1. Introduction

1.1 General

Earth, its atmosphere, and the water on and below its surface are continuously in motion. The Earth's crust consists of stiff plates that float on magma of the Earth's interior with velocities noticeable only in a geologic time scale. Along the mid-ocean ridges, the crust breaks open and is closed again by upwelling melted rock. New crust formed in such a way pushes the ocean plates apart; at other locations, for example along the subduction zones around the Pacific Ocean, they are submerged and melted. The plates are bound at their edges, and tremendous tensions gradually build and then unload in sudden dislocations. There, most volcanoes are formed and earthquakes happen. With velocities varying in a short time scale, water and air are circulating. The effect of the Sun's radiation and the Earth's rotation makes the air masses of the atmosphere flow around the Earth on paths that are affected by mountains and valleys and by thermodynamic processes. Eddies are generated causing extreme winds and cyclones that whip up the seas and inundate coastal lowlands with huge waves and storm surges. Mixing of cold air with warm, wet air masses causes water vapor in the air to condense, and precipitation, with sometimes extreme intensity, causes floods, surface erosion, and landslides. Other places suffer from droughts due to a lack of precipitation for many years.

Man is subjected to these natural forces, so he tries to avoid places that have frequent extreme events, or at least seeks protection at these places. He is not always aware of the threat from rare natural events, or he feels safe because of the long quiet time between extreme events, and he establishes settlements and industrial parks in disaster-prone regions. If the event actually occurs, man is helplessly exposed to its power

A natural hazard becomes a natural disaster if it causes severe consequences for men and environment: the more people who live in a disaster-stricken area, the greater becomes the extent of the catastrophe through loss of lives and property. In a lonely desert, a natural event may be very strong, but it will not lead to disaster. However, even a minor event can cause great harm in a poorly protected town.

Disasters induced by natural events may deeply affect the social structure of the area struck. Mature societies may fall apart, places of employment may be destroyed, and infrastructure built up during several decades may break down Their re-establishment often requires too much of communities and even of whole regions. The poorer a region, the deeper are the social effects of natural disasters. International support is given mainly for immediate relief after a disaster. For reconstruction, local resources have to be activated and supported by loans from foreign sources.

The distribution of the different natural extreme events over the Earth varies regionally. The *World Map of Natural Hazards* developed by the Munich Reinsurance Company (Fig. 1) shows the threats from various forms of natural events for all re-

gions in the world. Apparently, the most severe events occur in coastal zones and in regions of the Earth where many of the poorest developing countries are located. Population growth in these areas is particularly high, and people move into the metropolitan regions in endangered areas, or merge into areas that seem to have favorable living conditions, but at the same time are highly exposed to natural hazards. These newly arrived people do not know the local risks and do not care about preventive measures. Because of this behavior, the consequences of natural disasters are increased and relief measures are made more difficult.

Reduction of the effects of natural disasters is not only an urgent humanitarian task, but it also must be an important goal of foreign aid for those countries that were able to establish effective preparedness and prevention measures against disasters because of their fortunate geographic location, their education and knowledge, and their wealth. The entire world community is challenged to face this task and to contribute through common effort to the reduction of natural hazards and to the minimization of risks and consequences for society and the environment from natural disasters by applying all current knowledge and technical abilities.

1.2 The International Decade for Natural Disaster Reduction

The United Nations has made prevention and preparedness against disasters caused by natural extreme events their task and has declared the nineties as the International Decade for Natural Disaster Reduction (IDNDR). The initiative for this task was prepared by Frank Press, president of the American Academy of Sciences, who suggested a "Decade for Natural Hazard Reduction." His suggestion was expanded by the United Nations to include disaster preparedness and relief. The General Assembly of the United Nations unanimously passed Resolution No. 44/236 of December 22, 1989, proclaiming the International Decade for Natural Disaster Reduction (IDNDR). Based on the "Tokyo Declaration," an action plan for the IDNDR formulated by a commission of highly recognized experts, the international Scientific and Technical Committee (STC) for the IDNDR, whose members were appointed by the Secretary General of the United Nations, drafted a program for the Decade in March 1991. According to this program, the following targets shall be reached during the decade:

"By the year 2000, all countries, some through regional arrangements, should have in place, as part of their plan to achieve sustainable development:

1. **national assessments of risk due to various types of disasters (e.g., earthquakes, volcanoes, landslides, storms, tropical cyclones, floods, storm surges, tsunamis, droughts, bushfires, locust infestations, etc.);**
2. **national and/or local prevention and preparedness plans; and**
3. **access to global, regional, national, and local warning systems."**

These rather general targets shall be achieved by implementation of a detailed program consisting of the following ten goals:

Identification of hazard zones and hazard assessment

Results of such investigations are maps showing the different causes of damage against which planning, structural, and so-

cial measures have to be taken and the extent of their threat.

Vulnerability and risk assessment, cost benefit analysis
The degree of damage is determined by direct and indirect damage. Apart from direct physical damage, natural disasters have effects on industrial and agricultural production, employment, drinking-water supply, and medical care, up to the point of losses in the trade balance and effects on the investment climate. Costs of damage due to different extreme events have to be compared with the costs for different possibilities of prevention and preparedness measures.

Raising the awareness for disaster reduction at the level of decision and policy makers
Planning and implementation of prevention and preparedness measures depend to a large degree on how much importance political authorities attach to disaster mitigation. The competing needs of development planning have to be balanced against each other. The reduction of threat to human life, however, should be the primary development political principle.

Establishment of monitoring, prediction, forecast, and warning systems
Experience shows that one of the most effective measures for reducing damage as a consequence of natural hazards is a well-functioning warning system. Such a system must work operationally in order to enable necessary preparedness measures or the evacuation of an area in case of danger (e.g. before volcanic eruptions or floods). The systems are based on early identification of extreme events. They require an observation network, such as those used for active volcanoes, or as developed in many countries for the observation of the formation and growth of hurricanes and tornadoes.

Planning and construction of long-term preventive measures (structural, nonstructural)
Technical measures can prevent, or at least reduce, many natural risks. Earthquake resistant building for instance is generally possible against earthquakes of almost any given intensities. But, as with many other protection measures, the people or nations concerned must be able and also willing to bear the costs. Damage can partly be avoided by nonstructural measures as well. Examples are restrictions on building houses and other facilities in flood-prone areas through appropriate land-use planning or by shifting damage risks (e.g. of landslides) toward insurance companies that may—by adequate structuring of their premiums—help to deter settling in threatened areas.

Preparation of short-term preparedness measures and emergency plans
Extreme natural events cannot be prevented. However, their disastrous effects may be drastically reduced, if at the onset of an event, everybody knows what to do, and if the town or the country concerned had planned and implemented preparedness measures. Sandbags against flooding, as well as evacuation plans in case of volcanic eruptions, belong to these measures.

Early intervention measures
The mobilization of relief and rescue teams, local or from outside, together with equipment, medical aid, and food, has to begin as fast as possible. The coordination of actions by different organizations is an important part of disaster management. The point is to bring teams with sufficient expertise, ex-

perience, and adequate equipment to the disaster area in the shortest possible time and to ensure their most efficient service

Education and training of disaster personnel, public information
The people assigned to carry out disaster reduction measures have to be well trained in order to act effectively. It is necessary, especially in regions with a lower educational level, to organize training courses and courses for information and instruction. For these courses, a sufficient teaching staff must be available. One task of the staff will be to inform the public about the threats from natural hazards. For some protection measures, e.g. the sealing of low-lying parts of a building at imminent flood danger, people themselves can take the initiative. These actions should be pointed out to them.

Transfer of technology
The existing methods and institutions concerned with disaster prevention and management are based on experience and research results ranging from the design and operation of warning systems and the development of adapted construction and design technologies to the investigation of human behavior and medical care in disaster situations. This information is available in guidelines and codes, empirical accounts, and scientific publications. Well-equipped disaster services have been established in many countries. In numerous actions, these services have developed and proven their methods and procedures of disaster relief and preparedness. All this experience and know-how should be made available worldwide. The transfer of technology will be promoted by international conferences and training courses, data banks and expert systems, exchange of experience after major interventions, and the development of preparedness measures and warning systems through multi- and bilateral cooperation.

Research on improved technology and disaster management
The realization of the main ideas of improved disaster reduction cannot be achieved simply by transferring proven technologies from one country to another. On the contrary, for many of the above mentioned tasks, a solution is not possible without further research. Therefore, the first concern of the promoters of the IDNDR was to outline an international research program, such as those that already exist for other international tasks. This concern was the starting point for the activities of the Scientific Advisory Board of the German National Committee for the IDNDR.

The scientific program of the IDNDR will emphasize the interdisciplinary aspects of disaster research and disaster management. This emphasis becomes obvious through some initially chosen projects named "Decade Projects" by the international Scientific and Technical Committee for the IDNDR. Among these projects are a detailed program for research of the causes for the formation and paths of tropical cyclones, a program for comparative research of typical volcanoes, implementation of a generally valid risk analysis concept, and data banks for all types of extreme natural events. The IDNDR projects involve research, transfer of technology, and education. Some projects will be conducted by organizations of the United Nations; others are national and international projects that will be brought into the IDNDR program by the respective countries.

1.3 The working program of the Scientific Advisory Board

Following a proposal by Foreign Minister Genscher, a National Committee for the IDNDR was established in Germany in 1989. The Committee is assisted by two boards: one for operational aspects of disaster preparedness and disaster relief and one for scientific aspects of natural disasters. The latter is supported by the Deutsche Forschungsgemeinschaft (DFG, German Science and Research Foundation); its task is to define and present the German scientific contribution for the Decade

The Scientific Advisory Board was initiated by the DFG Commissions for Water Research, Atmospheric Sciences, Geosciences, and Oceanography and received further support from scientists in other fields, such as civil engineering, geophysics, geomorphology, volcanology, disaster research, disaster statistics, ethnology, social geography, and psychology. During its first year, the Scientific Advisory Board developed a framework concept for the German scientific contribution to the IDNDR. It was agreed amongst those involved that this contribution would not be realized through a totally new program, but rather through a collection and summary of all current research projects in Germany relevant to the IDNDR. This collection should be supplemented by a research program consisting of two parts: first, gaps in knowledge are to be closed through intradisciplinary studies in disaster-related research areas. Results of this part of the program are to be summarized in German National Reports for the Decade. Second, the chains from causes to consequences, inherent in a similar way in all types of disasters, should be investigated through interdisciplinary research.

For implementation of this concept, the Scientific Advisory Board saw the necessity to compile, as a first step, a state-of-the-art report in which knowledge about the different natural extreme events was collected and in which the state of the research, as well as the need for further research, was given. This state-of-the-art report was supported financially by the Foreign Office and was prepared by a large number of scientists and experts from different fields. The results are presented in the book „Naturkatastrophen und Katastrophenvorbeugung" (Natural Disasters and Disaster Reduction, in German). The book consists of contributions from the different fields of disaster-related sciences (chapters 2 through 7) and an introductory chapter summarizing the material and emphasizing those pieces of information essential for the scientific program. The following text is the English translation of the introductory chapter.

1.4 Abstract

The summary of the material comprising the state-of-the-art report is grouped according to the different types of natural extreme events. Results of investigations on the behavior of individuals and social communities before, during, and after natural disasters also are presented as this behavior substantially influences the extent of a disaster. In particular, the report consists of one chapter each about psychological and sociological aspects in connection with natural disasters, and five sections about different events, their causes, courses, and effects.

1.4.1 Psychological and sociological aspects

The chapters on psychological and social conditions, in connection with natural disasters, investigate the effects of natural extreme events on human reactions and interactions. The threat and effects of natural disasters on individuals and society are analyzed using specific psychological and sociological methods. Typical patterns of behavior that increase the extent of damage and rules for preparedness and the mitigation of consequences are revealed. Human behavior as a triggering factor for disasters with slow or sudden onset also is examined. Among other factors, the desire for insurance coverage determines protection measures, but, at the same time, the structure of the insurance premiums influences the behavior of individuals. Psychological and sociological aspects are relevant for all types of hazards and are presented at the beginning of the report.

1.4.2 Earthquakes

Effects of earthquakes touch many areas of human societies. Despite an improved understanding of the processes before, during, and after an earthquake, scientists still are not able to predict large earthquake events. Warning and evacuation are possible only in a very few cases. Earthquakes are characterized by sudden onset and are much more likely to catch people by surprise than are other natural events. International research is necessary to improve early warning methods. Protection measures must concentrate on the earthquake-resistant design of structures. Structural engineers are called upon to transform the achievements in seismology into design standards that can serve as a base for the design and construction of earthquake-resistant buildings. Development of simple and inexpensive solutions for residential buildings in economically less developed countries is especially important. Furthermore, information to and education of the population with regard to behavior during and after an earthquake is crucial. Earthquakes not only cause catastrophic damage by direct destruction, but they trigger other natural disasters such as landslides. They are well suited for interdisciplinary research of the sequence cause-effects-consequences. A task force team of experts from different fields sent into a disaster area immediately after an event may help to promote the development of preparedness measures considerably.

1.4.3 Volcanoes

The location of potential volcanic eruptions is usually rather well known, and long-term regional planning near high risk volcanoes may avoid great disasters. Knowledge of the different types and products of eruptions and of the histories of dangerous volcanoes is urgently needed. Based on observation, early warning can be given and evacuation can be carried out because volcanic eruptions are usually indicated weeks or months in advance by tremors, tilting, temperature increase, or gas emissions. During the IDNDR, a number of high risk volcanoes will be selected; these *decade volcanoes* will be studied intensively through extensive international cooperation. Accompanying actions, such as training courses and public information campaigns, will play an important role. Volcanic eruptions often have far-reaching effects on the environment; they incriminate water courses (e.g. Pinatubo in the Philippines, 1991), or they

induce—by gas injections, especially SO_2—the formation of widespread aerosols in the stratosphere that may influence the global climate, such as what happened after the eruptions of El Chichón in Mexico, 1982, and Pinatubo, 1991.

1.4.4 Landslides

Mass movements occur either slowly as slope creeping or quickly as landslides or rockfalls. Sudden landslides are rarely original events; they are often triggered by other natural events such as earthquakes or long-lasting, heavy rain. In turn, the catastrophic consequences of mass movements, as a rule, do not threaten men and buildings by direct burying, but often result from secondary effects. Landslides into reservoirs are particularly dangerous as the soil or rock masses may make the water spill over the dam and even lead to its collapse. Such events have caused catastrophic floods downstream from reservoirs (e.g., Vajont in Italy, 1963). If a landslide forms a barrier in the course of a river, like in the Veltlin in Italy in 1987, the river is dammed up. If the water overflows, the dam breaks and a flood wave rushes down the valley. Landslides are subject to laws different from those of other natural disasters that initiate them. Therefore, they are regarded as separate and not as secondary natural events.

1.4.5 Floods and droughts

Inundations cause the greatest damage worldwide. Disasters are caused by floods resulting from heavy precipitation or snowmelt, by storm surges created through the interaction of strong wind and high tidal waves, and by the occurrence of tsunamis (for instance after a submarine earthquake or landslide). Storm surges have threatened the inhabitants of low-lying coastal flatlands for centuries, and a sea-level rise as a result of climate change will increase the risk in these areas. In recent years, flood disasters have become more serious because of their effects on water quality. Pollutants enter drinking water aquifers during floods, and waste-water discharges from settlements and industrial plants pollute rivers during low-flow periods and eventually endanger even the marine ecosystems. Erosion of agricultural areas, water courses, and along coasts are phenomena with potentially catastrophic consequences. Water shortage due to long-term drought may lead to disaster. In the beginning, the shortage does not cause significant harm, but it may develop to more and more perceptible and finally serious catastrophes.

1.4.6 Storms

Even in a country rarely afflicted by natural disasters, such as Germany, storm damage can occur. Windstorms as causes of disasters have increased dramatically in recent years. The series of gales in Western and Central Europe in spring 1990 caused, according to the Munich Reinsurance Company, economic damages of 25 billion German Marks, more than any previous natural disaster. A tremendous disaster potential exists in the form of tropical cyclones and tornadoes. Often, extreme precipitation that can induce floods, erosion, and landslides accompanies strong winds. Analyses and forecasting of storms and extreme precipitation are among the most difficult tasks meteorologists must face.

2. Psychology

Psychology is the science of human cognition, emotions, and behavior. In our context, the subject of investigation is man as a cause of natural disasters and as being affected by them.

2.1 Situation in view of a natural hazard

Investigations on human reactions to hazards indicate that risk awareness definitely exists, but the dangers are often misjudged (over- or underestimated). Seriously endangered people may develop coping strategies: however, common strategies are to deny and ignore the danger or to overestimate the chances for protection

Preparedness measures generally are accepted and considered necessary and useful. When supplied with sufficient information, individual measures are taken but frequently not to the necessary extent. Public institutions rather than oneself are regarded as being responsible for such measures. The efficiency of existing measures is often overestimated. People living in frequently struck natural disaster regions learn how to live with the danger and how to protect themselves better. Investigations on the propagation of risk awareness and campaigns to promote individual preparedness measures come to an important conclusion: values and convictions and modes and limits of the human way of processing information must be taken into consideration.

2.2 Situation in view of the warning of an imminent disaster

A warning can be successful only if the people in danger actually perceive and understand it. Another important question is whether the information comes from a credible source. Furthermore, the reliability of warnings will increase considerably with confirmation through other sources and through temporal and regional specification Besides hinting at the imminent danger, the warning also should include information on suitable protection and counter measures. The sensitivity of the warning system (e g from what level of danger onward a warning is delivered) may, in case of several warnings, influence observance of the warning

2.3 Situation during a disaster

Panic is a relatively rare phenomenon that arises only if the people concerned perceive a serious and direct danger, if the possibility of evacuation appears more and more imminent, and if appropriate communication about the situation is not available. The observance of, or resistance to, evacuation measures depends on different aspects: first, the existence of direct hints about the disaster and the credibility and assessment of the source, and second, fear for the property left behind. Evacuation will be more effective if the evacuation routes, check points, and destinations are known. An information and evacuation center will provide particulars on the disaster, on available shelter, and on

available assistance. The provision of a "family and neighborhood message center" to enable communication between relatives is advisable

2.4 Situation after a disaster

Because of the range and scope of disaster, emotional stress and psychological problems are noticeable (i.e., depression, irritation, etc.). Children and the elderly are particularly vulnerable. Relief should include social work components. social and psychological care especially may help to handle immediate traumatization and to reduce the likelihood of post-traumatic stress disorders Appropriate training of relief personnel is of key importance. Besides severe and strong emotional reactions, different behavior patterns, modes of evaluation, and coping strategies are noticeable in the aftermath of disastrous events.

2.5 Psychological research on risk and stress

Psychometric risk research is the investigation of how man perceives and assesses different risks with which he is confronted. Laymen do not assess risks according to the actual consequences as experts do. Instead, they orient themselves by other characteristics, such as how voluntary is their risk confrontation or their supposed control over the consequences Thus, considerable discrepancies may occur between the actual danger and the assessment by laymen.

Risk communication is the exchange of information between groups and individuals about risks to health or environment. In disaster situations, communication is a basic requirement for successful management of danger. Therefore, the collapse of normal communication channels as a direct or indirect effect of a disaster is a serious problem. Furthermore, effective risk communication depends on clearly defining who is responsible for decision making. In general, warnings and instructions for evacuation and behavior are distributed effectively only by mass media.

The *psychological research of stress* studies the reaction of people to oppressive or even disastrous events and how they cope with these situations Stress is caused by requirements that one faces, but sees no way to meet. There are different ways to handle stress. By using problem-oriented strategies, the individual will try to influence or change the threatening situation directly. Emotion-oriented strategies are not aimed at managing the situation itself, but at controlling the emotions released by the imminent danger. Understanding of the nature and development of such stress situations is an essential precondition for successful crisis intervention and, therefore, should be emphasized during the training of relief staff.

2.6 Man as a cause of natural disaster

The influence of man on nature may increase the negative consequences of natural disasters. Through certain actions, man evokes changes that seem quite insignificant when viewed separately that may, however, have disastrous effects in the long run. Therefore, it is necessary to analyze the ecological awareness of people and to stimulate appropriate ecological behavior. Statistics on ecological awareness in Germany indicate that citizens attach a high priority to protection of the environment as a political task. At

the same time, this awareness results in only limited changes in ecologically relevant habits. The reasons for this phenomenon are:

Conditions frequently enhance and encourage individual behavior that degrades the environment, whereas ecologically adequate behavior is rather impeded. Besides, the personal advantage of behavior degrading the environment often becomes immediately obvious, whereas the consequences of negative behavior are delayed and have to be borne not just by the individual but by the community as a whole. Another unfavorable factor is the experienced disproportionality between the globality of the problem and the locality of individual action. Environment-related behavior takes place in an exceedingly complex, integrated, non-transparent, and dynamic context. Thus, even good intentions may lead, because of errors in reasoning, to fateful decisions and measures. Frequent mistakes in the approach to nature are insufficient analysis of the situation and neglect of the negative side and long-term effects.

2.7 Research needs

Based on the above remarks, the following research priorities and measures to stimulate research are viewed as particularly relevant for the IDNDR:

Research priorities:

- risk awareness and risk communication;
- preventive behavior and safety psychology;
- psychological disturbances in victims of disaster,
- structure and dynamics of commons dilemma situations;
- reasoning and action in complex, dynamic situations;
- ecological awareness and ecological acting; and
- training of relief staff in the field of psycho-social care for victims.

Measures to stimulate research:

- support of individual studies on the mentioned topics; and
- support of interdisciplinary studies in developing countries, for instance in connection with seasonally recurring natural events (heavy precipitation, storms) with consequences similar to disaster.

3. Sociology of disaster

The primary goal within the framework of the IDNDR is effective disaster mitigation in each member country To reach this goal, the evaluation of potential disasters and proneness to domestic disaster is crucial. Both will be assessed through (worst-case) scenarios. An insoluble interaction between society and environment/nature has to be taken into account.

Within the context of disaster sociology and taking into account the knowledge of natural science and its technical and organizational realization, the question arises about the prevailing level of acceptance and behavior of the population. Which sociocultural developments could have made the disaster so striking that the environment became dangerous to live in and how to meet them efficiently have to be examined. In any case, "disaster" also is the unwanted result of long-term social acting (social processes).

3.1 General outlook and most urgent needs of interdisciplinary communication

A closer look at the term disaster reveals that the conceptualization of disaster depends upon socially constructed interpretations within which disastrous events are perceived. However, individual perceptions derive from the entire set of cultural assumptions, including science and technology, politics and religion, and knowledge and experiences. Thus, the perception of disastrous events and how to cope with them are intertwined.

Consequently, disaster relief and protection have to correspond with the modes of cultural interpretations in effect when disaster strikes. In most cases, an unsuccessful disaster reduction results from an inappropriate application of local conditions and cultural assumptions. Thus, an inventory of the regionally predominant mixture of perception of and reaction to disastrous events is as necessary as an evaluation of the factual vulnerability, the existing preventive capabilities, and the available resources. As a matter of fact, no such data exist on a worldwide basis despite the necessity for adequate planning, preparedness, and logistics and for optimized missions of disaster relief work. However, supranational organizations like UN, UNHCR, etc., urgently need an objective basis for their disaster relief work A first step might be an atlas that organizes and visualizes these data. To achieve such a world-wide *disaster reduction atlas*, an initial exemplary version should be developed within a 3-year research program:

1 basic spatial model of the atlas processing three states of the Federal Republic of Germany;
2. upgrading of the spatial model with the expertise of all relevant data being processed by the sciences included in the German IDNDR committee; and
3. upgrading of the model toward applicability, transfer to particularly disaster-prone areas, and testing

Existing expertise has to be coordinated and prepared for the transfer to other regions. Existing/assumed resources need to be

modified or converted to be able to display their effects. A mutual understanding among the specialists in various disciplines working for this project at different levels is necessary, but is otherwise predicted as a result of this work. The project should be pushed forward by a quick-alert unit (*task force*) of natural and social scientists who are permanently in contact with the IDNDR committee.

3.2 Sociological modeling

From a sociological viewpoint, disaster is a result of processes in society. It develops in accordance with the state of society, striking or creeping, and sets in at the concurrence of social developments favorable to the disaster. The task of disaster sociology consists of analyzing this social change. The analysis of change may, if put into practice, already have preventive effects.

A disaster represents an extreme of social change in no less than three dimensions: it is *radical*, it is *accelerating*, and it is *magified* through ad-hoc statements of the people concerned. The dimension of *radicality* hereby ranges from processes utterly separated from to extremely interacting with each other. The dimension of *rapidity* ranges between the extremes of utter delay and extreme acceleration. Finally, the dimension of *rituality* (creation of patterns) ranges from rational-causal understanding to irrational-causal understanding.

The model should proceed analytically from the assumption of failure in order to be able to develop means of effective prevention and mitigation. What appears unthinkable and imponderable must be faced and controlled.

3.3 The macrosociological model FAKKEL

The process model FAKKEL, being developed for disaster relief, is based on the assumption that disasters are under way for a long time in society. During this process, they are characterized by interwoven relations within society. Various processes of problem solution are basically conceivable. Applied to the phenomenon of disaster, a differentiation can be made between the adequate solution (i.e., the solution is radical, the problem is satisfactorily solved for all people involved), the equivalent solution (i.e., the problem is somehow solved), and the antagonistic solution (i.e., there is a good chance to take further advantage of the people involved).

In the model FAKKEL, the instant "disaster" may be followed up over six phases (Figs 2 and 3):

- **F**riedensstiftung—peacemaking (certain urgent problems are solved satisfactorily for everyone);
- **A**lltagsbildung—establishment of everyday life (risks are being forgotten, the central moment of danger is shifted aside; the social distance in regard to this problem between relief experts and relief laymen increases),
- **K**lassenformation—class formation (the relation between relief experts and relief laymen is being deranged);
- **K**atastropheneintritt—onset of disaster (risks within the surroundings become striking; neglected side effects and consequential problems of the formerly peacemaking solution culminate);
- **E**nde kollektiver Abwehrstrategien—end of collective defense strategies (basic needs can no longer be covered

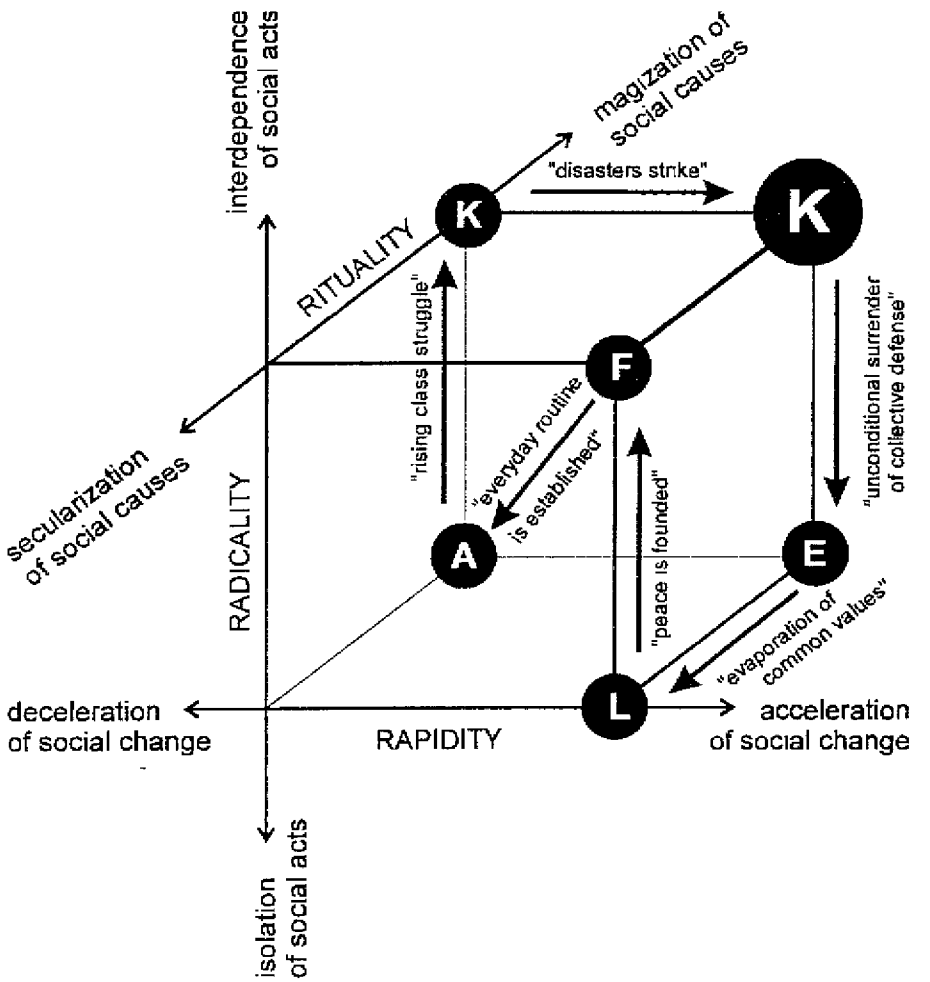

Figure 2: The model FAKKEL as three-dimensional representation of social change (after Clausen)

collectively, scapegoats are being looked for); and

- Liquidation der Werte—liquidation of values (all certainty about norms has failed, misery is reality).

The phase model in figure 2 depicts mutual interferences of long-term process developments under social change, including technical and infrastructural changes as well as changes in attitudes and values. Based on this model, a further, model-assisted methodology was developed at the Disaster Research Center in Kiel that corresponds with the immediate reactions of the people directly concerned.

On the basis of empirical data, the phase model LIDPAR was outlined. This model is addressed to the experts of disaster relief and to the population During the stage of

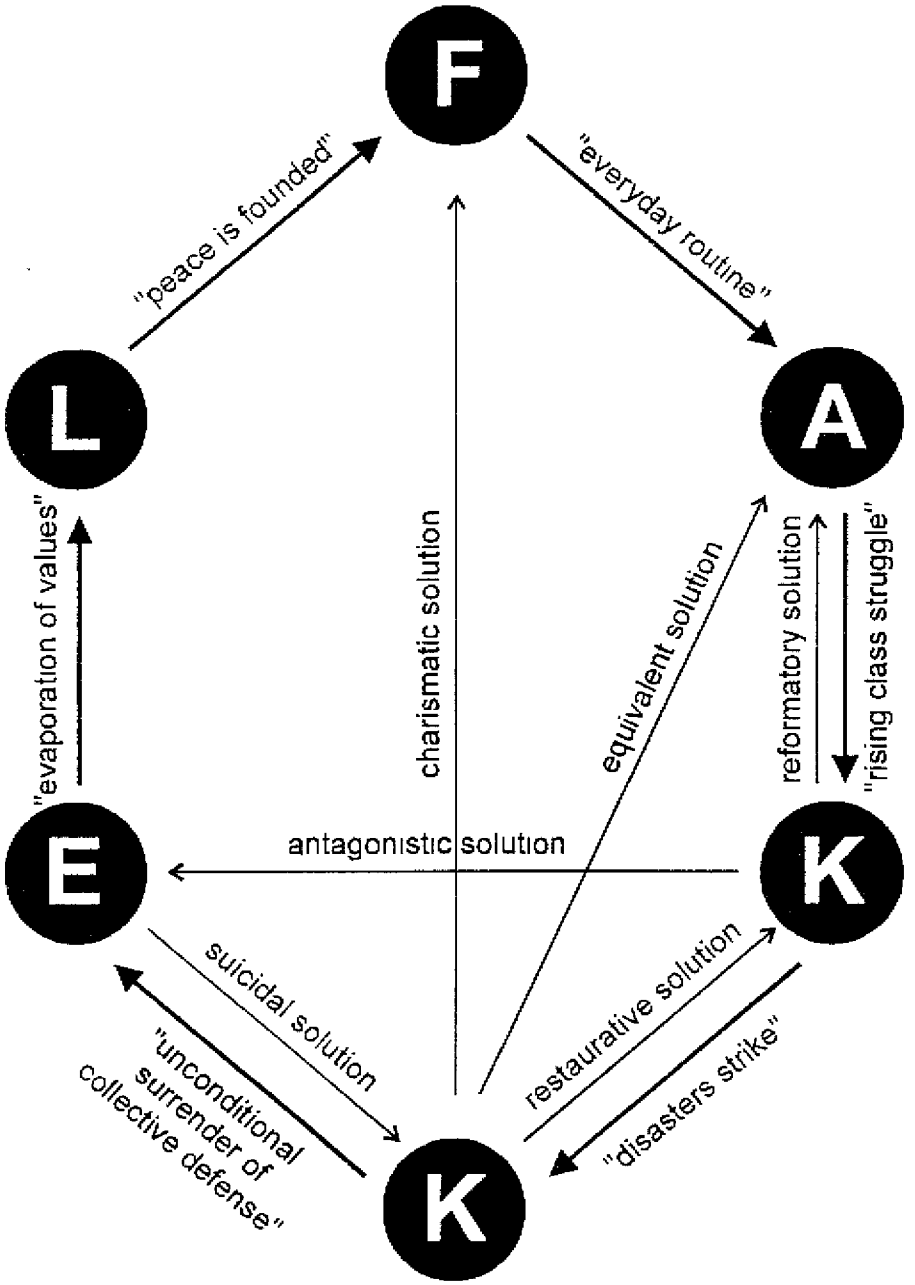

Figure 3: *Empirically elaborated form of the model FAKKEL (after Clausen)*

disaster onset, six phases proceed (Latency, Identification, Definition, Personalization, Action and Feedback (in German, Rückkopplung). Each of these six phases of coping contains characteristics relevant for acting that may, according to the requirements, be transformed for working out disposition profiles.

3.4 Effective disaster management from the viewpoint of sociology of disaster

The successful management of crisis involves elements of reaction as well as of prevention. These elements have to be considered systematically, taking into account the conditions in the respective region. Preventive and defensive disaster relief has to be tailored to the conditions of the particular society; otherwise, it will not be accepted.

Interactions among disaster management and the fields of socio-cultural surroundings, scientific and technical development, and regional planning have to be included. Cooperation among respective natural sciences and psychology researchers offers possibilities to reduce the fatal effects of magization of disaster origination. With the help of a necessarily cooperative management of crisis, appropriate measures will be flexibly carried out for the sake of the people concerned. What a natural disaster means for the particular society, how specific protection measures can be found and initiated, and how to organize the mutual exchange between helpers and people in need of help have to be ascertained.

Therefore, sociological prediction for disaster preparedness and relief are relevant within disaster research. A prediction can be transformed into a successful action if a solid theory is at hand. From earlier disasters, further data may be gained by epignosis in order to add these to the above mentioned disaster reduction atlas and to develop preparedness measures.

Warnings lead to a sensitization of the population if the event actually happens. If the event does not happen, the threshold of sensitization sinks. Accurate warnings launched in time minimize failure, and chances of survival grow. Prior to implementing warning concepts, knowledge of the effects and the acceptance of warnings among the population of different societies is required, including the effect of warnings if the probability of a natural event (e.g., an earthquake) is still very much uncertain.

The structure of the institutions responsible for disaster preparedness in a society should be known as exactly as possible in order to enable the adoption of appropriate measures for improvement. It has to be stated in sociological terms which federal or central structures and which potentials of self-help are available.

3.5 Identification of regional disaster hazards

The improvement of existing concepts of disaster management and the implementation of new knowledge into these concepts should be enhanced on the basis of national programs. The compilation of an expansible disaster reduction atlas would allow identification of disaster potentials first on a regional level, then on a national level. A transformation of the knowledge gained in one federal state of Germany (e g. Schleswig-Holstein) could be effected to other re-

gional units with possibly other hazard priorities Later on, an internationalization would follow. In Germany, challenges are seen in the field of data connection of disaster hot-line systems National data networks could be integrated into international networks (e.g. UNIENET)

3.6 Quantification of risk potential

A first necessity for quantification of risk potential will be a standardization of terms (e.g., *damage, disaster*) to be used by all involved scientists. The next step, based on the first, will be an agreement on the possibilities of damage quantification Damage quantification depends on the quality of damage registration. From an economical point of view, evaluation and assessment of damages need improvement because insurance companies cover only evaluated risks. The question about social costs is more or less unsettled; as a rule, insurance companies do not register damage that happens to non-insured persons Thus, the determination and evaluation of possible damages (costs of social risk) need an institutionalization as well.

The proneness of systems to malfunction grows with their increasing complexity, which implies a rising potential of unexpected synergistic aggregate effects due to assumed individual effects, mainly of events not even recognizable as dangers within the system. The increasing frequency of events with capital damages, as recorded by insurance companies, is correspondingly explained by the growth of the world population, the concentration of people and values in cities, the rise in living standards, the colonization and industrialization of disaster-prone regions, the segregation of especially vulnerable groups (e g., settlements of elderly people), or risky technologies.

The extent of a disaster depends on the vulnerability of the concerned society and its capability for regeneration Effective mitigation requires interdisciplinary cooperation among natural and social scientists within the framework of the IDNDR. The improvement of disaster management also includes the identification of individual preparedness potential and ways to enlarge it. Furthermore, how protection of the population in case of disaster may be politically guaranteed must be specified. In any case, the consideration of social conditions and circumstances is of vital importance for disaster mitigation in the concerned countries.