivity – Can the data be reproduced under changing conditions?

Specific consideration was given to the requirement of the indicators to be easily applicable in data-scarce environments by communities and local authorities. To this end required key information was defined to be available from knowledgeable people on community level. A questionnaire collects the information. Scientific survey data can support this information, but is not essential.

To be able to indicate to communes their current position regarding various risk factors and their performance in risk reduction, each indicator comes with cut-off-points that group the communities' indicator value into a high, medium or low category.

An indicator system can be made especially useful for policy decisions if it feeds into an indexing system that can be used to compare different communes across a country and monitor progress of risk management policies and measures. This is accomplished by simplifying the interpretation of data, condensing often technical information to summary figures. Some ideas towards an indexing system are presented in chapter 3.5.

Using case studies from Guatemala and Switzerland, employed risk and vulnerability assessment methods are described. At the same time the elaborated indicator system is applied and validated.

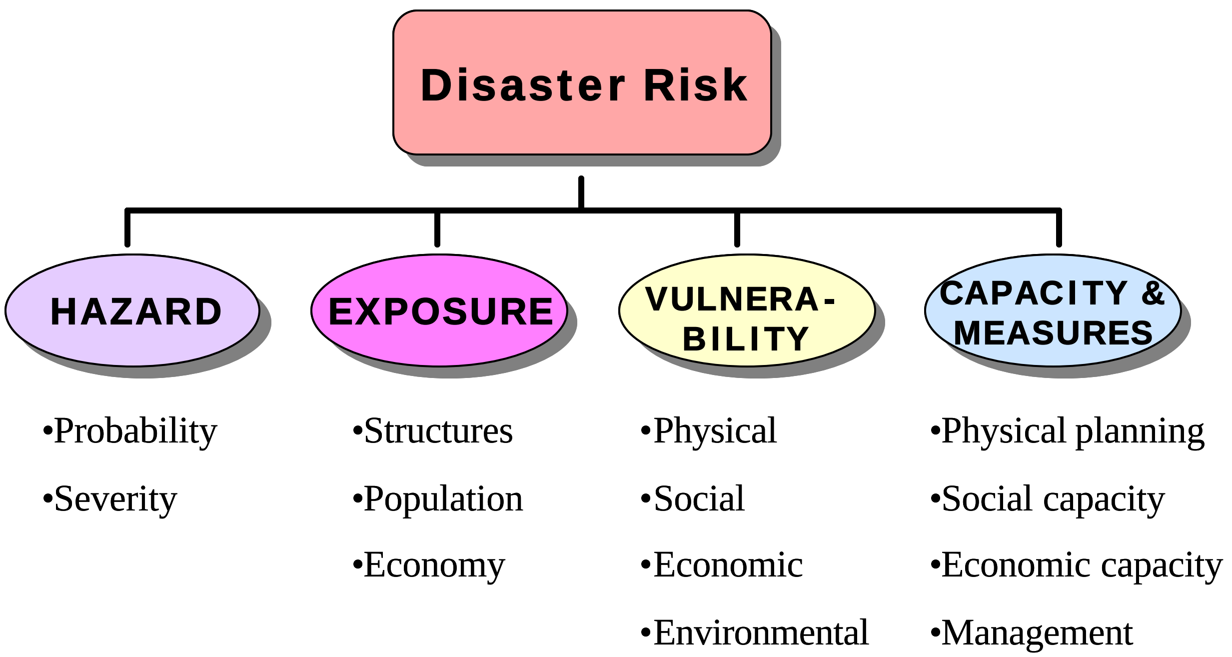
3 Community Based Indicator System

3.1 Conceptual Framework

For the conceptual framework, those main factors were identified that are believed to determine disaster risk at commune level in Latin America. These are: Hazard, Exposure, Vulnerability and Capacity & Measures. The underlying understanding is that in order to manage risk, decision makers and local communities need to understand the threat posed by a *hazard*, the magnitude of lives and values *exposed* to the threat, the specific susceptibility towards hazards through present *vulnerabilities*, and the range of *capacities & measures* to protect against risk.[1]

These four factors are suggested to form a conceptual framework (see graph 1) that subsequently provides the rational for the choice of indicators to be included in the risk analysis.

Graph 1: The Conceptual Framework



[1] ISDR acknowledges capacity as a key factor in the disaster risk formula. The incorporation of vulnerability and capacity into tools such as risk indexes, along with clear targets or benchmarks and indicators, will engage the work towards highlighting disaster risk efforts. The Global Risk Vulnerability Index under development by UNDP, as well as the framework to monitor progress on risk reduction, being developed by ISDR, are good examples of current efforts towards that objective. (ISDR 2002, p.78).

3.2 The Indicators

The presented indicators were selected according to the established framework applying the criteria of suitable indicators established under 2.3.

The indicator selection took not only existing work into consideration, but also builds on experiences gathered with implementation in Latin America, Asia and Europe. The limitation of existing work is that collected data is rather descriptive than analytical and gathered in different ways, making comparisons difficult. They also are applied either on the micro-scale, with extreme focus on local detail (individual and household level) or on a national or regional scale where data is so aggregated and generalized that the underlying processes are difficult to discern (see Vogel 1997).

A comprehensive community level indicator system to measure key elements of disaster risk and changes in that risk is therefore a rather new and unique exercise. Basic idea behind is to establish a "baseline" assessment of the hazards, exposure and current vulnerabilities and capacities, so that possible future changes can be captured and ideally tied to applied policies and measures.

Table 1 presents the indicator system grouped according to the main factors and factor components and names the indicators. The indicators itself with the suggested measurements are detailed in separate Indicator Description Sheets to be found in appendix 1: Application Guide and Indicator Explanation, which also discusses rational and validity of the indicators to make them operational on community level. To gather the data for the indicators a questionnaire was developed to be administered to the communes. It can be found in appendix 2: Questionnaire.

For each indicator cut-off-points are then provided that result in low/medium/high classes for each indicator. This gives the local level an immediate feedback whether their community is at the lower, medium or upper level regarding each captured aspect. This also creates an immediate awareness e.g. about existing vulnerabilities or deficits in capacity.

In the following chapters the rational of the conceptual framework and the logic behind the selected indicators are discussed.

Table 1: Set of Community Based Disaster Risk Indicators

Main Factor	Factor Component	Indicator Name
HAZARD		
	Probability	(H1) Occurrence (experienced hazards) or (H2) Occurrence (possible hazards)
	Severity	(H3) Intensity (experienced hazards) or (H4) Intensity (possible hazards)
EXPOSURE		
	Structures	(E1) Number of housing units (E2) Lifelines
	Population	(E3)Total resident population
	Economy	(E4) Local gross domestic product (GDP)
VULNERABILITY		
	Physical/demographic	(V1) Density (V2) Demographic pressure (V3) Unsafe settlements (V4) Access to basic services
	Social	(V5) Poverty level (V6) Literacy rate (V7) Attitude (V8) Decentralization (V9) Community participation
	Economic	(V10) Local resource base (V11) Diversification (V12) Small businesses (V13) Accessibility
	Environmental	(V14) Area under forest (V15) Degraded land (V16) Overused land
CAPACITY & MEASURES		
	Physical planning and engineering	(C1) Land use planning (C2) Building codes (C3) Retrofitting/ Maintenance (C4) Preventive structures (C5) Environmental management
	Societal capacity	(C6) Public awareness programs (C7) School curricula (C8) Emergency response drills (C9) Public participation (C10) Local risk management/ emergency groups
	Economic capacity	(C11) Local emergency funds (C12) Access to national emergency funds (C13) Access to intl. emergency funds (C14) Insurance market (C15) Mitigation loans (C16) Reconstruction loans (C17) Public works
	Management and institutional capacity	(C18) Risk management/emergency committee (C19) Risk map (C20) Emergency plan (C21) Early warning system (C22) Institutional capacity building (C23) Communication

3.2.1 Hazard

Hazard stands for the threat a community is facing resulting from a possible occurrence of a natural phenomenon (flood, earthquake, etc.). It is determined by its probability and severity exhibited at a certain location. (among others: ISNDR 2002). According to their importance in Latin America floods, storms, earthquakes, landslides, droughts, and volcanic eruptions are considered (see Chaveriat 2000).

The "occurrence (experienced hazard)" (H1) reflects the history of an event and gives us thus an indication of the frequency/probability. As an alternative the "occurrence of a possible hazard " (H2) indicator can be used, which reflects the probability of a hazardous event the community might not be aware of, because it is without historical precedent or has occurred more than a generation ago and might thus not be remembered. This information has to come from scientific sources.

The severity of natural hazards is usually measured for a specific location applying hazard specific scales (e.g. the Richter scale for earthquakes, Beaufort wind strength, 100 year floodplain level etc.). Given the data scarce environment and to obtain a common denominator to make different hazards comparable, instead of different hazard specific scales, a "proprietary" intensity scale is used ("intensity" (H3) or (H4)). Produced destruction serves as a proxy for the intensity of a hazard. To capture multi-hazard environments all experienced events are assessed separately one after the other.

3.2.2 Exposure

Exposure describes the people (population), the value of structures (structures) and economic activities (economy) that will experience hazards and may be adversely impacted by them. Exposure will indicate the decision makers what is at stake if disaster hits, for it makes a difference if a small community or a big city is threatened by a hazard.

Exposed structures are assessed in a simplified manner by considering the number of "housing units " (E1) only. Main interest is in magnitude and not in actual economic values. Since industrial sites, public infrastructure etc. is assumed to grow proportionately with the housing units, no additional indicators are used to capture them. "Lifelines" (E2) at stake are gauged by the availability of piped water in houses that also reflects the development level of a community. The indicators is supposed to represent also other lifeline services such as electricity, sewage and communication. The indicators of "total population" (E3) and "Local gross domestic product GDP" (E4) for the economic exposure are self-explanatory.

3.2.3 Vulnerability

Vulnerability lists a number of factors that represent the susceptibility towards a hazard grouping it into physical, economic, social and environmental vulnerabilities.

The term "vulnerability" is used in a very large number of ways depending on the audience and decisions in question. ISDR (2002) defines vulnerability as "a set of conditions and processes resulting from physical, social, economical and environmental factors, which increase the susceptibility of a community to the impact of hazards". For our purpose we identified a number of structural key vulnerability components, that influence the probability of a community to suffer human and material damages when exposed to a natural threat. The extent of such damages can, in turn, be reduced by approaches that were grouped under Capacity & Measures (see chapter 3.2.4).

Physical/demographic Vulnerability

As the main physical vulnerability the "density" of the population (V1) is seen. When people are concentrated in a limited area, a natural hazard will have a greater impact than if people are dispersed. Closely linked is the "demographic pressure (V2)" expressed as the population growth rate. Population pressure, especially as in-migration to urban areas, is seen as a main contributor to unsafe living conditions in terms of location, building standards, service provision and social infrastructure. Directly at risk are those parts of the population living in unsafe settlements in high risk areas such as along river shores or steep slopes ("unsafe settlements" (V3)) and in more general terms, those parts that lack "access to basic services (V4)".

Social Vulnerability

Besides the fact of people in general being exposed to a hazard, most of the literature on vulnerability identifies the aged, the very young, the poor, the socially and physically isolated, the disabled and ethnic groups as being particularly vulnerable (see Buckle 1998). In the current approach, for simplicity reasons, it is argued that good proxies to cover all the above mentioned main dimensions of vulnerability of groups within a community are the "poverty level" of people (V5) and the education ("literacy rate" (V6)).

An important factor that drives the response towards risk is the perception of risk and the priority it is given to. "Attitude" (V7) tries to capture this aspect. The more decentralized a system is, the better it can react on risk management needs. The chosen "decentralization" indicator (V8) measures the portion of own revenues as a part of the total local budget. There is evidence that the more a society is allowed to participate in decision making and thus being in a process of democratization and empowerment, the less vulnerable they are towards suffering from disaster. Without being able to clearly determine the exact driving forces behind this processes of "community participation" (V9) a proxy indicator to capture this effect might be the voter turnout at community elections.

Economic Vulnerability

The "local resource base" (V10) expressed as the total available local budget is a key aspect to determine the strength of a community to cope with a disaster. The less diverse a society is, the higher is the susceptibility also in the medium and long run to recover from a disaster. This is summarized by the "diversification" indicator" (V11), asking for the mix of sectors income stems from. Recent studies indicate[2] that small businesses (fewer than 20 employees) are particularly vulnerable to disaster impacts and losses because they have relatively low levels of disaster preparedness and relatively little capacity to recover. Vulnerability of economic activities, therefore, is represented by the indicator of "small business" (V12), expressed as percentage of businesses with fewer than 20 employees. Communes in danger of being isolated are more vulnerable when it comes to evacuation, emergency support or flows of goods and services in a post disaster situation. This aspect is reflected in the "Accessibility" (V13) indicator, measuring previous occurrences of interruptions of physical access in the last 30 years.

Environmental Vulnerability

Environmental vulnerabilities are hazard specific. While there is little vulnerability towards earthquakes and volcanic eruptions, landslides and hydro-meteorological hazards are favored by poor ecological environments, specifically a lack of "area under forest" (V14) and "degraded land" (V15) that determine the rain absorption capacity of the soil. A potential vulnerability is indicated if agricultural land is overused threatening the sustainability of production. The percentage of overused agricultural "overuse" (V16) captures this effect.

3.2.4 Capacity & Measures

Without hazard assessments, exposure measures and vulnerability studies, communities will not know in what way they are vulnerable and how hazards may affect them.

---

[2] Cited after Davidson and Lambert (2001) who make reference to Alesch et al. (1993) "earthquake risk reduction and small businesses" proc. 1993 Nat. Earthquake Conf. Monograph 5: socioeconomic impacts, K.J. Tierney and J.MM. Nigg, eds., Central United States earthquake Consortium, Memphis, Tenn, 133-160. and Tierney, K. J., and Dahlhamer, J. M. (1998). ''Earthquake vulnerability and emergency preparedness among businesses.'' Engineering and socioeconomic impacts of

Vulnerability and capacity are closely linked and can in fact not be separated since an increase of capacity means at the same time a decrease of vulnerability. Measures that reduce the vulnerability also reduce the disaster risk.

The distinction made in this approach groups structural factors under vulnerability, while those factors that can actively be influenced were placed under the heading Capacity & Measures. While Vulnerability focuses on the underlying factors of a community's vulnerability (inherent weaknesses, structural factors etc.), Capacity & Measures is about measures of prevention, mitigation, preparation, response and rehabilitation & reconstruction grouped into the thematic rather than chronological topics of (1) physical planning and engineering, (2) management and institutional capacity, (3) economic capacity and (4) societal capacity. They reflect all policies, systems, kinds of public and private investment on community level that help to prevent disaster, mitigate their effects, prepare society to cope with extreme events and assist victims to recover. (see Wisner 2000). In this way the Capacity & Measures indictors will point to the risk reducing potential of a community, which is directly addressable.

Indigenous strategies to deal with disaster are not explicitly considered. They are very diverse, hard to identify and often location specific only. While these strategies play an important role in the intervention planning and need to be carefully analyzed, for an community level risk assessment their omission does not really pose a problem, since we only underestimate the actual capacity.

Basic idea behind the Capacity &Measures indicators is the assumption that there is a limited number of interventions that can improve the risk reducing capacity. Assessing them over the years will directly indicate the progress made by policies that should subsequently lead to a reduction of vulnerabilities and risk.

The capacity status is assessed in form of questions. In addition to asking whether a certain factor is present, a qualitative judgment is required that gives information on the expected performance or impact of the factor; e.g. the mere existence of an emergency plan will not reduce the risk unless relevant institutions are informed and regular drills show that the plan is working.

earthquakes, M. Shinozuka, A. Rose, and R. T. Eguchi, eds., Multidisciplinary Center for Earthquake Engineering Research, Buffalo, 53–72.

Physical Planning and Engineering

"Land use planning" or zoning (C1) keeps away production and buildings from hazard prone areas such as flood plains and thus reduces the impact of disasters. "Building codes" (C2) influence the way buildings are constructed to make them more resistant to disaster. "Retrofitting/maintenance"(C3) has the same effect, but applies to buildings already in place. "Preventive structures" (C4) are build to directly limit the impact of a hazard (e.g. dykes, retaining walls, dams, barrages etc.). The "Environmental management" indicator (C5) stands for proactive measures that can positively impact on the severity of an impact and does also reflect a heightened awareness of the role the environment plays.

Societal Capacity

Societal capacity is about awareness and participation. Awareness has to do with education and a culture of risk management. The indicators represent to which degree the public understand the dangers associated with hazards and how to prepare for and respond to them. Key indicators are whether "public awareness programs" are carried out (C6), whether risk management is part of the "curricula in schools" (C7), whether "emergency response trainings (drills)" (C8) are conducted and whether a broad "participation" (C9) of society in tasks of risk management is searched for and whether "local risk management/emergency groups" (C10) exist.

Economic Capacity (Risk Transfer)

It is often not possible to eliminate completely the vulnerability of key assets either because some assets, due to their function or to prior location decisions, are located in hazardous areas or because retrofitting is too expensive. In such cases it is important to reduce financial risk through risk transfer mechanisms, which ensure that funds are readily available to rectify the damage or replace the facility, should a loss occur (Worldbank 2002).

Classical instruments of risk transfer are access to local, national and international "emergency funds" (C11, C12, C13) and insurances for house owners through an "insurance market" (C14). Loans for "mitigation" (C15) and "reconstruction" (C16) are well known financial instruments to protect loss of assets. "Public works" programs (C17) can be used for a wide variety of risk reducing measures, reflecting the strength and willingness of a local government to act.

Management and Institutional Capacity

Prerequisite for a coordinated effort on community level is the existence of a functioning "risk management/ emergency committee" (C18). The "existence of a risk map" (C19) already represents a major step towards systematically tackling risk. An "emergency plan" in place (C20) reflects an active administration and is an important element to reduce human losses. Into the same direction works an "early warning system" (C21). "Institutional capacity building" (C22) is a cornerstone of activating and improving performance of existing institutions like police, fire brigade, hospitals etc. for risk management. Established "communication" (C23) reflects the important link to national institutions, not only in case of an emergency.

3.3 Application

The use of the indicator system is described in appendix 1: Application Guide. All information is supposed to be collected on community level using a questionnaire (see appendix 2: Questionnaire). It can be completed and verified through information from secondary sources. To get reliable information a group of knowledgeable people on local level should be called together. They should include formal and informal community leaders (like the governor, mayor, administrative heads, elders, etc.), members of risk management groups, historians, representatives from the public and the private sector (factory owners, architects, etc.) and also from marginalized and thus vulnerable groups.

By systemizing the information into the four factors, the driving forces behind risk on commune level becomes obvious. The provided cut-off-points for each indicator gives the community an immediate feedback whether they are at the lower, medium or upper level regarding each captured aspect.

Based on that insight, further assessment steps can be initiated to plan necessary key interventions. Subsequently, regular application of the indicator system will allow to monitor changes in identified risk vulnerability and capacity deficiencies as a measure of evaluation of initiated policies and interventions.

3.4 Limitations

The advantage of a systematic indicator system based on a direct questionnaire approach on commune level is especially convincing in data scarce environments. However, there are some issues that merit consideration.

The selected indicators only approximate or interpret a complex situation we would like to measure. They are not really a measure of the situation itself. Although the indicator set has been condensed from past experience and current research, the combination and use of such an indicator system is new. It is based on the hypothesis that the indicators we have put into the conceptual framework pick up the determining forces and give us thus a proper image of the existing risk. Only a test application can validate the indicators for suitability and policy sensitivity.

The defined cut-off-points for the low/medium/high grouping of indicator values are rather subjective and need to be adjusted for the specific geographical and cultural context of each country. The challenge is to define sensible low/medium/high groups that actually reflect qualitative differences in these groups. Experience has to be gathered on this aspect.

The data comes from selected people on commune level. The quality of the data will therefore depend on the knowledge of those people. While most of the information can be validated through statistical sources (e.g. density, budget etc.) some information is qualitative and depends on the subjective assessment of the respondents (e.g. environmental management: many/some/few). This is especially then critical if the system is used to monitor progress and distinctive interests could bias the answers. It is therefore important to have a well composed respondent group and to come to a standardization of procedures and measurements.

For the application we have to bear in mind that the indicator system is only one element within a comprehensive risk management approach. It documents the current situation of a commune. For actual intervention planning additional (participatory) location specific analysis on hazards and vulnerabilities is necessary. Risk maps e.g. are in addition suitable tools to illustrate results.

A meaningful comparison between communities can only compare those affected by the same hazards. This is because many indicators are hazard specific. A "low" vulnerability rating for the "area under forest" (V14) has not the same meaning for drought than it has for floods or land-slides. Also is the lack in capacity of an "early warning system" (C21) for earthquakes acceptable (because of unpredictability of earthquakes), while it is very important for floods. This shortcoming can be addressed through an indexing system that used hazard specific weights, as it is proposed in the following chapter.

3.5 Towards a Community Disaster Risk Index

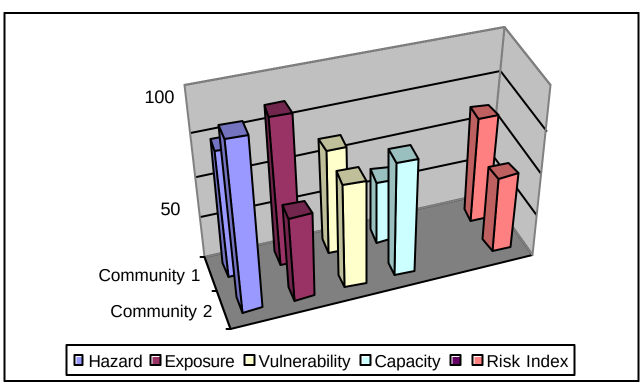
The indicator system gives a good insight into the current situation of a community regarding the risk determining factors and allows to trace changes in those factors over time. However, to be able to compare different communities and to facilitate interpretation of the data, an indexing system is proposed that will condense the technical and individual information of the indicators into summary figures. See appendix 3: Towards a Community Disaster Risk Index.

Indices are appealing because of their ability to summarize a great deal of often technical information about natural disaster risk in a way that is easy for non-experts to understand and use in making risk management decisions.

Basic idea is that each indicator is given a value of 1,2 or 3 according to the achieved range of low, medium or high. Since indicators have different meanings for specific hazards (e.g. "early warning" for foods and earthquakes), a hazard specific weight is then applied. The resulting values of the indicators of the four factors of the conceptual framework are then summed up into scores. Depending on the indicator measures the factor scores vary between 0 and 100. The overall risk index is derived from the factor scores using a small mathematical model. The factor scores and the risk index allow now to compare communes across different hazards.

An example on how a risk index could summarize and visualize the rather disperse information of the different indicators can be seen in graph 2.

Graph 2: Risk Index Comparison (Factor Breakdown) Between Two Communities



The first community has a lower Hazard risk but also a very low Capacity compared to the second community. This explains the overall higher risk index of the first community. The Exposure score indicates also much higher values are at stake for this community. The existing Vulnerabilities are about the same.

The suggested indexing system is not yet operational. Additional work is still needed to make it applicable. The basic idea, the procedures and main features are outlined in appendix 3: Towards a Community Disaster Risk Index.

4 Case Studies

4.1 Case Study Guatemala

4.1.1 Background

Guatemala has a population of 11.4 million, which are very unevenly distributed over its area of 108 889 km² resulting in an average density of 105 inhabitants/km². 40 percent of the population lives in cities. Population growth is a high 2.58 percent.

The country is a parliamentary democracy, administratively divided into 22 departments with a total of 331 municipal districts and more than 10.000 villages (aldeas). While governors at the level of departments are appointed directly by the president, mayors are elected by the population at the municipal level.

Decentralization efforts are ongoing, however, in the moment only a de-concentration can be observed, with many ministries and agencies having local branches, directed by the national level.

At this time there are two centralized institutions in charge of dealing with risk management. There is the National Coordination for Risk Reduction (CONRED, Coordinadora Nacional para la Reducción de Desastres) and the Secretary of Planning and Programming of the Presidency (SEGEPLAN (Secretaría de Planificación y Programación de la Presidencia). Assigned responsibilities overlap, but a division of work can be observed with CONRED being strong in preparedness and response, while SEGEPLAN is focusing on risk assessment and coordination of risk management measures.

Functions and responsibilities are not decentralized. For identified high risk areas a recent law stipulates that regional planning and land use planning has to be oriented towards risk reduction.

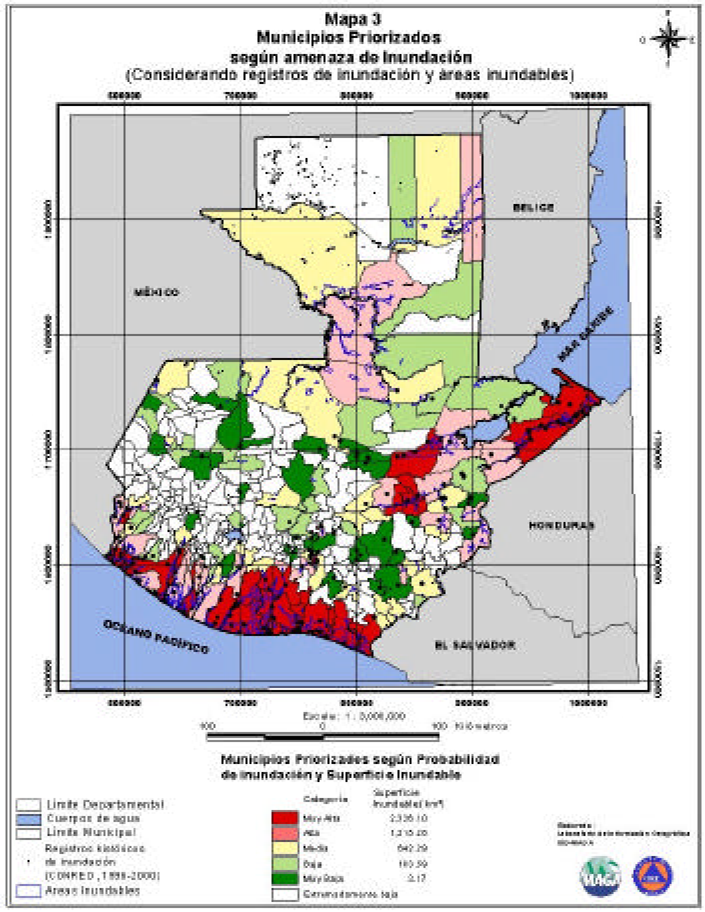
Risk management and risk analysis are rather new topics in the whole Latin American region and work on systematic methodology is still ongoing. Some approaches that have been used recently in Guatemala are presented below.

4.1.2 Hazard Assessment

In a joint effort in 2002 of the Ministry of Agriculture, Livestock and Food (MAGA, Ministerio de Agricultura, Ganadería y Alimentación) and the National Institute for Seismology, Volcanism, Meteorology and Hydrology (INSIVUMEH, Insituto Nacional de Sismología, Vulcanología, Meterología e Hidrología), national hazard maps of hydro-meteorological phenomena (drought, frost, flood and land slides) have been elaborated (MAGA, INSIVUMEH 2002). See map 1 for an example.

Also national hazard maps for earthquakes and eruptions of the volcanoes Fuego, Acatenango y Pacaya exist. Different methodologies based on scientific surveys have been used to produce these national level maps. The given level of detail unfortunately does not allow a sensible application of those maps on municipal level.

Map 1: Hazard Map for Floods at the Municipal Level for Guatemala.



Source: PEDE-MAGA 2002

Also there is currently work ongoing of hazard characterization for the central and southern region of the county as a joint effort of Japanese Cooperation, INSIVUMEH and the National Geographical Institute of Guatemala (IGN, Instituto Geográfico Nacional).

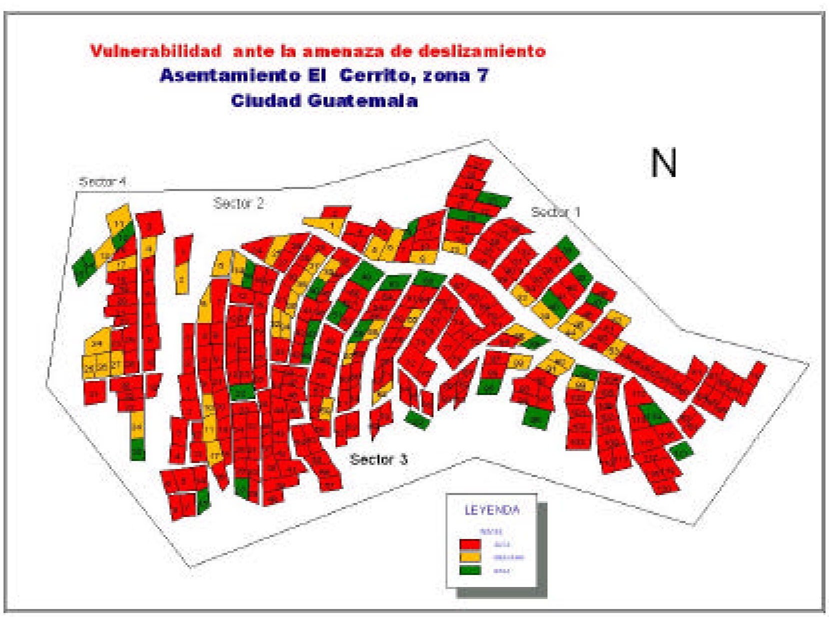
4.1.3 Risk Assessment

Compared to hazard assessments, risk studies are still in their infancy, specifically due to lack of methodologies to estimate or evaluate vulnerabilities. Only few surveys have been done that used own methodology to assess risk.

In a study of CONRED (2001), Dr. Juan Carlos Villagran developed a methodology to assess and analyze risk for a squatter settlement of the capital threatened by land slides. Own surveys on household level captured different vulnerabilities using the following indicators

- For structural and functional aspects of each home:
  - ?? the floor, wall and roof material,
  - ?? levels of availability for service like water and electricity.
- Vulnerabilities of incomes:
  - ?? Sources of income (number & type),
  - ?? Work place (at the location or elsewhere),
  - ?? Savings and assets (accounts, property).
- Social and community vulnerabilities:
  - ?? Age structure of household members.
  - ?? Communal infrastructure (access roads, water and electricity networks).

Map 2: Combined Vulnerabilities on Household Level of a Settlement



The map shows the result of the analysis, color coding each household to be highly, medium or little vulnerable to be affected by a landslide. Each vulnerability was given a score and entered with a certain weight into a total vulnerability score which was then grouped into low, medium and high levels.

Source: Perez 2001

Acción Contra el Hambre (2002) carried out a risk assessment of all 32 villages of the municipal district of Jocotán, Department of Chiquimula. The assessment focused on various types of hazards, including earthquakes, landslides, forest fires, floods, winds, and food security. Hazard mapping was subcontracted to a consultant from INSIVUMEH, and vulnerabilities evaluated through a household survey as well as an appraisal of the municipal administration.

Conceptually both risk assessment studies are on an individual/household level They are intervention oriented and required substantial investment in terms of time and money since a lack of detailed information to identify the vulnerabilities had to be overcome by own household level surveys. Without a common methodology for these kind of assessments and surveys the results can not be compared.

A community oriented approach on risk assessment using census data was carried out in 2002 by SEGEPLAN for the departments of Escuintla, Guatemala, Sololá and Sacatepéquez.[3] While the hazard information on landslides, volcanic eruptions, earthquakes and floods was gathered from various existing scientific sources, the vulnerability assessment was based on census data that came from the 1994 census and from an existing basic needs survey.

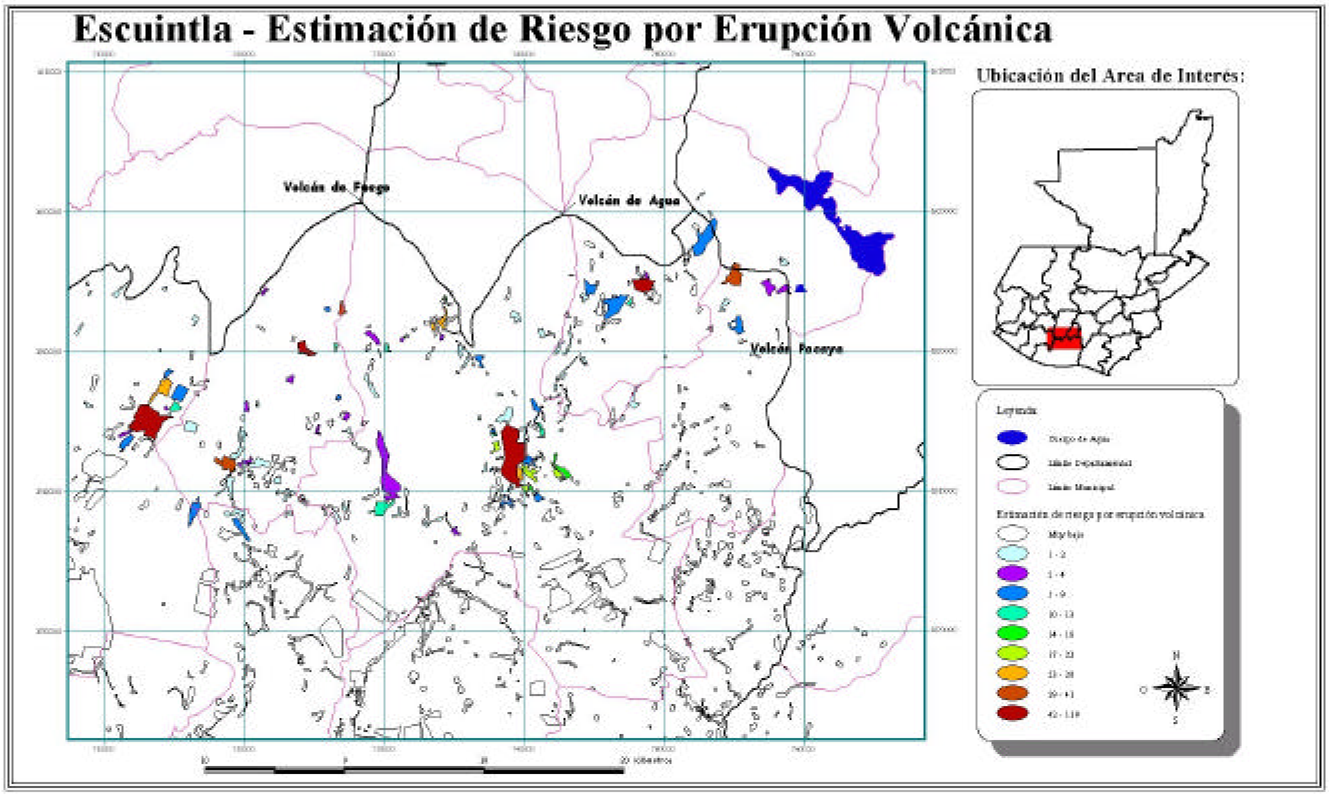
Two composit vulnerability indicators were constructed from available data. Structural/physical vulnerability was measured using census data on the material houses are built of (walls and roofs). Social vulnerability was measured using census data on population (growth rate, density, poverty, age distribution) and characteristics of household heads (sex, age). From the basic needs survey data on the living conditions (access to services, education and income level, housing conditions) were used.

With these parameters a series of workshops with representatives from various institutions were held to assign weights that were then used to calculate the two main vulnerabilities (physical and social). Combined with the identified hazards they resulted in risk maps as shown below. (see map 3).

The data that was used from the census to access the vulnerabilities are basically the same as used in the present indicator system. The idea to use existing data from a census is striking, since they are readily available and detailed. However, there are two major disadvantages. The first is that not all needed information for a vulnerability assessment can be extracted form the census. The other is that census data are normally collected only every decade, rendering available information mostly out-dated and preventing a timely monitoring of vulnerabilities or risk reduction.

[3] Source: Personal communication of Juan C. Villagrán, consultant for the survey.

Map 3: Risk Map on Volcanic Eruptions for the Department of Escuintla



Source: SEGEPLAN 2003 (not yet published)

4.1.4 Capacities and Measures

Similar to the lacking methodology for vulnerability analysis, also the situation regarding capacity assessments on departmental and community level is very weak. Without existing guidelines how to manage risk and lacking funds for relevant measures, the communities rarely show any initiative to react on hazards. Exceptions are recurrent hazards like yearly floods that cause frequently damages and thus create a heighten level of awareness. In the commune of Villas Canales for example, the river is dredged periodically and protective structures try to channel the water masses during a flood away from populated areas.

With only few exceptions in the case of major cities such as the capital, most municipal districts have not developed land-use ordinances to prevent settlements in high-hazard areas. And if a building permit is required to begin construction, it can be easily waived off or neglected without penalty.

In most of the communes there is little understanding of the concept of risk management and subsequently no coordinated measures to reduce risk. Due to the existing limitations within CONRED on issues related to risk management, most activities at the community level focus on disaster preparedness. In general, activities begin with a simple study related to emergency preparedness and response within the municipal district and its communities.

4.2 Case Study Switzerland

4.2.1 Background

Switzerland with its 7.2 Mio. inhabitants (population density: 182 inh. /km²; Pop. growth: -0,06 percent) is a confederation consisting of 26 sovereign states (Kantone, departments) with a total of 2,902 autonomous communes (Gemeinden, average population: 2,500). The country pursues direct democracy and is highly decentralized. The states have their own constitution, parliament and juridical system. All tasks not explicitly delegated to the national level (e.g. defense, foreign policy, customs) are with the state level. Each state is subdivided into communes (Gemeinden), which have far reaching autonomy e.g. in the field of disaster protection (Zivilschutz), schooling, electricity, infrastructure development etc.

A national framework defines standards and procedures for the disaster management. Key elements of risk assessment are hazard and risk maps on commune level.

It is within the responsibility of the states that an integrative planning takes place considering among others disaster risk in the context of forest management, environmental protection, hydraulic structures, agriculture and spatial planning. Where necessary, the states have to establish early warning systems and are responsible to engage in constructive measures to protect against avalanches, land slides and floods.

The protection and management of forests has an outstanding importance because of the hazard protective function of the forests in this mountainous country. This is e.g. reflected in the fact that disaster prevention is part of the forest legislation.

On commune level the established hazard and risk maps and existing risk management guidelines control the land use planning. A mandatory government insurance system protects against losses.

Financing of protective measures like protective structures, warning systems, dams, drainages, forest management etc. are covered approximately by one half from national level funds while the other half comes from state and commune level.

Legislation obliges the communes to fulfill the following tasks:

- Identify natural hazards
- Assess the hazards
- Consider hazards in the planning
- Protect against hazards

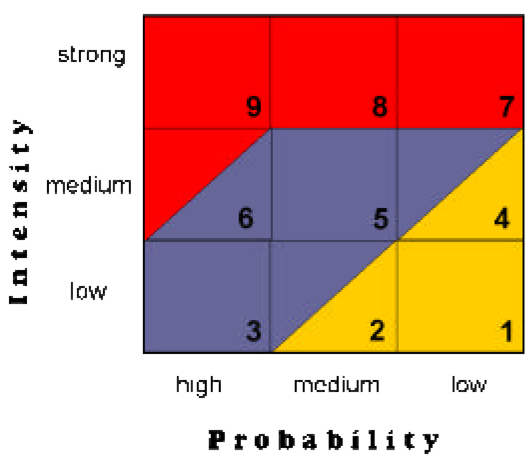
The main procedures are described in the following chapters.

4.2.2 Hazard Assessment (Hazard Maps)

Central tool for risk analysis in Switzerland on commune level are hazard maps (Gefahrenkarten). They are mandatory for each commune and consider only location relevant hazards such as snow and stone avalanches, land slides and floods.

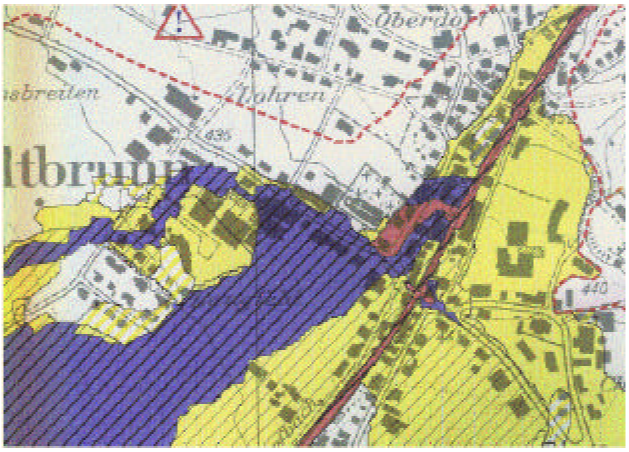
Based on standard scientific procedures of the identification and categorization of hazards, the intensity and probability of a possible hazard threatening a commune are established and grouped into strong/high , medium and low. The groups are then combined in a matrix (see graph 3) and hazard levels of high (red), medium (blue) and low (yellow) marked.

Graph 3: Intensity Probability Matrix (Hazard Levels)



The colour coding of the established hazard levels are worked into maps, which show what areas are threatened to what extent and probability for one or more hazards (see map 4). Such a hazard threat is seen as an attribute of that area, similar to e.g. fertility or inclination. It limits or prohibits certain usage of the area.

Map 4: Flood Hazard Map of a Commune in St. Gallen, Switzerland



Source: Egli 2001, p. 81

The map shows an actual hazard map for floods in a village of the Kanton St. Gallen. Red areas are areas with a high hazard threat, blue areas signal medium threat, and yellow stands for low threat.

In the planning process, the hazard areas determine the land use. To protect lives and avoid damages to property and environment certain land use e.g. settlements is prohibited in the red zones. Other uses e.g. parks for recreational purposes are possible. In the blue areas new building are only allowed if adequate measures to protect the buildings are taken. In yellow areas, new buildings may be erected, which need to take protective measures for the case of a hazard impact. Hazards maps thus serve in the process of land use to avoid *future risk* and potential damage.

Hazard maps are updated only if hazardous conditions change like in the case of a new dam that changes the probable impact of a flood.

For existing land use the overlaps with hazardous areas show current conflicts. Since existing land use like settlements, industry etc. is hardly to be changed, protective measures need to be considered to protect lives and assets. This is done in a further step through risk or protection deficit maps as described in the next chapter.

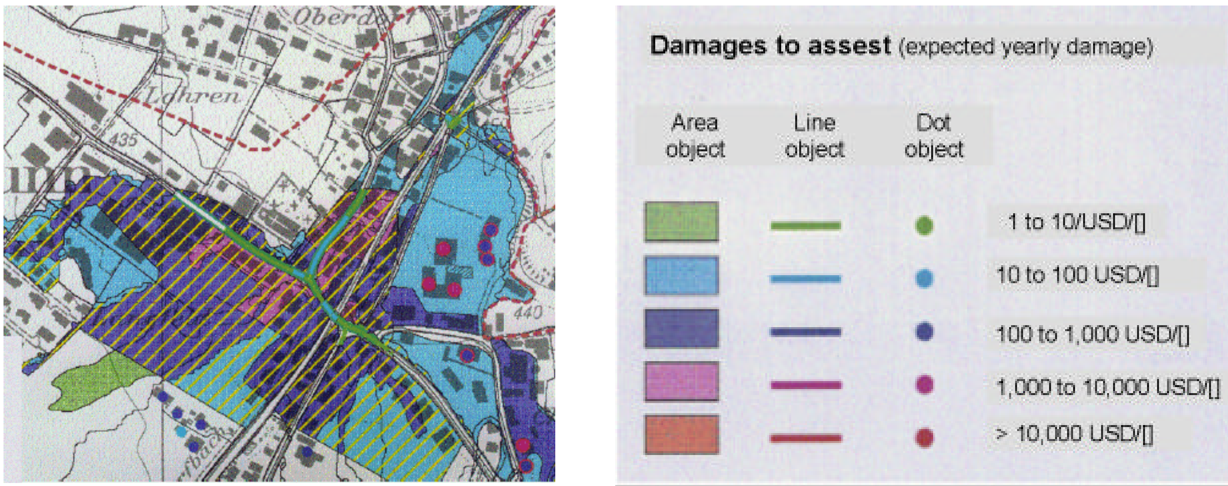
4.2.3 Risk Analysis (Risk Maps)

The additional elaboration of risk maps and protection deficit maps is not a set standard but used especially in urban areas to come to rational choices about investments in risk mitigation measures for objects at risk. To this end, the value of exposed vulnerable physical structure is assessed, marked on maps and then combined with the hazard maps.

In the vulnerability assessment only potential damages to object categories (i.e. land use types, like parks, settlements, roads etc.) but also to individual costly structures like bridges, hospitals etc. are estimated. The calculation is based on the "expected yearly damage" a product of the expected damage and the probability of the occurrence of damages through hazards.

For each category and object, levels of acceptable damage values are defined. In combination with the hazard maps now areas and objects become visible where higher than acceptable damages will occur, given the existing hazard level (yellow, blue and red areas) (see map 5). In these areas a protection deficit exist. The commune now can decide whether under cost-benefit considerations it is useful to implement any risk protective measures such as protective structures, retrofitting etc.

Map 5: Flood Risk and Protection Deficit Map of a Commune in St. Gallen, Switzerland



Source: Egli 2001, p. 81

While the hazard maps are used to avoid *new* risks through land use planning, risk or protection deficit maps are used to avoid risks to *existing* structures through mitigation measures. Risk maps need periodic updating since values of structures change, not at least through initiated measures.

4.3 Main Findings of the Case Studies

Switzerland has a highly decentralized structure with the responsibility of risk management delegated to autonomous communes. Standards and procedures are regulated by national laws and guidelines. A mandatory insurance system protects against losses. Enforcement of the procedures and resulting measures is guaranteed through laws governing regional and land use planning.

All risk management is based on mandatory hazard maps and optional risk and protection deficit maps. Factors taken into consideration are the characteristics of the hazard (probability and intensity) and the physical structures with their respective values. Environmental considerations play an important role, since forests have a strong protective function. In Switzerland other aspects such as social, economic, institutional or political vulnerabilities do not show marked deficits in their manifestation and are therefore of much less importance as in developing countries.

Guatemala, and this is true for most of the Latin American countries, risk management is a rather new policy area. The structures and policies in place in Guatemala are centralized and have achieved good results in preparedness and emergency response. There is little integration of commune and local levels.

Other areas of risk management namely prevention, mitigation and rehabilitation and reconstruction are still in their infancy. This is also due to a lack of assessment methods for vulnerability and risk. While there are some pilot projects initiated from different parties, including government and NGOs, there is no systematic approach or validation of methodologies that could lead to proper identification of hazards and vulnerabilities and subsequently to a systematic implementation of risk reducing measures. Under this perspective the presented indicator system offers a well structured initial approach to disaster risk that can orient further studies for intervention planning on commune or local level.

Where before detailed and thus costly case by case analysis lead to location specific knowledge of risk within a commune, the indicators system can be used as a cost and time efficient initial approach to gain a countrywide overview over disaster risk at communes (municipalities), vulnerability levels and lack of capacities.

Main conclusions that can be drawn from a comparison of the country case studies are:

- The importance of a normative and validated approach to assess risk that also leads to the identification of proper interventions.
- A regulatory legal framework that covers risk management as part of a general development effort making it a mandatory part e.g. for regional and land use planning.
- An understanding that disasters can only be dealt with using a comprehensive risk management approach that comprises prevention, mitigation, preparation, response and rehabilitation and reconstruction.

In both case studies it can be observed, that only a very limited number of indicators is used to feed into the establishment of hazard maps or serve to identify vulnerabilities. They are mostly intensity and probability figures for the description of hazards and physical/material vulnerabilities.

The application of the proposed indicator system on commune level showed that most of the data is available and that a comprehensive picture of the risk situation can be achieved. The application of the questionnaire is easy, fast and cost effective, which makes it suitable also for a country wide use.

While this is seen as a very efficient approach for Guatemala, Switzerland went already beyond the need for such an initial and rapid method. Switzerland already has implemented a more narrow but in-depth system that not only identifies hazards on a commune wide level but also marks specific areas on a detailed map where the hazard poses a threat. Most of the responsibilities of risk management are with the autonomous communes. With the high values at stake, all necessary measures are taken to protect the population and public infrastructure under cost benefit considerations. Avoiding future damages is seen as an investment and with sufficient own funds on commune level the investments are made. Local land use planning and building codes also oblige the private sector to make provisions against risk. In addition a functioning insurance system protects against losses.

5 Conclusions

The proposed indicator system provides an efficient methodology on community and local level to generate information guiding decision-makers to manage risks of natural hazards. It is an instrument that improves the capacity of communities and local governments to measure key elements of their current disaster risk and also to monitor progress towards risk reduction.

The approach to use a comprehensive indicator system for that task is new and promising. The application in various communes in two countries has shown that an indicator system based on a clear conceptual framework offers a unique way to bring the many components and relationships of disaster risk together to reveal the big picture.

Appling the indicator system creates risk awareness among the involved actors within the commune. The results give communes a structured insight into the driving forces behind the disaster risk they are facing, answering the key questions of:

- What is the threat? Hazards
- What is at stake? Exposure
- What are the weaknesses? Vulnerability
- What are the strengths and possibilities? Capacity & Measures

It is a very cost efficient way of an initial risk analysis that can guide complementary in-depth studies for implementation planning. Repetitive application of the indictor system over time will allow a monitoring of the changes towards disaster risk reduction.

Since the system can be applied rapidly and with little cost to a large number of communes it is also a useful tool for the national level to identify especially risk exposed communities. National funds can then be targeted accordingly. Also it becomes possible to evaluate national policies and investments in risk reduction by comparing progress in indicator achievement over time and across communes.

The inherent problem of an indicator based approach is the right choice of indicators. The complex reality is reduced to what are believed the key aspects, which are then captured with few selected indicators. Although the work has placed great care in that process, only the application in different geographical and cultural contexts can validate the appropriateness of the indicators. To this end existing risk management projects and programs can be very instrumental.

The suggested development of a risk index would synthesize and summarize the individual information of the indicators into easy to interpret factor scores. Indexing would also allow to directly compare different communities among each other, even if they are threatened by different hazards.

6 References

Acción Contra el Hambre (2002). *Final Report, Prevention and Preparedness in Relation to Natural Disasters.* Published on CD, Coordinator: William Ollson ACH/ECHO, Guatemala.

Bethke, L., J. Good, and P. Thompson (1997). *Building Capacities for Risk Reduction.* Disaster Management Training Programme, First edition, United Nations Department of Humanitarian Affairs UNHDA.

Blaikie, P., T. Cannon, I. Davis, and B. Wisner (1994). *At Risk. Natural Hazard, People's Vulnerability and Disasters.* London and New York.

Buckle, Philip. (1998). Centre for Disaster Studies, Nov 1–4, 1998

Charvériat, Céline (2000). *Natural disasters in Latin America and the Caribbean: An Overview of Risk.* IDB, Research Department Working Papers Series; 434, Washington D.C.

Coburn, A.W., R.J.S. Spence, and A. Pomonis (1994). *Disaster Mitigation.* Disaster Management Training Programme. United Nations Department of Humanitarian Affairs UNDHA

Davidson, R. (1997). *An Urban Earthquake Disaster Risk Index*. The John A. Blume Earthquake Engineering Center, Report No. 121. Stanford, California.

Davidson, R. (1998). *Evaluation and Use of the Earthquake Disaster Risk Index*. Proceedings, 6th U.S. Nat. Conf. on Earthquake Engineering, Earthquake Engineering Research Institute, Oakland, California.

Davidson, R. and K. Lambert (2001). *Comparing the Hurricane Disaster Risk of U.S. Costal Counties.* Natural Hazards Review / August 2001, pp. 132 – 142.

Egli, Thomas (2001). *Gefahrenkarten für die Bauvorsorge und Notfallplanung.* Workshop vorbeugender Hochwasserschutz.

Emergency Management Australia (1999). *Australian Emergency Risk management, Applications Guide.*

Freeman Paul K. and Leslie A. Martin (2001), *National Systems and Institutional Mechanisms for the Comprehensive Management of disaster Risk.* Phase I Working paper, Natural Disaster Dialogue First Meeting, Inter-American Development Bank, Washington D.C.

Freeman Paul K. and Leslie A. Martin (2002). *National Systems for Comprehensive Disaster Management: Financing Reconstruction*. Phase II Background Study, Regional Policy Dialogue. Inter-American Development Bank, Washington D.C.

Inter-American Development Bank (2000). *Facing the Challenge of Natural Disasters in Latin America and the Caribbean: An IDB Action Plan.* Washington D.C.

ISDR. (2002). International Strategy for Disaster Reduction, *Living with Risk. A Global Review of Disaster Reduction Initiatives.* Geneva.

Kuban, Ron Heather and Carey MacKenzie (2001). *From Community-wide Vulnerability and Capacity Assessment (CVCA).* Office of Critical Infrastructure Protection and Emergency Preparedness (OCIPEP), Canada.

MAGA, INSIVUMEH (2002). *Estimación de amenazas inducidas por fenómenos hidrometeorológicos en la República de Guatemala.* Guatemala.

Pearce, Laurie (2000). *An Integrated Approach for Community Hazard, Impact, Risk and Vulnerability analysis: HIVR.* Unpublished doctoral thesis. Vancouver: University of British Columbia UBC.

PED-MAGA (2002). *Estimación de Amenazas inducidas por Fenómenos Hidrometeorológicos en la República de Guatemala*. PMA y CONRED, Guatemala.

Perez, I. (2001). *Study of Vulnerability of 9 Urban Settlements of the Metropolitan District of Guatemala.* CONRED, Guatemala.

Quarantelli, E. L. (2002). *Urban Vulnerability to Disasters in Developing Countries: Managing Risks.* ProVention.

Vogel, Coleen (1997). *Vulnerability and Global Environmental Change.* University of Witwatersrand, Johannesburg, NUCC Newsletter 3. www.geo.ucl.ac.be/LUCC/publications/luccnews/news3/coleen.html

Wisner, Ben (2000). *Issues and Challenges in Vulnerability and Risk Indexing.* Expert Meeting on Vulnerability, Risk Analysis, and Indexing, 11.12 September 2000 Geneva, UNDP Disaster Reduction Response Programme, Emergency Response Division.

Worldbank (2002). *Natural Hazard Risk Management in the Caribbean, Revisiting the Challenge.* Caribbean Group for Cooperation in Economic Development, Discussion Draft.

Zentrum für Naturrisiken Zentrum für Naturrisiken und Entwicklung, ZENEB (2002). *Bericht zum deutschen Beitrag für den World Vulnerability Report des United Nations Development Programme.* Bonn/Bayreuth

Appendix 1: Application Guide and Indicator Explanation

Table of content

7 INTRODUCTION

The application guide gives instructions on how to apply the questionnaire and provides details on the selected indicators especially concerning the rational and background of why they were chosen.

7.1 Administering the Questionnaire

The questionnaire can be applied to the smallest administrative unit, which is headed by a government official and manages an own budget. Usually this is a commune.

It is recommended that staff from a national institution dealing with risk management administers the questionnaire to a commune. To this end he can collect prior to his visit statistical information for the commune from available sources like yearbooks, census information, historical data etc.

In the commune a group of knowledgeable people should sit together with the national staff to fill the questionnaire. The more divers the group the better will be the results.

Pearce (2000) identifies potential representatives who may enhance the effectiveness of such a group:

Disaster manager	community planner	local resident	business representative	industry representative
land developer	environmentalist	engineer	insurer	utilities representative
hazards expert	representative from the third sector[4]	media representative	public relations officer	elected official

An alternative approach would be to send the questionnaire to a commune, where somebody will be assigned to gather all the required information. Although much more cost effective, there is much less control over the reliability of the collected data.

The questionnaire needs to be filled for each present hazard, because some of the indicators are hazard specific. To this end the relevant hazards are listed first and put into an order of importance.

[4] Paterson (1998, 204) defines the third sector as the nonprofit, nongovernmental, independent, or voluntary sector.

7.2 Indicator Description Sheets

The indicator sheets discuss give in structured way additional information on the questions of the questionnaire. This information on the Ranges, Rational/Background, and Validity/Limitation should be used to properly fill the questionnaire.

The indicated cut-off-points in the section Ranges are for orientation only. They are needed to give an immediate feedback to the commune on where a commune is positioned regarding an indicator. Only then a commune will know where deficits are.

It is obvious that these kind of performance targets need to be adapted to each specific geographical and cultural context of individual countries.

Since the questionnaire also request the absolute figures for each indicator, it is possible to adjust the cut-off points still at a later stage and subsequently adjust the system e.g. to improved standards for e.g. literacy rate. This way "target" figures can be augmented to induce additional efforts by the communities.

1. HAZARD

1.1. Experienced hazards

Indicator Name	**Occurrence (hazard 1,2 …)**	**Code**	**(H1)**
Indicator/ Question	How often did an emergency with this hazard happen in the past 30 years?		
Ranges	0 – 1 Times	Low	
	2 – 3 Times	Medium	
	> 3 Times	High	
Rational/ Background	If a certain type of emergency has occurred in the past, then it is known that there were sufficient hazardous conditions to cause the event. Unless these conditions no longer exist, or unless they have been substantially reduced, a similar emergency may happen again.		
Validity/ Limitations	An emergency is defined as an event that has caused a situation loss of lives or at least damage to various homes or families. Since people remember historical events only for a generation, a 30 year history period is used. Records (books, chronics, newspapers etc) should be used to verify and complement the information, since in many cases, even when disasters have occurred relatively frequently, public awareness of these events is generally poor (Pearson 2000).		

Indicator Name	**Intensity (hazard 1,2 …)**	**Code**	**(H3)**
Indicator/ Question	What was the intensity of the worst event in the last 30 years?		
Ranges	No persons killed, only damages to houses and infrastructure	Low	
	Few persons killed, destruction of	Medium	

<table>
<tr><td></td><td><table><tr><td>some houses and infrastructure</td><td></td></tr><tr><td>More than few persons killed, destruction of many houses and infrastructure</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/ Background</td><td>The severity of hazards is usually measured using hazard specific scales (e.g. the MMI for earthquakes, Beaufort wind strength, 100 year floodplain level etc.). Given the data scarce environment and to obtain a common denominator to make different hazards comparable, instead of different hazard specific scales, a "proprietary" intensity scale described as ranges is therefore used.
Produced destruction serves as a proxy for the intensity of a hazard.</td></tr>
<tr><td>Validity/ Limitations</td><td>For droughts, which leave physical infrastructure untouched only use the impact on people and disregard the aspect of infrastructure in the ranges of the question.</td></tr>
</table>

1.2. Possible hazards

Indicator Name	**Occurrence (possible hazards)**	**Code**	**(H2)**
Indicator/ Question	What is the probability of the possible hazard the community is not aware of?		
Ranges	Chances per year: Less than 1 in 1000 — Low Between 1 in 1000 and 1 in 10 — Medium Greater than 1 in 10 — High		
Rational/ Background	Since the memory is limited and the lack of a past occurrence of a hazard does not mean that there is no future possibility (e.g. volcanic eruptions), scie ntific sources should be used to also consider hazards with long return periods.		
Validity/ Limitations	The probability is expresses as chances per year for an occurrence, which is a common measurement as it can be found in research documents.		

Indicator Name	**Intensity (possible hazard)**	**Code**	**(H4)**
Indicator/ Question	What is the expected intensity of the possible event?		
Ranges	No persons killed, only damages to houses and infrastructure — Low Few persons killed, destruction of some houses and infrastructure — Medium More than few persons killed, destruction of many houses and infrastructure — High		

Rational/ Background	The severity of hazards is usually measured using hazard specific scales (e.g. the MMI for earthquakes, Beaufort wind strength, 100 year floodplain level etc.). From the scientific source a conversion from the expected severity into the proposed categories has to be made to obtain a common denominator.
Validity/ Limitations	

2. EXPOSURE

2.1. Structures

Indicator Name	**Number of housing units**	**Code**	**(E1)**
Indicator/ Question	Total number of housing units		
Ranges	< 10.000	Low	
	10.000 - 100.000	Medium	
	> 100.000	High	
Rational/ Background	Exposure describes the people (population), the value of structures (structures) and economic activities (economy) that will experience hazards and may be adversely impacted by them. Exposure will indicate the decision makers what may be at stake if disaster hits, for it makes a difference if a small community or a big city is threatened by a hazard. (Bethke, Good, Thompson 1997) For a quantitative assessment of exposed structures the total number of housing units independent of size and location. is used, for it is generally available trough census data. It is closely correlated to other existing buildings like industrial or public buildings. Following the definition of the U.S. Bureau of the Census, a “housing unit" is a house, an apartment, a mobile home or trailer, a group of rooms or a single room occupied as a separate living quarters.		
Validity/ Limitations	This information should be available from land registry offices or the last census.		

Indicator Name	**Lifelines**	**Code**	**(E2)**

<table>
<tr><td>Indicator/ Question</td><td>% of homes with piped drinking water?</td></tr>
<tr><td>Ranges</td><td><table><tr><td>< 20 %</td><td>Low</td></tr><tr><td>20 – 50 %</td><td>Medium</td></tr><tr><td>> 50 %</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/ Background</td><td>Lifelines provide basic services to the population. Most important is regarded access to drinking water. The piped water supply is assumed to reflect also the general provision with other services such as electricity, communication, sewage, gas etc.</td></tr>
<tr><td>Validity/ Limitations</td><td></td></tr>
</table>

2.2. Population

Indicator Name	**Resident population**	Code	**(E3)**
Indicator/ Question	Total number of population living in the commune.		
Ranges	< 50.000 — Low 50.000 - 500.000 — Medium > 500.000 — High		
Rational/ Background	Exposure describes the people (population), the value of structures (structures) and economic activities (economy) that will experience hazards and may be adversely impacted by them. Exposure will indicate the decision makers what may be at stake if disaster hits, for it makes a difference if a small community or a big city is threatened by a hazard. (Bethke, Good, Thompson 1997) The obvious measurement for exposed population is the resident population.		
Validity/ Limitations	Also, in communes, where strong migration takes place and communes with high numbers of tourist the indicator may not accurately reflect the actual population at stake at a certain moment in time.		

2.3. Economy

Indicator Name	**Local gross domestic product**	Code	**(E4)**
Indicator/ Question	Total locally generated gross domestic product value		
Ranges			

<table>
<tr><td></td><td><table><tr><td></td><td>Low</td></tr><tr><td></td><td>Medium</td></tr><tr><td></td><td>High</td></tr></table>Cut-off-points need to be defined for each specific country.</td></tr>
<tr><td>Rational/
Background</td><td>Exposure describes the people (population), the value of structures (structures) and economic activities (economy) that will experience hazards and may be adversely impacted by them. Exposure will indicate the decision makers what may be at stake if disaster hits, for it makes a difference if a small community or a big city is threatened by a hazard. (Bethke, Good, Thompson 1997)

The obvious measurement for the exposed economic activities in a commune is the GDP. The GDP (gross domestic product) is the total output of goods and services for final use produced by an economy, by both residents and non-residents, regardless of the allocation to domestic and foreign claims.

To be able to use the indicator across years, the figures have to be adjusted for inflation. I.e. the values must be converted to constant dollars e.g. 1990 GDP figures.</td></tr>
<tr><td>Validity/
Limitations</td><td>It is not sure that all countries have the GDP figure broken down to commune level. Instead income figures of residents could be used.</td></tr>
</table>

3. VULNERABILITY

3.1. Physical/demographic

Indicator Name	Density	Code	(V1)
Indicator/ Question	How many people per sqkm live in the commune?		
Ranges	< 100 — Low 100 – 500 — Medium > 500 — High		
Rational/ Background	When people are concentrated in a limited area, a natural hazard will have a greater impact than if people are dispersed. Population density in the largest cities in countries is high, and often higher in old parts of the city or in squatter settlements. Indirect control of densities is sometimes possible through simple methods such as wide roads, height limitations and road layouts that limit the size of plots available for development. At a regional level, the concentration of population growth and industrial development in a single, centralized city is generally less desirable than a decentralized pattern of secondary towns, satellite centers and development over a broader region. (Bethke, Good, Thompson 1997).		
Validity/ Limitations			

Indicator Name	Demographic pressure	Code	(V2)
Indicator/ Question	Population growth rate (including migration for urban communes).		

<table>
<tr><td>Ranges</td><td><table><tr><td>< 2 %</td><td>Low</td></tr><tr><td>2 – 4 %</td><td>Medium</td></tr><tr><td>> 4 %</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/ Background</td><td>Especially urbanization process increases vulnerability to natural disasters through the concentration of people and assets. Increasing pressure to expand housing and commercial space has also accelerated the pace of vulnerability. Housing complexes and industrial parks are being rapidly constructed on unused land, formerly swamps or wetlands, in and near cities. Such land is often unstable for construction and property in these areas is some of the first damaged during floods and earthquakes.(Quarantelli 2002)

The demographic pressure is the root cause of these developments and is therefore used to capture this vulnerability.</td></tr>
<tr><td>Validity/ Limitations</td><td></td></tr>
</table>

Indicator Name	**Unsafe settlements**	**Code**	**(V3)**
Indicator/ Question	How many people live in hazard prone areas (ravine, river banks, slopes)		
Ranges	< 100 homes – Low 100 – 1000 homes – Medium >1000 – High		
Rational/ Background	In many rapidly developing cities, the control of private sector land use through urban master planning and development policy guidelines is extremely difficult. It is often private sector land use, particularly the informal sectors and shanty towns that have the highest risk of disaster. Flood plains, steep slopes, and other marginal lands are often the only building sites available to lower-income communities and the most vulnerable social groups. The economic pressures that drive people, first to the city for jobs and opportunity, and second to these marginal lands to live, must be fully understood as the context for considering their risk. (Bethke, Good, Thompson 1997). Accounting for such settlement gives a direct indication of vulnerable population and homes and can be used to measure the impact of land use planning activities.		
Validity/ Limitations	The areas are defined separately for each hazard.		

Indicator Name	**Access to basic services**	**Code**	**(V4)**
Indicator/ Question	% of homes with piped drinking water		
Ranges			

	> 50 %	Low
	20 – 50 %	Medium
	>20 %	High
Rational/ Background	The same indicator as for "lifelines" for the "exposure factor" is used, however with a different rational and reverse signs. People in cities depend on infrastructure and public services. It is difficult for the population to meet their daily needs if the electricity is cut, bridges have collapsed, telephones don't work and water mains are broken. The extend to which basic services reach settlements is also a reflection of the grade of development. Less fortunate poor population tends to live in squatters and settlements that lack basic services. Those areas are generally more vulnerable. As approximation to general service provision to settlements that also include health services, social security, communication etc., the connection to water and electricity services is chosen.	
Validity/ Limitations		

3.2. Social

Indicator Name	**Poverty level**	**Code**	**(V5)**
Indicator/ Question	Percent of population below poverty level?		
Ranges			

	<10%	Low
	10 - 30%	Medium
	>30%	High
Rational/ Background	Besides the fact of people in general being exposed to a hazard, most of the literature on vulnerability identifies the aged, the very young, the poor, the socially and physically isolated, the disabled and ethnic groups as being particularly vulnerable (see Buckle 1998). Most of these aspects are also closely correlated either to poverty or education. Thus the "poverty level" of people (V5) and the "literacy rate" (V6) are used as good proxies to cover all the above mentioned main dimensions of vulnerability of groups. Inevitably it is those who have least that, proportionally, lose most in a disaster. The weakest members of the economy have few economic reserves. If they lose their houses or their animals, they may have no means of recovering them. They are unlikely to have insurance or access to credit and can easily become destitute.	
Definitions	There are standard Worldbank definitions of poverty (e.g. less than 1 USD/day). But usually countries have own measurements of poverty level that are better suited to their situation.	
Validity/ Limitations		

Indicator Name	**Literacy rate**	**Code**	**(V6)**
Indicator/ Question	% of adult population that can read and write		
Ranges			

	<table><tr><td>>70%</td><td>Low</td></tr><tr><td>40 - 70%</td><td>Medium</td></tr><tr><td><40%</td><td>High</td></tr></table>
Rational/ Background	See V5. With more attention being given to the social and economic conditions of vulnerability, conventional thinking about disaster management has become much more closely linked to basic developmental issues. Lack of education is regarded as one of the key factors for social vulnerability. As people's understanding and the exercise of their professional skills are essential components of any risk reduction strategy, an investment in human resources and capacity building across generations will have more lasting value than any specific investment made in technological systems to reduce risks. (UNISDR 2002)
Validity/ Limitations	

Indicator Name	**Attitude**	**Code**	**(V7)**
Indicator/ Question	What priority does the general population give the protection against a threat from a hazard?		
Ranges	<table><tr><td>High priority. Protection against a hazard is an often expressed need</td><td>Low</td></tr><tr><td>Concerned, but only if a disaster has hit.</td><td>Medium</td></tr><tr><td>Not concerned. Other issues (food, work etc.) are much more important.</td><td>High</td></tr></table>		
Rational/ Background	An important factor that drives the response towards risk is the perception of risk and the priority it is given to. "Attitude" (V7) tries to capture this aspect of the population. The mitigation of disasters will only come about when there is a consensus that it is desirable, feasible and affordable. In many places, the individual hazards that threaten are not recognized, the steps that people can take to protect themselves are not known and the demand of the community to have themselves protected is not forthcoming.		

	Besides the lack of knowledge it is often the dire economic situation and the many other daily problems that simply overrule any worry about potential hazards. Also deeply rooted beliefs that are destiny oriented or pose a fatalistic vision of disasters, may present a great challenge in moving towards the acceptance of a culture of prevention and protection. (Coburn, Spence Pomonis 1994)
Validity/ Limitations	

Indicator Name	**Decentralization**	**Code**	**(V8)**
Indicator/ Question	What is the portion of self generated revenues of the total available local budget?		
Ranges	> 50% — Low 20 – 50% — Medium < 20% — High		
Rational/ Background	The more decentralized a system is, the better it can react on risk management needs. This contains elements of self governing, subsidiary, delegated functions and responsibilities. If decentralisation is taken seriously by national governments this will inevitably be reflected also in a fiscal decentralization increasing the amount of funds to be spend independently by the communes and in the consequence also to the transfer of revenue generating possibilities. The portion of own revenues as a part of the total local budget is thus taken as and "outcome" indicator for decentralisation.		
Validity/ Limitations			
Indicator Name	**Community participation**	**Code**	**(V9)**
Indicator/ Question	% voter turn out on last commune elections		

Ranges	<table><tr><td>> 70%</td><td>Low</td></tr><tr><td>50 – 70%</td><td>Medium</td></tr><tr><td>< 50</td><td>High</td></tr></table>
Rational/ Background	There is evidence that the more a society is allowed to participate in decision making and thus being in a process of democratization and empowerment, the less vulnerable they are towards suffering from disaster. Without being able to clearly determine the exact driving forces behind this processes of community participation, a proxy indicator to capture this effect might be the voter turnout at community elections.
Validity/ Limitations	This indicator can not be used if participation in elections are mandatory. Also the use for monitoring "community participation" is limited since elections are usually not annually.

3.3. Economic

Indicator Name	**Local resource base**	**Code**	**(V10)**
Indicator/ Question	The total available local budget in USD		
Ranges	<table><tr><td></td><td>Low</td></tr><tr><td></td><td>Medium</td></tr><tr><td></td><td>High</td></tr></table>		
Rational/ Background	A strong economy in which the benefits are shared throughout the society is the best protection against a future disaster. A strong economy means more money to spend on stronger buildings and larger financial		

	reserves to cope with future losses. The reality, however, is that many countries where hazard risk is high also have low income economies, and are unable to devote significant economic resources to addressing their risks. The total available local budget is thus seen as a key aspect to determine the strength of a community to cope with a disaster. This is irrespective of the actual use of the money. It is rather a reflection of the size of a community and subsequently the potential to invest in react in cases of emergency.
Validity/ Limitations	No cut-off-points are given here for the marked differences between the countries resulting mainly from the different sizes of the communes. Meaningful cut-off-points have go be defined for each individual country.

<table>
<tr><td>Indicator Name</td><td>Diversification</td><td>Code</td><td>(V11)</td></tr>
<tr><td>Indicator/ Question</td><td colspan="3">Employment for the working force comes from one, two or three sectors?</td></tr>
<tr><td>Ranges</td><td colspan="3"><table><tr><td>Mix of 3 sectors</td><td>Low</td></tr><tr><td>Mix of 2 sectors</td><td>Medium</td></tr><tr><td>More than 80% in 1 sector (e.g agriculture)</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/ Background</td><td colspan="3">Economic development is likely to be the main goal of any regional planner or national government agency, regardless of risk reduction objectives. Some aspects of economic planning are directly relevant to reducing disaster risk. Diversification of economic activity is as important an economic principle as reducing concentration is in physical planning. A single industry (or single-crop) economy is always more vulnerable than an economy made up of many different activities. (Bethke, Good, Thompson 1997).

Economic sectors to be considered are: (1) agriculture, (2) commerce, (3) industry, (4) natural resources, and (5) tourism.</td></tr>
<tr><td>Validity/ Limitations</td><td colspan="3"></td></tr>
</table>

<table>
<tr><td>Indicator Name</td><td>Small businesses</td><td>Code</td><td>(V12)</td></tr>
<tr><td>Indicator/ Question</td><td colspan="3">Percentage of businesses with fewer than 20 employees</td></tr>
<tr><td>Ranges</td><td colspan="3"><table>
<tr><td>> 50%</td><td>Low</td></tr>
<tr><td>50 – 80%</td><td>Medium</td></tr>
<tr><td>> 80%</td><td>High</td></tr>
</table></td></tr>
<tr><td>Rational/ Background</td><td colspan="3">Recent studies indicate that small businesses (fewer than 20 employees) are particularly vulnerable to disaster impacts and losses because they have relatively low levels of disaster preparedness and relatively little capacity to recover (Davidson and Lambert 2001).

Vulnerability of economic activities, therefore, is represented by the ‘‘percentage of businesses with fewer than 20 employees"</td></tr>
<tr><td>Validity/ Limitations</td><td colspan="3"></td></tr>
</table>

<table>
<tr><td>Indicator Name</td><td>Accessibility</td><td>Code</td><td>(V13)</td></tr>
<tr><td>Indicator/ Question</td><td colspan="3">How often in the last 30 years was the commune isolated through interruption of access roads for more than 2 days</td></tr>
<tr><td>Ranges</td><td colspan="3"><table>
<tr><td>0 – 1 times</td><td>Low</td></tr>
<tr><td>1 – 5 times</td><td>Medium</td></tr>
<tr><td>> 5 times</td><td>High</td></tr>
</table></td></tr>
<tr><td>Rational/ Background</td><td colspan="3">Communes in danger of being isolated are more vulnerable when it comes to evacuation, emergency support or flows of goods and services in a post disaster situation. This aspect is reflected in the indicator, measuring previous occurrences of interruptions of physical access in the last 30 years.</td></tr>
<tr><td>Validity/ Limitations</td><td colspan="3"></td></tr>
</table>

3.4. Environmental

Indicator Name	**Area under forest**	**Code**	**(V14)**
Indicator/ Question	How much of the total territory of the commune is covered with forest?		
Ranges			

	> 30 %	Low
	10 – 30%	Medium
	< 10 %	High
Rational/ Background	Disasters do not only affect the built environment but also the natural environment. But more important, environmental degradation increases the intensity of natural hazards and is often the factor that transforms the hazard, or climatic extreme such as a heavy downpour, into a disaster. For example, river and lake floods are aggravated or even caused by deforestation which causes erosion and clogs rivers. An environmental key indicator especially for hydro-meteorological hazards is therefore the remaining area under forest.	
Validity/ Limitations	Not applicable for earthquakes and volcanic eruptions.	

<table>
<tr><td>Indicator Name</td><td>Degraded Land</td><td>Code</td><td>(V15)</td></tr>
<tr><td>Indicator/
Question</td><td colspan="3">How much of the total territory is degraded/eroded/desertified?</td></tr>
<tr><td>Ranges</td><td colspan="3"><table><tr><td><5 %</td><td>Low</td></tr><tr><td>5 – 15 %</td><td>Medium</td></tr><tr><td>> 15 %</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/
Background</td><td colspan="3">Following the same rational as under (V14), degraded land is already an outcome indicator of a lack of environmental policies reflecting the complementary part to the forest area of environmental vulnerability.

Adapted, sustainable and integrated management of natural resources, including reforestation schemes, proper land use and judicious settlements should increase the resilience of communities to disasters by reversing current trends of environmental degradation and solutions to an exclusively engineering approach.</td></tr>
<tr><td>Validity/
Limitations</td><td colspan="3">Not applicable for earthquakes and volcanic eruptions.

Definitions or perceptions of what is degraded land may vary. If there is no existing classification (my be from the agricultural sector) a countrywide definition should be introduced.</td></tr>
</table>

<table>
<tr><td>Indicator Name</td><td>Overuse</td><td>Code</td><td>(V16)</td></tr>
<tr><td>Indicator/
Question</td><td colspan="3">How much of the agricultural land is overused?</td></tr>
<tr><td>Ranges</td><td colspan="3"><table><tr><td><5 %</td><td>Low</td></tr><tr><td>5 – 15 %</td><td>Medium</td></tr><tr><td>> 15 %</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/
Background</td><td colspan="3">The role the environment plays in natural disasters has been pointed out under (V14 and V15; see also C5). An "early warning" indicator to</td></tr>
</table>

Background	environmental degradation is the overuse of agricultural land. Inappropriate cultivation practices such as slash-and-burn agricultural, too short fallow periods or unsuitable crops (erosion) can lead to an irreversible degradation of land. Is observed that poverty and hazard vulnerability is integrally linked to this situation. The poor are compelled to exploit environmental resources for survival, therefore increasing both risk and exposure to disasters, in particular those triggered by floods, drought and landslides.
Validity/ **Limitations**	Not applicable for earthquakes and volcanic eruptions. Overuse or unsustainable land use follow different approaches. This indicator can only be applied if a classification is already in place. E.g. El Salvador has a country wide overuse mapping.

4. CAPACITY

4.1. Physical planning and engineering

Indicator Name	**Land use panning**	**Code**	**(C1)**
Indicator/ Question	Does a land use plan or zoning regulations exist that keeps local production and housing out of hazardous areas?		
Ranges	Their enforcement is: Low — Low --- — Medium High — High		
Rational/ Background	Many hazards are localized with their likely effects confined to specific well defined areas. Floods occur in flood plains, landslides occur on steep, soft slopes, earthquake damage happens on geological areas known to amplify ground vibration and so on. The effects can be greatly reduced if it is possible to avoid the use of hazardous areas for settlements or as sites for important structures. Integrating awareness of natural hazards and disaster risk reduction into the normal planning process results in land use zoning that avoids inappropriate land uses in hazardous areas. However, prohibitions, or other measures to clear settlers from hazardous areas, are unlikely to be successful if the underlying economic pressures are not addressed. Some indirect measures, such as making safer land available or making alternative locations more attractive, may be effective, but they can only succeed to the extent that there is strong understanding and support by the people immediately affected. This may be accomplished through better access to public transport and better provision of services. Deterring further development in unoccupied areas by clearly declaring areas as hazard zones, denying services, reducing accessibility and limiting availability of building materials may also be effective. Ultimately, however, it is only when the local community		

	recognizes the true extent of the hazard and accepts that the risks of being in a dangerous location outweigh the benefits that they will locate elsewhere or protect themselves in other ways. (Bethke, Good, Thompson 1997)
Validity/ Limitations	

<table>
<tr><td>Indicator Name</td><td>Building Code</td><td>Code</td><td>(C2)</td></tr>
<tr><td>Indicator/
Question</td><td colspan="3">Do building codes, design standards, and performance specifications for facilities exist that guarantee the use of hazard resistant methods, techniques and material. building codes?</td></tr>
<tr><td>Ranges</td><td colspan="3">Percent of buildings in threatened area complying to code/standards

<table><tr><td>< 30%</td><td>Low</td></tr><tr><td>30-70%</td><td>Medium</td></tr><tr><td>> 70%</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/
Background</td><td colspan="3">Many countries have adopted building codes requiring disaster-resistant design and construction. Their provisions and adequacy vary, but where they are rigorously applied the resultant buildings are more disaster-resistant than they might otherwise be. The problem is not so much that codes are inadequate but that they are not enforced effectively.

Codes vary according to hazard; e.g. there should be no adobe houses with clay tiles in earthquake zones, roof design can reduce the proneness to storms, strong foundations and elevated floors can resist flooding.

However, building codes based on disaster-resistance are unlikely to result in stronger buildings unless the engineers and builders who implement them accept their importance and endorse their use. In addition, engineers and builders must understand the code and the design criteria required of them. Responsible authorities must fully enforce the code by checking and penalizing designs that do not comply.

Methods for achieving risk reduction through “engineering” measures should therefore be complemented by training for engineers, designers, and builders; explanatory manuals to interpret code requirements and the establishment of an effective administration to check code compliance in practice. The recruitment of ten new municipal engineers, for example, to enforce an existing code may have more of an effect on improving</td></tr>
</table>

	construction quality in a vulnerable community than proposing legislation for higher standards in existing building codes. (Bethke, Good, Thompson 1997)
Validity/ Limitations	Not directly applicable for droughts.

<table>
<tr><td>Indicator Name</td><td>Retrofitting/maintenance</td><td>Code</td><td>(C3)</td></tr>
<tr><td>Indicator/ Question</td><td colspan="3">Are existing infrastructure (e.g. bridges, roads) and buildings (schools, hospitals etc.) retrofitted to withstand natural hazards (flood proofing, hurricane shutters, roof straps etc.) and/or are regular maintenance works carried out (River dredging, flood canals, etc.)?</td></tr>
<tr><td>Ranges</td><td colspan="3">Implemented measures:
<table><tr><td>Many</td><td>Low</td></tr><tr><td>Some</td><td>Medium</td></tr><tr><td>Few</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/ Background</td><td colspan="3">Actions to make structures more resistant to hazards primarily involve improvements in design, construction and maintenance of buildings. Equally important as building codes, but much more difficult and expensive to do, there is a need in particularly threatened areas or badly exposed critical facilities to strengthen, or retrofit, older buildings where practical.

Wind hazard "proofing" can be done by constructing wind-resistant or easily rebuilt houses; by securing elements that could blow away and cause damage or injury elsewhere, such as metal sheeting, fences, and signs; by taking protective measures for boats, building contents or other possessions at risk; and by protecting food storage facilities from storms. planting windbreaks, and planning forestry areas upwind of towns can also reduce the risk associated with storms. Strong, wind-safe public buildings which can be used for community shelter in vulnerable settlements can also reduce the risk to community members whose homes are not safe in storms.

Where construction in a flood-prone site is necessary or cannot be avoided, houses can be constructed to be flood resistant using materials resistant to water damage and strong foundations. Awareness of water hazards can be reflected in living practices such as constructing elevated storage and sleeping areas. Crop cycles can be modified to avoid the flooding season, and flood-resistant crops can be introduced.</td></tr>
<tr><td>Validity/ Limitations</td><td colspan="3">Does not apply to drought.</td></tr>
</table>

<table>
<tr><td>Indicator Name</td><td>Preventive Structures</td><td>Code</td><td>(C4)</td></tr>
<tr><td>Indicator/
Question</td><td colspan="3">Do hazard exposure-limiting mechanisms/ structures exist (dykes retaining walls, dams, barrages, rock fall barriers, terraces, drainage, windbreaks, water wells, etc.)?</td></tr>
<tr><td>Ranges</td><td colspan="3">Expected effect on damage:
<table><tr><td>Low</td><td>Low</td></tr><tr><td>Medium</td><td>Medium</td></tr><tr><td>High</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/
Background</td><td colspan="3">Preventive structures intend to reduce the impact of hazards on people and buildings via engineering measures. Examples include designing infrastructure such as electrical power and transportation systems to withstand damage. Underground transmission lines, for example, are protected from hurricane damage. Examples of structural flood mitigation are flood control structures, levees, dikes and dams, channel diversions and infiltration dams.

Communities can construct check dams, reservoirs, wells, and water tanks, as well as develop planting and re-forestation efforts to reduce the risk of drought and desertification. They can also change cropping patterns and livestock management practices, introduce water conservation policies, and develop alternative non-agricultural industries.

(Bethke, Good, Thompson 1997)</td></tr>
<tr><td>Validity/
Limitations</td><td colspan="3">Although this indicator will be applied to a specific hazard at a time, the assessment is rather subjective.</td></tr>
</table>

Indicator Name	**Environmental management**	**Code**	**(C5)**
Indicator/ Question	Are there activities to promote and enforce conservation of national resources in risk areas (e.g. protection of water reserves and other of natural resources, desertification control techniques, reforestation etc.)?		
Ranges	Number of activities and projects Many — Low Some — Medium Few — High		
Rational/ Background	Environmental risk reduction measures are designed to protect existing, or rehabilitate degraded, environmental systems that have the capacity to reduce the impacts of natural hazards. These can take the form of policies and programs, such as development control or environmental impact assessments, that reduce or eliminate the effect of human activities on the environment. They can also include physical measures that restore or fortify damaged environmental systems, such as coral reef protection, reforestation of critical watersheds or restoration of degraded river courses (Worldbank 2002). Protection of forest and other natural resources helps reduce risks associated with floods, drought, landslides, strong winds and desertification. Trees aid in reducing pollution and are vital for stopping erosion which occurs more readily in deforested areas. Furthermore, areas with adequate vegetation can slow the spread of flood waters and reduce the risk of flooding. Some risk reduction strategies that can be applied to the forestry sector in order to encourage forest growth and discourage deforestation include: planting trees and other vegetation to deter flood damage, establishing new tree plantations, encouraging strip planting of roads, supporting nursery development, using tree-planting projects for income-generation and employment projects (food-for-work, cash-for-work), adopting tax incentives for maintaining forested land, introducing alternative fuels and/or fuel efficient stoves, promoting all aspects of forestry development (reforestation and afforestation, wildlife, soil and water conservation and research). Similar measures can be taken for other resources such as wetlands and coastal zones. For example,		

	protecting mangroves can help reduce the impact of storms and stabilize the coastline. Planting and re-forestation efforts can also reduce the risk of drought and desertification. Cropping patterns can be changed and livestock management practices modified, water conservation policies introduced, and alternative non-agricultural industries developed. (Coburn, Spence Pomonis 1994, Bethke, Good, Thompson 1997)
Validity/ Limitations	This indicator is not meaningful for earthquakes and volcano eruptions

4.2. Societal capacity

Indicator Name	**Public awareness programs**	**Code**	**(C6)**
Indicator/ Question	Are public awareness programs executed?		
Ranges	Yearly frequency of execution of programs: Once — Low Sometimes — Medium Regular — High		
Rational/ Background	Planning for risk reduction should aim to develop a "safety culture" in which people are aware of the hazards they face, assume a responsibility to protect themselves as fully as they can, and continuously support public and institutional efforts made to protect their community. To this end public education and awareness programs play an important role. They can be raised in a number of ways, from short-term, high-profile campaigns using broadcasts, literature and posters, to more long-term, low-profile campaigns that are carried out through general education. Education should attempt to familiarize and de-sensationalize hazards. Everyone who lives in a hazard-prone area should understand the potential for hazards as a manageable fact of life. Their understanding should include an awareness of what to do in the event of a hazard; and a sense that their choice of house, the placement of a bookcase or a stove and the quality of construction of the garden wall around an outdoor work or play area, all affect their own safety. (Bethke, Good, Thompson 1997)		

Ranges:

Once	Low
Sometimes	Medium
Regular	High

Validity/ Limitations	

Indicator Name	School curricula	Code	(C7)
Indicator/ Question	Are risk, disaster, environment and development topics part of taught lessons at school?		
Ranges	The topics are taught at: One grade only — Low 2-3 grades — Medium all grades — High		
Rational/ Background	Information about hazards should be part of the standard curriculum of children at school and be part of everyday information sources, with occasional mention of hazards in stories, TV soap operas, newspapers and other common media. The objective is to develop an everyday acknowledgment of hazard safety in which people take conscious precautions because they are aware of the possibility of hazard occurrence. Schools for community outreach play a vital role in the community. A proper education through the schools not only teaches the children but also reaches deep into the community through the parents and teachers. It is observed from past experience that the basic problems related to disaster mitigation and preparedness are frequently attributed to lack of training, awareness, education, and self-reliance within the communities. An appropriately educated and trained community is much more capable to cope successfully with natural hazards and to reduce their impacts. (USINDR 2002)		
Validity/			

Limitations	

<table>
<tr><td>Indicator Name</td><td>Emergency response drills</td><td>Code</td><td>(C8)</td></tr>
<tr><td>Indicator/ Question</td><td colspan="3">Is regular (at lest yearly) emergency response training and drills at multiple levels ongoing?</td></tr>
<tr><td>Ranges</td><td colspan="3">Drills at levels:
<table>
<tr><td>One level only</td><td>Low</td></tr>
<tr><td>2 levels</td><td>Medium</td></tr>
<tr><td>All levels</td><td>High</td></tr>
</table></td></tr>
<tr><td>Rational/ Background</td><td colspan="3">Community involvement in mitigation planning processes can include public meetings and consultations, public inquiries and full discussion of decisions in the normal political forum (see (V9), (C9) and (C 18)).

Further awareness can develop through regular practice drills, practice emergencies and anniversary remembrances. In hospitals, schools and large buildings, it is necessary to rehearse what the occupants should do in the event of fire, earthquake or other hazard. In schools, children may practice earthquake drills. This reinforces awareness and develops automatic behavioral responses.

At police, fire brigades and other emergency response units drills for possible disaster events should be part of regular training activities; also communication and collaboration practices between these units in cases of big events are necessary.
For the indicator three levels have been defined: (1) administration (like the mayors office, planning department, etc. practicing planning, coordination and communication), (2) relevant response institutions (mainly civil defense, police, fire brigade, emergency health) and (3) the public (for hospitals, schools, exposed settlements, and large buildings etc.).</td></tr>
<tr><td>Validity/ Limitations</td><td colspan="3">Not directly applicable for slow onset disasters like droughts.</td></tr>
</table>

<table>
<tr><td>Indicator Name</td><td>Public participation</td><td>Code</td><td>(C9)</td></tr>
<tr><td>Indicator/ Question</td><td colspan="3">Is the public represented as member in the risk management/emergency committee?</td></tr>
<tr><td>Ranges</td><td colspan="3">Composition of management/emergency committee:
<table><tr><td>One level only (administration)</td><td>Low</td></tr><tr><td>2 levels</td><td>Medium</td></tr><tr><td>Mix of 3 levels</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/ Background</td><td colspan="3">The scarce participation by the public, private sector, civil organizations and local governments make disaster prevention and attention inefficient; the weakness of democracy and problems of governability limit participatory development. Successful vulnerability reducing measures involve the cooperation and participation of the local communities and stakeholders.

Building capacities for risk reduction depends on the participation of those who are potentially affected by a hazard event—including representatives of governments, businesses and other organizations, as well as the public.

For the indicator three levels have been defined to be part of the risk management/emergency committee: (1) administration (like the mayors office, planning department, etc.), (2) relevant institutions (mainly civil defense, police, fire brigade, education, health etc.) and (3) the public (with representatives from businesses, civil society, NGOs etc.).</td></tr>
<tr><td>Validity/ Limitations</td><td colspan="3"></td></tr>
</table>

<table>
<tr><td>Indicator Name</td><td>Local risk management/emergency groups</td><td>Code</td><td>(C10)</td></tr>
<tr><td>Indicator/ Question</td><td colspan="3">Do local groups exist, that have organized members with specific tasks (e.g. emergency response)?</td></tr>
<tr><td>Ranges</td><td colspan="3">% of villages at risk with local emergency group
<table><tr><td>< 30</td><td>Low</td></tr><tr><td>30 - 60</td><td>Medium</td></tr><tr><td>> 60</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/ Background</td><td colspan="3">Local communities are those most aware of historical risk scenarios and the ones closest to their own reality. It is not only a question of public awareness, it is a question of local community groups having the chance of influencing decisions and managing resources to help reduce vulnerability and to cope with risks.

The most efficient and effective disaster preparedness systems are usually provided at the neighborhood level through volunteer contributions and local groups.

It has also been argued that governments and large development agencies tend to adopt a “top-down” approach to disaster mitigation planning whereby the intended beneficiaries are provided with solutions designed for them by planners rather than selected for themselves. Such “top-down” approaches tend to emphasize physical mitigation measures rather than social changes to build up the resources of the vulnerable groups. They rarely achieve their goals because they act on symptoms not causes, and fail to respond to the real needs and demands of the people. Ultimately they undermine the community’s own ability to protect itself.

Applying such community-based policies depends on several factors– the existence of active concerned local community groups and agencies able</td></tr>
</table>

	to provide technical assistance and support at an appropriate level, is a crucial one for success. (Coburn, Spence Pomonis 1994)
Validity/ Limitations	

4.3. Economic capacity (risk transfer)

<table>
<tr><td>Indicator Name</td><td>Local emergency fund</td><td>Code</td><td>(C11)</td></tr>
<tr><td>Indicator/ Question</td><td colspan="3">Does a local fund for emergency exist?</td></tr>
<tr><td>Ranges</td><td colspan="3">Fund as % of local budget:
<table>
<tr><td><0.1</td><td>Low</td></tr>
<tr><td>0.1 – 0.5</td><td>Medium</td></tr>
<tr><td>> 0.5</td><td>High</td></tr>
</table></td></tr>
<tr><td>Rational/ Background</td><td colspan="3">Classical instruments of risk transfer are access to local, national and international "emergency funds".

The existence of an emergency fund already reflects the disaster risk awareness of the commune administration. A local fund can be mobilized much faster than national or international resources and is thus an instrument of quick response.

However, it is not useful to tie up too much resources for a probable emergency, which could be used more productive for e.g. disaster prevention or poverty reduction.</td></tr>
<tr><td>Validity/ Limitations</td><td colspan="3"></td></tr>
</table>

Indicator Name	**Access to national emergency fund**	**Code**	**(C12)**

<table>
<tr><td>Indicator/ Question</td><td>Is there access to a national emergency fund?</td></tr>
<tr><td>Ranges</td><td>How fast can it be released/received

<table><tr><td>> 7 days</td><td>Low</td></tr><tr><td>3-7</td><td>Medium</td></tr><tr><td>< 3 days</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/ Background</td><td>To ensure that damage incurred during hazard events can be quickly repaired, allowing for continuity, governments should allocate contingent disaster funding in the annual budget and insure key assets.

In the commune context national emergency funds have the task to finance activities shortly after a disaster has occurred to stabilize the situation allowing to go beyond the capacity of a local fund. It can be used in many ways like to provide food, water and shelter to affected population, finance supplies and transport, etc.

A decisive criteria for the usefulness is its timely availability. Therefore the chosen indicator assesses the days anticipated that will be needed before the national fund is available.</td></tr>
<tr><td>Validity/ Limitations</td><td></td></tr>
</table>

Indicator Name	**Access to international emergency funds**	**Code**	**(C13)**
Indicator/ Question	Is there access to international emergency funds?		
Ranges	Access to funds is:		

	Difficult	Low	
	------	Medium	
	Easy	High	
Rational/ Background	International funds often provide a substantial share of goods and services in an emergency situation. However the magnitude and ways the international commune reacts on a disaster are as varied as organizations exist. Key consideration for a commune prior to the onset of a disaster is to be familiar with potential sources of international funds (e.g. locally active NGOs, religious organizations, churches, the UN system etc.) and specific application procedures. Therefore, the decisive criteria for international funds is the assessment of their accessibility, as expressed in the suggested indicator.		
Validity/ Limitations			

Indicator Name	**Insurance market**	**Code**	**(C14)**
Indicator/ Question	Is disaster risk insurance coverage for buildings available?		
Ranges	The use is:		
	Not common	Low	
	------	Medium	
	Common	High	
Rational/ Background	Insurance and reinsurance are essential instruments for recovering losses and supporting post-disaster recovery. Insurance schemes need to be complemented by other low-cost risk sharing mechanisms in poorer communities, such as kinship networks, microfinance and public works programmes to in increase coping capacities. (UNISDR 2002)		

	Insurance is a major economic protection device, although more difficult to achieve in low income countries where the costs may seem expensive. If the risk of economic loss is spread widely over a large number of premium payers, the loss is safely dissipated. The more widespread that policy holding becomes, the lower the premiums are and the more common insurance use is likely to be. Disaster insurance is high-risk finance and only national or multi-national insurance companies can gather the resources to cover the losses of any sizable disaster. Unless backed by a large development or government agency, insurance is less likely to be available to protect poor or rural communities and their investments.
Validity/ Limitations	Not considered are insurances for agricultural production.

Indicator Name	**Mitigation loans**	**Code**	**(C15)**
Indicator/ Question	Do private banks (including micro-credit institutes) or the government offer loans or subsidies for disaster risk reduction measures (relocation, retrofitting, protective structures etc.)?		
Ranges	The use is:		
	Not common	Low	
	------	Medium	
	Common	High	
Rational/ Background	Many of low-income residents residing in hazard-prone areas do not adopt mitigation measures or protect themselves against financial losses from disasters principally because they "live from pay day to pay day". Equity considerations argue for providing these residents with low-interest loans and grants for the purposes of adopting cost-effective mitigation measures or for enabling them to hazard "proof" or relocate their property in a safer area. Subsidizing these mitigation measures may alleviate their need for disaster assistance so this policy can also be justified on efficiency grounds. (IDB 2001)		

Validity/ Limitations	

Indicator Name	**Reconstruction loans**	**Code**	**(C16)**
Indicator/ Question	Are there reconstruction credits for affected households?		
Ranges	With collateral — Low ------ — Medium Without collateral — High		
Rational/ Background	Especially the vulnerable poor population has in most cases no savings or resources to recover from losses. Hence, after a disaster they require special assistance from either private groups or the public sector. Loans with soft conditions are one important way of financial support for recovery. For those who have lost much of their property the loan has to be granted without need for collateral. However, if a loss of job and income is involved this may well make recovery a long and slow process or generates increased vulnerability to a future disaster. Even if generous loans to victims to aid their recovery are in place, a family without an income has little prospect of making repayments and is therefore most probable unable to benefit (Bethke, Good, Thompson 1997).		
Validity/ Limitations			

Indicator Name	Public works	Code	(C17)
Indicator/ Question	Do local public works programs (e.g. food for work) exist to support risks reducing measures (retrofitting, preventive structures, reconstruction)?		
Ranges	Their magnitude is: Low — Low Medium — Medium High — High		
Rational/ Background	A public works program represents an important social safety net in dealing with situations of mass deprivation. Its effectiveness in protecting poor households from severe shocks is consistent with longer-term goals of economic growth and environmental protection. Public works programs provide employment when households find it difficult to restore their productive assets. Public works programs may also contribute to reduce physical risks, by engaging in structural measures. However, some experience show that a number of public works programs have not been satisfactory because they are not sufficiently targeted and suffer from inefficient implementation. Also, public works programs have been more effective in dealing with droughts or famine, and its applicability to dealing with other natural hazards such floods and earthquakes have not yet been tested. (UNISDR 2002)		
Validity/ Limitations			

Ranges:

Low	Low
Medium	Medium
High	High

4.4. Management and institutional capacity

<table>
<tr><td>Indicator Name</td><td>Risk management/emergency committee</td><td>Code</td><td>(C18)</td></tr>
<tr><td>Indicator/ Question</td><td colspan="3">Does a community risk management or emergency committee exist, that deals with prevention, mitigation, preparedness and response?</td></tr>
<tr><td>Ranges</td><td colspan="3">Meeting frequency
<table><tr><td>Only during emergency</td><td>Low</td></tr><tr><td>Once in a year</td><td>Medium</td></tr><tr><td>at least quarterly</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/ Background</td><td colspan="3">Risk management or emergency committees are the backbone of any disaster risk management activity in a commune
Emergency risk management requires the formation and management of a committee or consultative group. A committee is essential to emergency risk management for the following reasons (EMA 1999):
o Committee members who represent the community can facilitate communication with a broad cross-section of stakeholders.
o Rapid access to gathered and systemized information (risk maps, early warning, emergency plans)
o No single person is expert in everything and so the input of subject experts is required. If local subject experts are ignored they may become the greatest critics of your emergency risk management project.
o If emergency risk management is to be taken seriously, then the commitment of all the relevant players is required. An effective means of gaining this commitment is through encouraging people to participate in emergency risk management, and working together to produce the end result.
However, it is not so much the pure existence but the work they are doing that makes the difference. Since a qualitative assessment is very difficult the frequency of meetings is taken as an indicator for the work being done by a committee.</td></tr>
</table>

Validity/ Limitations	

Indicator Name	**Risk Map**	**Code**	**(C19)**
Indicator/ Question	Is there a worked out and circulated emergency plan?		
Ranges	The map is available at different levels: (see (C9) for levels) Only at level 1 — Low Also at level 2 — Medium Also at level 3 — High		
Rational/ Background	One of the best ways of presenting the results of hazards and vulnerabilities is through maps. Maps are familiar to everybody, and the characteristics of hazards can be overlaid on other types of information, such as features of the environment, and relevant characteristics of a community. These maps are useful tools for development planning and for emergency preparedness and give an idea of the problems and opportunities posed by hazards and development can be achieved. They are also an excellent risk communication tool. (Emergency Management Australia 1999) Hazard and risk mapping projects use geographic information systems (GIS) to document the results. But equally important can be maps drawn up by community members in a participatory approach. The value of a risk map is determined largely by the use it is made of. To this end a prerequisite is that the maps are not only worked out but also distributed to the different levels for proper use.		
Validity/ Limitations			

Indicator Name	**Emergency plan**	**Code**	**(C20)**

Indicator/ Question	Is there a worked out and circulated emergency plan?
Ranges	Availability of copies at different levels: (see (C9) for levels) Only at level 1 — Low Also at level 2 — Medium Also at level 3 — High
Rational/ Background	One of the most important requirements of efficient emergency management is that all structures, procedures and installations should be prepared and agreed upon before a disaster happens. Experience shows, that the setting up of these elements only after an emergency has occurred lead to more confusion than coordination. An emergency plan will provide for the proper preparation. An emergency plan is thus an agreed set of arrangements for responding to and recovering from emergencies; it describes responsibilities, management structures, strategies, and resources. Since the details of an emergency plan can differ according to the specific location, organisational structures, hazards, etc. the assessment is about the dissemination of the plan to the different levels.
Validity/ Limitations	

Indicator Name	**Early warning system**	**Code**	**(C21)**
Indicator/ Question	Is an early warning system in place?		
Ranges	Does it work?		

	Low	Low	
	Medium	Medium	
	High	High	
Rational/ Background	Early warning has always been considered a cornerstone of disaster reduction. The objective of early warning is to empower individuals and communities, threatened by natural or similar hazards, to act in sufficient time and in an appropriate manner so as to reduce the possibility of personal injury, loss of life and damage to property, or nearby and fragile environments. However, even where abilities and procedures do exist, communities do not often respond appropriately to them, because there is a lack of planning, resources or viable protective options that they could utilize in a timely manner. (UNISDR 2002)		
Validity/ Limitations			

.

Indicator Name	**Institutional capacity building**	**Code**	**(C22)**
Indicator/ Question	Do local institutions (administration, police, fire brigade, hospitals, building sector) receive training on risk management?		
Ranges	Frequency:		

<table>
<tr><td></td><td><table><tr><td>Sometimes</td><td>Low</td></tr><tr><td>Often</td><td>Medium</td></tr><tr><td>Constant</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/ Background</td><td>Developing risk reduction measures depends on the strength of local people – individually, organizationally and institutionally. Their capacities must be continuously strengthened

While the capacity of the population has been captured under indicator "public awareness programs" (C6), training courses and technology transfer provided to local institutions is measured here. The frequency of actually carried out training measures is recorded as an indicator to measure ongoing capacity building.</td></tr>
<tr><td>Validity/ Limitations</td><td></td></tr>
</table>

<table>
<tr><td>Indicator Name</td><td>Communication</td><td>Code</td><td>(C23)</td></tr>
<tr><td>Indicator/ Question</td><td colspan="3">Is there coordination with national level risk management organizations (national committees, government etc.)?</td></tr>
<tr><td>Ranges</td><td colspan="3">Within a year there is communication:
<table><tr><td>Seldom (< 5 calls or meetings)</td><td>Low</td></tr><tr><td>Sometimes (5 – 10 calls or meetings)</td><td>Medium</td></tr><tr><td>Often and regular (> =once a month)</td><td>High</td></tr></table></td></tr>
<tr><td>Rational/ Background</td><td colspan="3">While inter-community communication procedures are part of an emergency plan, communication with the national level should be already established in pre-emergency situations.

Links to national disaster research and respond institutions can provide information and training, government committees can inform about legal aspects and contact to relevant government officials are crucial for funding and direct communication lines with assigned responsibilities and contact persons in case of an emergency.</td></tr>
<tr><td>Validity/ Limitations</td><td colspan="3"></td></tr>
</table>

Appendix 2: Questionnaire

Table of content

Questionnaire

Date / Year of data collection

Involved Persons/function

8 COMMUNITY PROFILE

Country ______________________________

State/province ______________________________

Community ______________________________

9 HAZARD

9.1 Experienced hazards

What disasters (serious events) have you been suffering in your community or pose a significant threat? Give a ranking starting from 1 = most feared/important. Give a 0 for a hazard not present.

Hydro-meteorological	Rank	Geophysical	Rank
Flood		Earthquakes	
Drought		Landslides	
Wind storms/Hurricanes		Volcanic eruptions	

9.2 Probability/Severity

To be filled for each above identified significant hazard.

(H1) Occurrence (hazard 1,2 …) How often did an emergency with this hazard happen in the past 30 years?	**Evaluation**
0 – 1 Times	Low
2 – 3 Times	Medium
> 3 Times	High

(H3) Intensity (hazard 1,2 …) What was the intensity of the worst event in	**Evaluation**

the last 30 years??	
No persons killed, only damages to houses and infrastructure	Low
Few persons killed, destruction of some houses and infrastructure	Medium
More than few persons killed, destruction of many houses and infrastructure	High

9.3 Possible hazards

Is there scientific information on a severe event the community is not aware of, that might occur?

Hydro-meteorological	Rank	Geophysical	Rank
Flood		Earthquakes	
Drought		Landslides	
Wind storms/Hurricanes		Volcanic eruptions	

9.4 Probability/Severity

(H2) Occurrence (possible hazards) What is the probability of the possible hazard the community is not aware of. Chances per year:	**Evaluation**
Less than 1 in 1000	Low
Between 1 in 1000 and 1 in 10	Medium
Grater than 1 in 10	High

(H4) Intensity (possible hazards) What is the expected intensity of the possible event?	**Evaluation**

No persons killed, only damages to houses and infrastructure	Low
Few persons killed, destruction of some houses and infrastructure	Medium
More than few persons killed, destruction of many houses and infrastructure	High

10 EXPOSURE

10.1 Structures

(E1) Number of housing units Total number of housing units	
Value:	
< 10.000	Low
10.000 - 100.000	Medium
> 100.000	High
(E2) Lifelines % of homes with piped drinking water	
Value:	
< 20 %	Low
20 – 50 %	Medium
> 50 %	High

10.2 Population

(E5) Resident population Total number of population living in the commune.	
Value:	
< 50.000	Low
50.000 - 500.000	Medium
> 500.000	High

10.3 Economy

(E6) Local GDP Total locally generated gross domestic product/production value	
Value:	
	Low
	Medium
	High

11 VULNERABILITY

11.1 Physical/demographic

(V1) Density How many people per sqkm live in the commune?	**Evaluation**
Value:	
< 100	Low
100 – 500	Medium
> 500	High
(V2) Demographic pressure Population growth rate (including migration for urban communes).	**Evaluation**
Value:	
< 2 %	Low
2 – 4 %	Medium
> 4 %	High
(V3) Unsafe settlements How many people live in hazard prone areas (ravine, river banks, slopes)	
Value:	
< 100 homes	Low
100 – 1000 homes	Medium
>1000	High

(V4) Access to basic services Same as E 4: % of homes with piped drinking water	**Evaluation**
Value:	
> 20 %	Low
20 – 50 %	Medium
> 50 %	High

11.2 Social

(V5) Poverty level Percent of population below poverty level (country specific definition)	
Value:	
<10%	Low
10 - 30%	Medium
>30%	High
(V6) Literacy rate % of adult population that can read and write	
Value:	
>70%	Low
40 - 70%	Medium
<40%	High
(V7) Attitude What priority does the general population give the protection against a	

threat from a hazard?	
High priority. Protection against a hazard is an often expressed need	Low
Concerned, but only if a disaster has hit.	Medium
Not concerned. Other issues (food, work etc.) are much more important.	High
(V8) Decentralization What is the portion of self generated revenues of the total available local budget.	**Evaluation**
Value:	
> 50%	Low
20 – 50%	Medium
< 20%	High
(V9) Community participation % voter turn out on last commune elections	**Evaluation**
Value:	
> 70%	Low
50 – 70%	Medium
< 50	High

11.3 Economic

(V10) Local resource base The total available local budget in USD	**Evaluation**

Value:	
	Low
	Medium
	High
(V11) Diversification Employment for the working force comes from one, two or three sectors?	**Evaluation**
Mix of 3 sectors	Low
Mix of 2 sectors	Medium
More than 80% in 1 sector (e.g agriculture)	High
(V12) Small businesses Percentage of businesses with fewer than 20 employees	**Evaluation**
Value:	
> 50%	Low
50 – 80%	Medium
> 80%	High
(V13) Accessibility How often in the last 30 years was the commune isolated through interruption of access roads for more than 2 days.	**Evaluation**
Value:	
0 – 1 times	Low
1 – 5 times	Medium

> 5 times	High

11.4 Environmental

(V14) Area under forest How much of the total territory of the commune is covered with forest?	**Evaluation**
Value:	
> 30 %	Low
10 – 30%	Medium
< 10 %	High
(V15) Degraded land How much of the total territory is degraded/eroded/desertified?	**Evaluation**
Value:	
<5 %	Low
5 – 15 %	Medium
> 15 %	High
(V16) Overuse How much of the agricultural land is overused?	**Evaluation**
Value:	
<5 %	Low

5 – 15 %	Medium
> 15 %	High

12 CAPACITY & MEASURES

12.1 Physical Planning and Engineering

(C1) Land use planning Does a land use plan or zoning regulations exist, that keeps local production and housing out of hazardous areas (hazard specific: e.g. river banks, ravines, volcano slopes, etc.)?	Yes/No	Their enforcement is Low/ high
(C2) Building codes Do building codes exist, that define the use of hazard resistant methods, techniques and material design standards (hazard specific)?		Percent of buildings in threatened area complying to code/ standards >30%/30-70/>70%
(C3) Retrofitting/ Maintenance Are existing infrastructure (e.g. bridges, roads) and buildings (hospitals etc.) retrofitted to withstand natural hazards (flood proofing, hurricane shutters, roof straps etc.) and/or are regular maintenance works carried out (River dredging, flood canals, etc.)?		Implemented measures Few /some/many
(C4) Preventive structures Do hazard exposure-limiting mechanisms/ structures exist (dykes retaining walls, dams, barrages, rock fall barriers, terraces, drainage, windbreaks, water wells, etc.)?		Expected effect on damage Low/medium/high
(C5) Environmental management Are there activities to promote and enforce conservation of national resources in risk areas (e.g. protection of water reserves and other of natural resources, desertification control techniques, reforestation etc.).		Number of activities/projects Few /some/many

12.2 Societal Measures

Aspect	Existence	Assessment of viability, functioning, application, use …
(C6) Public awareness programs Are public awareness programs executed?	Yes/No	Frequency: Once/sometimes/ regular
(C7) School curricula Are risk, disaster, environment and development topics part of taught lessons at school?		Taught at One grad only/2-3 grades/ all grades
(C8) Emergency response drills Is emergency response training and drills at multiple levels ongoing? Levels:(1) administration, (2) relevant response institutions (civil defense, police, fire brigade, emergency health) and (3) the public (for hospitals, schools, large buildings etc.)		Regular drills take place: One level/ 2 levels/ all levels
(C9) Public participation Is the public represented as member in the Management/emergency committee? Levels: (1) administration (mayors office, planning department), (2) institutions (police, fire brigade, education, health etc.), (3) public (businesses, civil society, NGOs)		It is composed of Only1/ 2 or/ 3 levels of society

(C10) Local risk management/ emergency groups (volunteers) Do local groups exist, that have organized members with specific tasks (e.g. emergency response)?		% of villages at risk with group <30/30-60/>60%

12.3 Economic measures (Risk Transfer)

Aspect	Existence	Assessment of viability, functioning, application, use …
(C11) Local emergency funds Does a local fund for emergency exist?	Yes/No	Fund as % of local budget: <0.1/0.1 – 0.5/>0.5 %
(C12) Access to national emergency funds Is there access to a national emergency fund?	Yes/No	How fast released < 3 days/ 3-7 /> 7 days
(C13) Access to international emergency funds Is there access to international emergency funds?	Yes/No	Access is Difficult/easy
(C14) Insurance market Is disaster risk insurance coverage for buildings available?		Use: not common/common
(C15) Mitigation loans Do private banks (including micro-credit institutes) or the government offer loans or subsidies for disaster risk reduction measures (retrofitting, protective structures etc.)?		Use: not common/common

(C16) Reconstruction loans Are there reconstruction credits for affected households?		With collateral/without
(C17) Public works Do local public works programs (e.g. food for work) exist to support risks reducing measures (retrofitting, preventive structures, reconstruction) ?		Magnitude Low/medium/high

12.4 Management and institutional measures

Aspect	**Existence**	**Assessment of viability, functioning, application, use …**
(C18) Risk management/emergency committee Does a community risk management or emergency committee exist, that deals with prevention, mitigation, preparedness and response to hazards?		Meeting frequency: Only during emergency/ Once per year/ at least quarterly
(19) Risk map Does a risk map exist? (for levels see (V9))		The map is available at different levels: only level 1/ also at level 2/ also at level 3
(C20) Emergency plan Is there a worked out and circulated		Availability of copies at different levels

emergency plan? (for levels see (V9))		one/few/many
(C21) Early warning system Is an early warning system in place?		Does it work Low/medium/high
(C22) Institutional capacity building Do local institutions (administration, police, fire brigade, hospitals, building sector) receive training on risk management?		Sometimes/often/constant
(C23) Communication Is there coordination with national level risk management organizations (national committees, government etc.)?		Sometimes/often/constant (direct com. lines established)

Appendix 3: Towards a Community Disaster Risk Index

Table of Contents

13 Introduction

The indicator system gives a good insight into the current situation of a community regarding the risk determining factors and allows to trace changes in those factors over time. However, to be able to compare different communities across different hazards and to facilitate interpretation of the data, an indexing system is proposed. It will condense the technical and individual information of the indicators into comparable summary figures that allow direct comparison of the relative overall disaster risk of communities in a country, and describe the relative contributions of various factors to that overall risk.

Indices are appealing because of their ability to summarize a great deal of often technical information about natural disaster risk in a way that is easy for non-experts to understand and use in making risk management decisions. There is growing interest among academic researchers, development banks, governments, and the insurance industry to use indices to make systematic comparisons of natural disaster risk in different countries and regions.

The presented indexing exercise was inspired by the FEMA approach (as described in Pearce 2000) for its simplicity and influenced largely by the work of Davidson (Davidson 1997, Davidson 1998 and Davidson and 2001).

In a first step the different measurements of the individual indicators (e.g. 30,000 residents and 30% poverty level) have to be made comparable trough scaling. This is done by assigning a value of 1,2 or 3 according to the achieved category of low, medium or high.

Since indicators have different meanings for specific hazards, in a second step, a hazard specific weight has to be found and applied.

Then, separate composite indices (scores) can be calculated for the four main factors that contribute to the risk — Hazard, Exposure, Vulnerability and Capacity & Measures. All the indicators that relate to Hazard are combined into the Hazard index, all the indicators that relate to Exposure are combined into the Exposure index, and likewise for the remaining two factors. Depending on the scaled indicator values the factor indices (scores) vary between 0 and 100.

In a last step the "overall" composite risk index is derived from the four factor indices resulting again in a score that ranges between 0 and 100.

14 Indicator and Factor Scores (Scaling and Weighting)

Scaling performs the first comparison by transforming each value of an indicator into a scaled value simply by assigning the integer values of 1, 2 or 3 according to the low, medium and high category the indicators was grouped into. A 0 is given if the indicator does not apply. Scaling thus converts the indicators into compatible units of measurement.

Weighting performs the second comparison by multiplying the scaled values of each indicator by a constant, unitless coefficient whose magnitude represents the importance of the indicator relative to other indicators. This is necessary, because some indicators are believed to be more important than others, contributing differently to each of the factors. E.g. among the "capacity" factor an early warning system is regarded more effective than the existence of an emergency plan. While this is certainly true for "predictable" floods, in case of "unpredictable" earthquakes early warning is much less effective. Therefore indicators enter into the indexing with a hazard-specific weighting.

The suggested weights for each indicator for earthquake hazard are shown in annex A at the end of this appendix. They are subjective and based on descriptive literature, own experience and feedback of few practitioners. These weighting factors still need to be further validated and adjusted to county specific conditions. Weights for other hazards still have to be elaborated. One has to bear in mind that this is a subjective view of dependencies and interdependencies among the indicators and the risk factors.

Since all four factors are believed to contribute equally to the overall risk index (see chapter 3) the weights were chosen to allow each factor index to range between 0 and 100. This can be achieved in distributing a total of 33 weighting points (actually 33 1/3) according to the believed importance of the indicators for each factor.

The following equation determines the factor indices:

$$H = w_{H1}x'_{H1} + w_{H2}\,x'_{H2} + w_{H3}\,x'_{H3} + w_{H4}\,x'_{H4}$$

$$\mathbf{E = w_{E1}x'_{E1} + w_{E2}\,x'_{E2} + w_{E3}\,x'_{E3} + \ldots + w_{E6}\,x'_{E6}}$$

$$V = w_{V1}x'_{V1} + w_{V2}\,x'_{V2} + w_{V3}\,x'_{V3} + \ldots + w_{V14}\,x'_{V14}$$

$$C = w_{C1}x'_{C1} + w_{C2}\,x'_{C2} + w_{C3}\,x'_{C3} + \ldots + w_{C23}\,x'_{C23}$$

where H, E, V and C are the values of the Hazard, Exposure, Vulnerability and Capacity & Measures indices, respectively; $x'i$ refer to the scaled values of the indicators; and wi are the weights listed in annex A with $?_j w_j x_j = 33.33$.

15 The Risk Index

As with the indicator weighting, the actual relationship between the factors can not be determined statistically. Following the approach of Davidson (1997) a linear relationship is assumed being reasonable and easy to understand and implement. For the single composite risk index, the contribution of each factor is believed to be equal. While increasing scores of the factors Hazard, Exposure and Vulnerability represent an increasing disaster risk, the factor Capacity & Measures reduces the disaster risk.

Using the liner relationship, it is suggested to add up the factor scores Hazard, Exposure and Vulnerability and deduct the factor score of Capacity & Measures. To use the same scale between 0 and 100 as the individual factor indices do, a uniform weight of 0.33 for all factors is introduced. This way the overall risk index R can never exceed 100 and reasonably not get negative.

Expressed as equation:

$$R = (w_H H + w_E E + w_V V) – w_C C$$

where R is the overall risk index, H, E, V and C are the scores of the Hazard, Exposure, Vulnerability and Capacity & Measures indices, respectively and w_i is the constant coefficient of 0.33 as a uniform weight to all factors.

16 Index Presentation and Interpretation

The overall risk index tells us about the risk and the identified risk determining factors of communities. It allows:

1. To compare different communities across the country to identify communities with high disaster risk for targeting. This can also be done for communities that face risk from different hazards.
2. To recognize for each community what are the determining factors behind the existing risk. That is, whether the risk stems from the hazard itself (hazard), is due to elevated vulnerability levels (vulnerability) or comes from a lack of capacity (capacity & measures).
3. To distinguish the different possible magnitudes of damages through the Exposure score.
4. To reveal deficits in the risk management capacities and potential areas for interventions through a breakdown of the Capacity & Measure score into the factor components.

16.1 Single Community

The calculation of the factor scores and risk index of a single commune is based on the results of the questionnaire and the assumed hazard specific weights. Annex B shows how the computation is performed using the commune of Villa Canales as one of the investigated case communes.

Directly derived from the table in annex B the following Factor Scores were computed:

Hazard:	53
Exposure	56
Vulnerability	66
Capacity & Measures	28

The overall risk index (in our case for earthquake only) is then calculated:

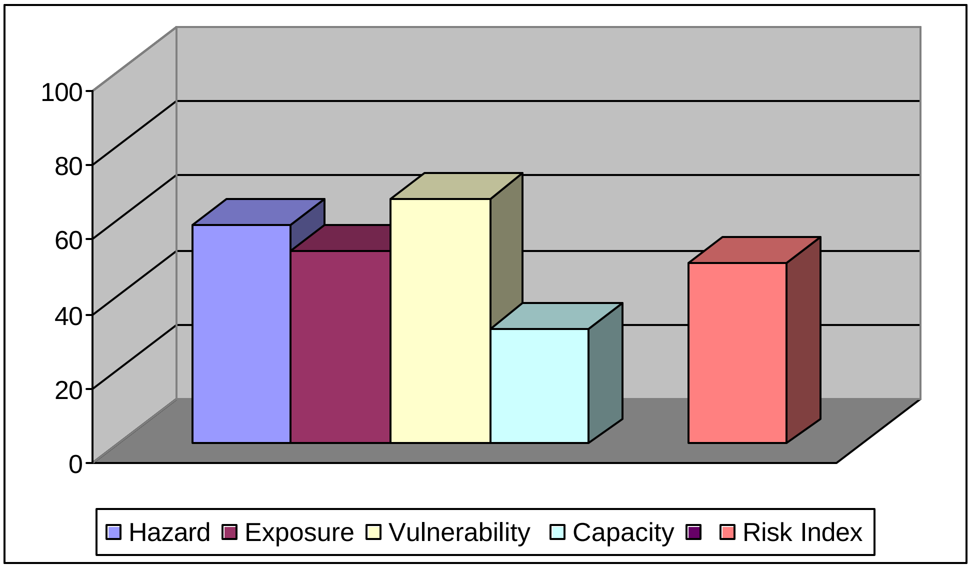
R = (wHH + wEE + wVV) – wCC

R = (0.33*53 + 0.33*55 + 0.33*66) – 0.33*28

R = 48.5

Graph 1 shows how these figures can be visualized for easy presentation and interpretation.

Graph 4: Factor Scores and Risk Index Villa Canales, Guatemala



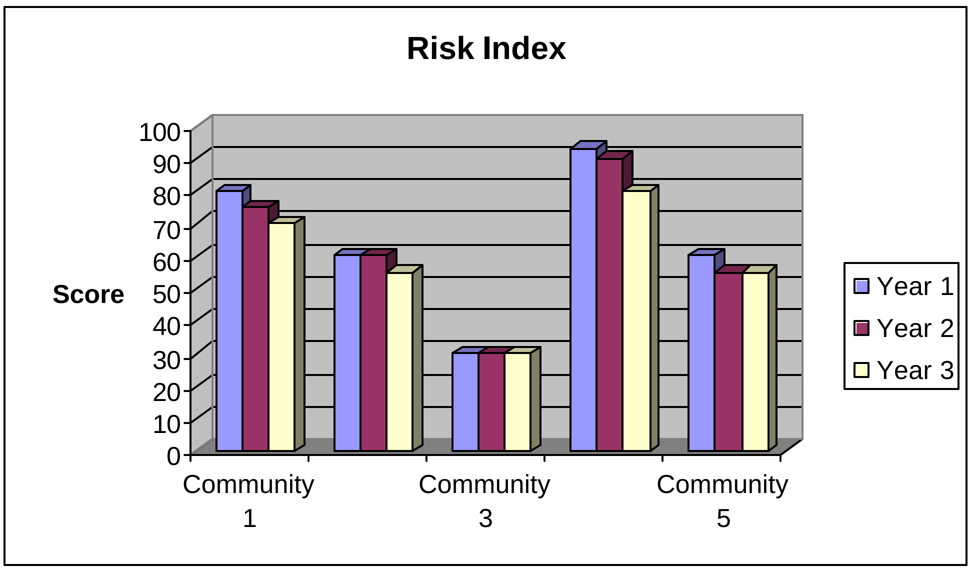
While the hazard and exposure scores show medium values, an elevated vulnerability score can be observed. With only little capacities & measures in place the related score is low and can not substantially reduce the risk index, which signals therefore a medium overall earthquake risk for Villa Canales.

Since Villa Canales faces multiple hazards, the procedure needs to be repeated with the other natural threats present. The overall risk would add up the different hazard specific risk indices to a summary index that can be used to directly compare various communes facing different hazards.

16.2 Direct Comparison

Through scaling the factors into a comparable score, communities can be compared directly over time and across different hazards.

Graph 5: Direct Comparison of Communities over Time



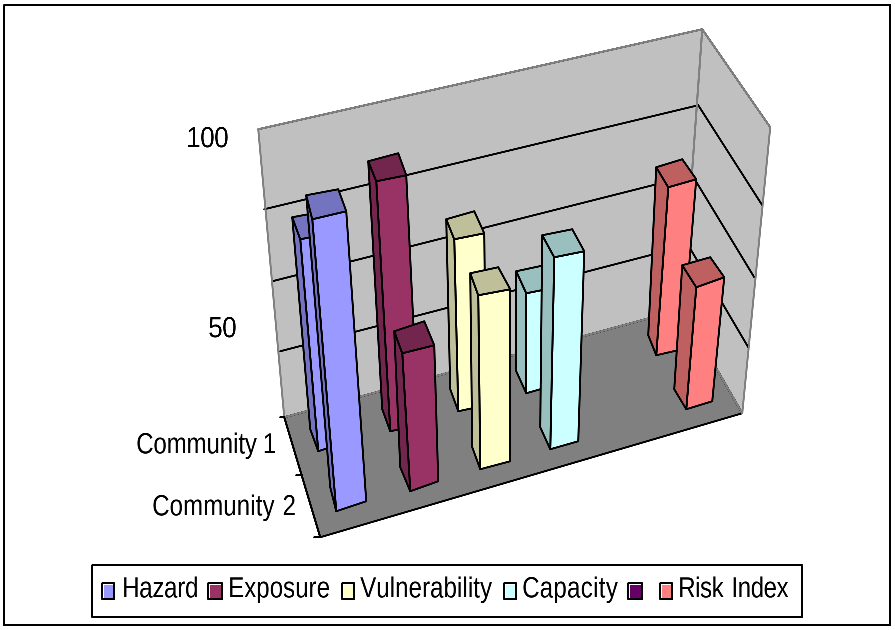
For a given year various communities can be directly compared. Community 1 has a risk index of 80 (year 1) which characterizes this community as much higher exposed to disaster as e.g. community 3 with an index of only 30.

If we focus on one community over various years one can also monitor progress towards a reduction of risk. While community 1 has reached a reduction over the years from an Index of 80 down to 70, community 3 stagnated at a very low level.

16.3 Factor Breakdown

The score of each factor gives us insight into the composition of the disaster risk. However, the scaling of the single factors is arbitrary and can thus not be interpreted as equally contributing to the overall risk. It allows, however, in a comparison across the communities to identify which communities are under a higher hazard threat, face larger damages, are more vulnerable or whether there is room to increase the capacities to withstand disasters.

Graph 6: Risk Index Comparison (Factor Breakdown) Between Two Communities

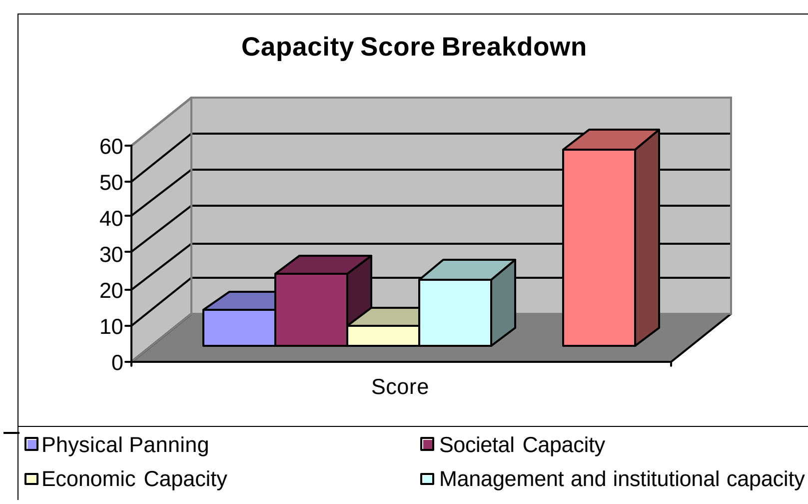


The first community has a lower Hazard risk but also a very low Capacity compared to the second community. This explains the overall higher risk index of the first community. The Exposure score indicates also much higher values are at stake for this community. The existing Vulnerabilities are about the same.

16.4 Capacity Component Breakdown

The capacity component breakdown reveals what intervention areas might be the most deficient ones. Again, for the selective representation of each component further assessment steps are necessary to actually plan interventions. The sores can only give hints.

Graph 7: Capacity Component Breakdown for a Single Community



Assuming a proper weighting of the different indicators used to assess the four components of capacity, a major deficit can be identified in the physical planning component and the economic capacity, while societal aspects and the management capacities can been considered as more contributing.

17 Application and Validation

The index summarizes a great deal of disparate information to facilitate comparison of the magnitude and nature of disaster risk in Latin America in a way that is easily accessible to potential users.

However, there is currently no convincing methodology to the conceptual problem on how to come to proper weights giving each indicator the right contributing share. Similarly, the relationship between hazard, exposure, vulnerability and capacity is not known. How much risk reducing effect do what capacities have? However, it is believed that the preliminary assumptions for the weights made and the linear equation proposed are sensible and backed by expert knowledge. And it is also believed that, although not scientifically verified, the resulting scoring system is a sensible step towards an analysis and interpretation that gives a better guidance to the local level than purely presenting the individual indicator values.

As long as the assumptions and techniques that guide the combination are explicit and clear, the user can interpret the combination based on his belief in the appropriateness of the approach. Furthermore, since the indicators that comprise the indices are presented as well as the risk index itself, the user can always refer to the indicator values themselves, and disregard the final risk index if he wishes.

18 Outlook

As mentioned earlier, the presented approach is not yet operational. Additional work is needed to finalize the model and confirm the scaling and weights.

To this end the indexing system needs to be tested and verified on a number of cases to:

- Adjust the system by modifying the factors according to different hazards
- Adjust the scoring system to actual conditions
- Assess the strength of indicating possible areas of interventions

It would be also functional to develop a simple software package that takes the raw data of the questionnaire for each community as input, performs the scaling and weighting, and produces the final tables and figures as output. It also could offer the possibility to add or modify indicators and their cut-off points and allow to adjust the choice of the used weight values, to fit the model for specific country settings. Such a software tool could make the application of the whole method easy for any potential user to assess even a great number of communities.

Annex A: Hazard specific Indicator Weights

Main Factor	Indicator Name	Weight Value					
		Earth-quake	Vol-cano	Land-slide	Flood	Hurri-cane	Drou-ght
HAZARD							
	(H1)/(H2) Occurrence (experienced/possible hazard)	20	?	?	?	?	?
	(H3)/(H4) Intensity (experienced/possible hazard)	13					
EXPOSURE							
	(E1) Number of housing units (E2) Lifelines	7 6					
	(E3)Total resident population	10					
	(E4) Local gross domestic product	10					
VULNERABILITY							
	(V1) Density (V2) Demographic pressure (V3) Unsafe settlements (V4) Access to basic services	3 3 1 1					
	(V5) Poverty level (V6) Literacy rate (V7) Attitude (V8) Decentralization (V9) Community participation	2 2 3 1 2					
	(V10) Local resource base (V11) Diversification (V12) Small businesses (V13) Accessibility	3 2 2 2					
	(V14) Area under forest (V15) Degraded land (V16) Overused land	2 2 2					
CAPACITY & MEASURES							
	(C1) Land use planning (C2) Building codes (C3) Retrofitting/ Maintenance (C4) Preventive structures (C5) Environmental management	2 2 1 1 1					
	(C6) Public awareness programs (C7) School curricula (C8) Emergency response drills (C9) Public participation	2 2 1 2					

	(C10) Local risk management groups	2					
	(C11) Local emergency funds (C12) Access to national funds (C13) Access to intl. emergency funds (C14) Insurance market (C15) Mitigation loans (C16) Reconstruction loans (C17) Public works	1 1 1 1 1 1 1					
	(C18) Risk management committee (C19) Risk map (C20) Emergency plan (C21) Early warning system (C22) Institutional capacity building (C23) Communication	2 1 2 2 2 1					

Annex B: Example Earthquake Risk Index Villa Canales, Guatemala

Main Factor	Indicator Name	Earth-quake weight	Scaled indicator value	Factor Scores
HAZARD		33		59
	(H1)/(H2) Occurrence (experienced/possible hazard)	20	1	20
	(H3)/(H4) Intensity (experienced/possible hazard)	13	3	39
EXPOSURE		33		52
	(E1) Number of housing units (E2) Lifelines	7 6	2 3	14 18
	(E3)Total resident population	10	1	10
	(E4) Local gross domestic product	10	1	10
VULNERABILITY		33		66
	(V1) Density (V2) Demographic pressure (V3) Unsafe settlements (V4) Access to basic services	3 3 1 1	2 2 1 2	6 6 1 2
	(V5) Poverty level (V6) Literacy rate (V7) Attitude (V8) Decentralization (V9) Community participation	2 2 3 1 2	2 2 2 2 3	4 4 6 2 6
	(V10) Local resource base (V11) Diversification (V12) Small businesses	3 2 2	1 3 3	3 6 6

	(V13) Accessibility	2	2	4
	(V14) Area under forest (V15) Degraded land (V16) Overused land	2 2 2	2 1 1	4 2 2
CAPACITY & MEASURES		33		31
	(C1) Land use planning (C2) Building codes (C3) Retrofitting/ Maintenance (C4) Preventive structures (C5) Environmental management	2 2 1 1 1	0 1 1 1 1	0 1 1 1 1
	(C6) Public awareness programs (C7) School curricula (C8) Emergency response drills (C9) Public participation (C10) Local risk management groups	2 2 1 2 2	2 3 1 3 1	4 6 1 6 2
	(C11) Local emergency funds (C12) Access to national funds (C13) Access to intl. emergency funds (C14) Insurance market (C15) Mitigation loans (C16) Reconstruction loans (C17) Public works	1 1 1 1 1 1 1	0 0 1 1 0 0 0	0 0 1 1 0 0 0
	(C18) Risk management committee (C19) Risk map (C20) Emergency plan (C21) Early warning system (C22) Institutional capacity building (C23) Communication	2 1 2 2 2 1	1 0 0 1 0 2	2 0 0 2 0 2