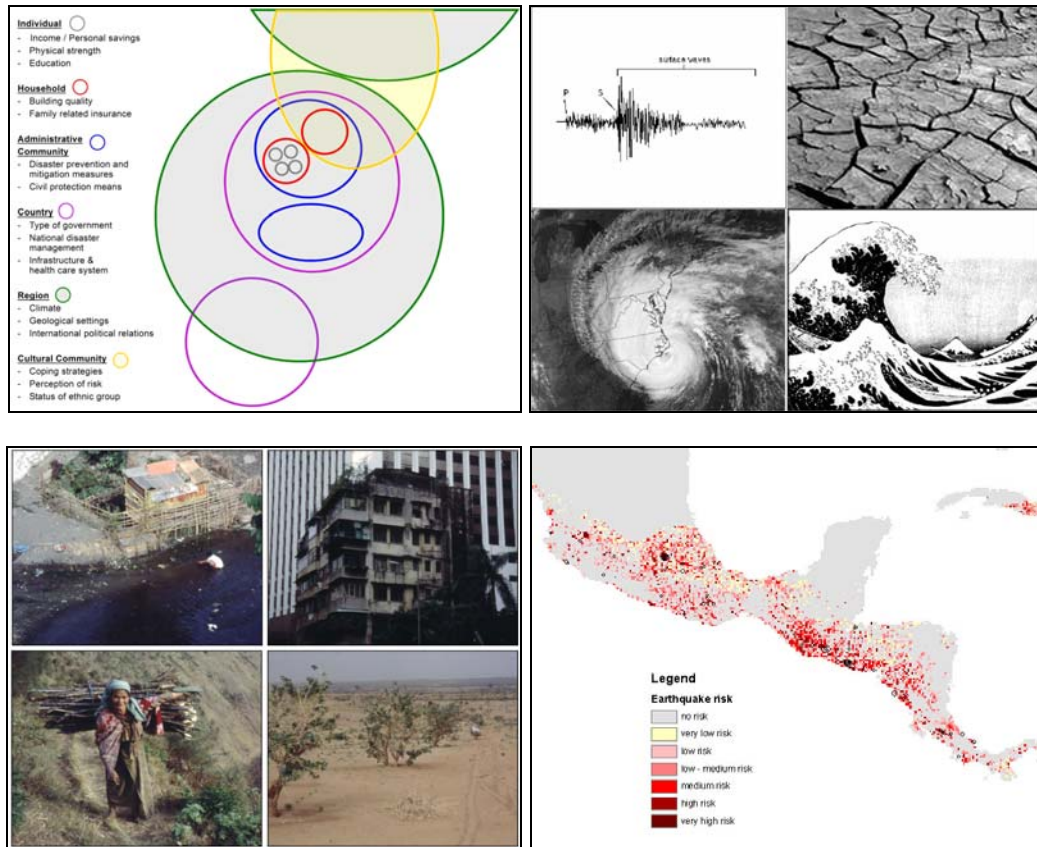


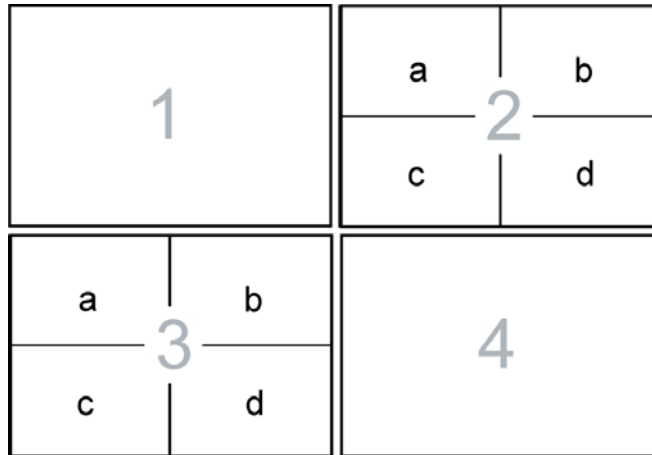
Risk and Vulnerability to Natural Disasters - from Broad View to Focused Perspective

Theoretical background and applied methods
for the identification of the most endangered
populations in two case studies at different scales



Stefan Schneiderbauer

Explanation for the front page:



- 1 - Conceptual diagram of social levels for vulnerability assessments
- 2 - a Example of a seismogram
b. Drying clayey soil in a riverbed
c. Satellite Image of hurricane Isabel (University of Maryland / NASA)
d. "The big wave" - illustration by Hokusai Katsushika
- 3 - a. Hut without sanitation facilities (Java / Indonesia)
b. Old and new building in Hong Kong
c. Woman collecting firewood (Java / Indonesia)
d. Desertification in Darfur / Sudan
3 a. - d. All photos taken by Stefan Schneiderbauer
4. - Section of a global map showing people's risk to earthquakes

*FREIE UNIVERSITÄT BERLIN
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Fachbereich Geowissenschaften*

Risk and Vulnerability to Natural Disasters - from Broad View to Focused Perspective

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Diese Abhandlung ist die Dissertation zur Erlangung des akademischen Grades
Dr. rer. nat. im Fachbereich Geowissenschaften der Freien Universität Berlin
vorgelegt von Stefan Schneiderbauer.

Gutachter: Prof. Dr. Bernd Meissner (Freie Universität Berlin)
Prof. Dr. Janos Bogardi (United Nations University/Universität Bonn)

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This work is dedicated to all
those uncounted and unnamed,
who suffered and continue to
suffer as a result to disasters.

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Zusammenfassung

Im Fokus dieser Studie stehen jene Bevölkerungsgruppen, die im ständigen Risiko vor natürlichen Katastrophen leben. Hauptanliegen der Arbeit ist es, theoretische Grundlagen zu erarbeiten und in der Praxis anwendbare Methoden zu entwickeln, die das Bereitstellen von Informationen im Vorfeld und im Verlauf solcher Katastrophen und Krisensituationen erleichtern. Ein Forschungsschwerpunkt liegt auf dem Potenzial moderner Technologien, insbesondere von GIS und Fernerkundung, die rechtzeitige Verfügbarkeit relevanter Daten in Krisensituationen zu verbessern und die notwendige räumliche Abdeckung dieser Daten zu gewährleisten.

Die Arbeit stellt häufig verwendete Definitionen der wichtigsten Begriffe im Bereich des Katastrophenmanagements zusammen und erläutert detailliert die verschiedenen Aspekte des Konzeptes der Vulnerabilität. Es wird eine eindeutige Zuordnung der Begriffe 'susceptibility', 'coping capacity', 'recovery', 'resilience' und 'vulnerability' zu bestimmten Phasen eines typischen Krisenablaufs vorgeschlagen, wobei Unterschiede im zeitlichen Verlauf von plötzlich eintretenden und sich langsam entwickelnden Naturgefahren berücksichtigt werden. Das Konzept von 'sozialen Ebenen' wird eingeführt und eine Liste potenzieller hasardabhängiger und hasardunabhängiger Indikatoren aufgelistet, um eine Risikoabschätzung von Bevölkerungen gegenüber Naturgefahren in unterschiedlichen räumlichen Maßstäben zu ermöglichen.

Anschließend erfolgt die Erläuterung einer Methode, die eine Identifizierung von hot spots bezüglich des Risikos von Bevölkerungen gegenüber Naturgefahren weltweit auf sub-nationalem Maßstab ermöglicht. Diese Methode wird exemplarisch an der Naturgefahr Erdbeben angewandt und die Ergebnisse auf einer Weltkarte visualisiert. In diesem Zusammenhang wird ein 'Composite Indicator' für die Einschätzung der Bevölkerungsvulnerabilität auf nationalem Maßstab entwickelt. Die Auswahl der relevanten Sub-Indikatoren dieses 'Composite Indicator' stützt sich auf statistische Auswertungen, insbesondere auf die Faktorenanalyse.

Bevölkerungsanzahl und -verteilung sind entscheidende Datensätze im Katastrophenfall, insbesondere für eine Einschätzung der Vulnerabilität betroffener Bevölkerungsgruppen. Aus diesem Grund wird eine Methode erläutert und in einem ländlichen Gebiet in Simbabwe getestet, die eine Abschätzung der Bevölkerungsdichte auf feinem sub-nationalem Maßstab erlaubt. Dabei erfolgt die räumliche Disaggregation von Zensusdaten aufgrund eines Geländemodells sowie Daten zur Infrastruktur, Siedlungsverteilung und Landnutzung. Das Testresultat unterstreicht das Potenzial des verfolgten Ansatzes, bereits existierende globale Bevölkerungsdatensätze sowohl in ihrer räumlichen Auflösung wie auch in ihrer Genauigkeit zu verbessern. Die entwickelte Methode kann prinzipiell auf andere Entwicklungsländer übertragen werden unter der Grundvoraussetzung, dass das erforderliche Mindestmaß an Lokalkenntnissen für den Modellierungsprozess vorhanden ist.

Abstract

The focus of the study is on populations threatened by natural disasters. It aims to develop the theoretical base and applicatory methods to support information generation before and during crisis situations. The work emphasises the deployment of modern technology, namely GIS and remote sensing, for an improvement in timely delivery and spatial coverage of relevant data in crisis management.

The work reviews definitions of crucial terms in the realm of disaster management and elaborates on the concept of vulnerability. It proposes a clear allocation of the expressions 'susceptibility', 'coping capacity', 'recovery', 'resilience' and 'vulnerability' to specific phases of a crisis, taking into account the difference in temporal development of slow onset and sudden hazard impacts. The concept of "social levels" is introduced and a list of potential hazard dependent and hazard independent indicators is provided, paving the way for estimating vulnerability of populations to natural hazards at various spatial scales.

A methodology is proposed in order to identify hot spots worldwide regarding people at risk of natural hazards at sub-national scale. This method is implemented and the results are mapped for the specific case of earthquakes. In this context the development of a composite indicator for the assessment of people's vulnerability at country level is suggested, which is based on theoretical findings elaborated earlier. The selection of relevant sub-indicators is carried out and supported by statistical analysis, namely the Factor Analysis.

Since population data is a crucial information layer within disaster management in general and for the estimation of populations' risk in particular, a methodology for the estimation of population densities at sub-national level is introduced. This method is tested for a rural area of central Zimbabwe. It allows the spatial disaggregation of district census data by applying a surface model based on a number of data layers describing the infrastructural, topographical and land use characteristics of the area. It was found that this approach has the potential to improve the spatial resolution and accuracy of existing population data layers and that it can be transferred to other developing countries when respecting the requirement of some local field knowledge for the modelling process.

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List of Acronyms

BCPR	Bureau for Crisis Prevention and Recovery
CI	Composite Indicator
CIFP	Country Indicators for Foreign Policy
CGIAR-CSI	Consultative Group on International Agricultural Research - Consortium for Spatial Information
CPI	Corruption Perception Index
DCW	Digital Chart of the World
EO	Earth Observation
ETM	Enhanced Thematic Mapper
FAO	Food and Agriculture Organization (UN)
GDI	Gender-related Development Index
GDP	Gross Domestic Product
GIS	Geo Information System
GLC	Global Land Cover
GNI	Gross National Income
GSHAP	Global Seismic Hazard Assessment Program
GVF	Goodness of Variance Fit
HDI	Human Development Index
HDR	Human Development Report
IDNDR	International Decade for Natural Disaster Reduction
IDPs	Internally Displaced People
IFRC	International Federation of Red Cross and Red Crescent Societies
ISDR	International Strategy for Disaster Reduction
JRC	Joint Research Centre
Ln	Natural logarithm
MAR	Minorities at Risk
MMI	Modified Mercalli Intensity
NIS	Newly Independent States
OCHA	UN Office for the Coordination of Humanitarian Affairs
ODA	Official Development Assistance
PCA	Principle Component Analysis
pga	Peak Ground Acceleration
pgv	Peak Ground Velocity
PRIO	Peace Research Institute, Oslo
pw	Pixel Weighting Value
SRTM	Shuttle Radar Topography Mission
SU	Soviet Union
TI	Transparency International
UN	United Nations
UNDP	United Nations Development Programme
UNISDR	United Nations International Strategy for Disaster Reduction
UNU - EHS	United Nations University - Institute for Environment and Human Security
WB	World Bank
WHO	World Health Organization (UN)
WMO	World Meteorological Organization

