

NATIONAL REPORT OF SWEDEN  
Prepared for the IDNDR mid-Term Review and the 1994  
World Conference on Natural Disaster Reduction

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## I. OVERVIEW AND EXECUTIVE SUMMARY

- **Executive Summary**
- **Context and Country-Specific Issues**

### SWEDEN

The IDNDR-work in Sweden is being co-ordinated by the Swedish Rescue Services Board. Together with other governmental agencies and institutions it forms a contact group for IDNDR.

Some countries, for instance Germany, the United States and Canada, have formed national committees.

These committees normally have three major tasks:

1. **Mapping of national vulnerability to natural disasters**
2. **Establishing early-warning systems**
3. **Education**

Up till now it has not been considered necessary to establish a Swedish national committee. All three points mentioned above are already being taken care of within the regular preventive and rescuing activities carried out by governmental agencies and institutions in Sweden.

1. **Mapping of national vulnerability to natural disasters**
2. **Establishing of early-warning systems**

The major risks in Sweden like in many other north European countries are not natural disasters, but man-made, technological disasters. The major part of the activities and the resources of the rescue services in Sweden are directed towards prevention and mitigation of the latter.

The type and magnitude of the natural disasters that hit Sweden are relatively minor from an international perspective.

As a matter of fact it is questionable whether these events that occur in Sweden really should be described as disasters. Accidents might be a better word.

The reasons for this are several:

- Geographical setting, climate and bed rock conditions
- The country is sparsely populated
- Authorities at national, regional and local level are aware of the risks and take these into consideration when planning.
- Information is given to regional and local authorities when there is a high risk for storms, forest fires or high water along the coastline.
- Warnings are given out to regional and local authorities when there is a high risk of flooding from rivers.

All these factors contribute to the fact that Sweden has been spared from large scale natural disasters. In 1977 there was a landslide in Gothenburg which killed nine people and destroyed 67 buildings. This is the largest natural disaster to have occurred in recent years.

### 3. Education

All personnel within **the rescue services** receive education on rescue operations in connection with landslides, floodings, storms and other types of natural disasters.

**Evacuation** from schools and hospitals is regularly practised. Last year it was the theme of the yearly "Fire Protection Week". It is also one of the themes in the education material being produced by the Swedish Rescue Services Board for the compulsory school.

Educational material and hand books for the personnel responsible for **mapping** the risks at regional and local level have also been produced.

Risk mapping is compulsory for all municipalities.

The personnel and the organization handling the minor natural disasters that hit Sweden has been proven to function well in **rescue operations abroad** in connection with large scale natural disasters, as well.

By order of the Swedish government the Swedish Rescue Services Board is on stand-by for immediate emergencies such as natural disasters and refugee aid.

Three Swedish experts, two from the Swedish Rescue Services Board and one from the Fire and Rescue Brigade in Stockholm, have been assigned to the Stand-By Team, that by order of DHA/UNDAC should go to a place of disaster in order to co-ordinate the international rescue operation.

The Swedish Rescue Services Board also has an agreement with UNHCR as to putting up personnel and equipment at their disposal when necessary at short notice.

The rescue team can be organized and equipped according to the type of rescue operation at hand, for instance earthquakes, floodings or wild fire and should be prepared to leave the country 10-12 hours after a governmental decision.

During July 1992 large areas of **Latvia** were hit by wild fires. To help in the mitigation Sweden sent an expert team of 26 persons and material, helping out with command and co-ordination.

The Swedish Rescue Services Board is also assisting several countries, among them **the Baltic States**, to create national bodies for rescue services and to educate fire brigade and rescue services personnel.

The Royal Institute of Technology (KTH) is at present engaged in two programmes related to natural disaster reduction in the **developing countries**.

It is also engaged in a programme named Sustainable Use of Water

resources, which is focused on Southern Africa. The Royal Institute of Technology, further, has completed an inventory of Swedish institutes involved in water resource management in developing countries.

The Swedish Meteorological and Hydrological Institute is developing hydrological models in several places in Southern America, and in Zimbabwe. It is also helping the Baltic states in building up their meteorological institutes.

The Department of Geophysics is continuously engaged in various programmes related to Natural Disaster Reduction (Earthquakes), for instance in a project of early earthquake warning and seismic hazard assessments.

#### SCHEDULED ACTIVITIES FOR THE REST OF THE DECADE

The Swedish government has the intention of continuing the activities within the frame work of IDNDR, in much the same way as during the first half of the decade.

The main focus of IDNDR should be on action-oriented projects - that have a real effect "on the ground".

#### Nationally:

In it's program planning for the period of 1994-1999 the Swedish Rescue Services Board has decided, as an overall goal nationally, that:

- Damages caused by natural disasters shall be limited as much as possible.
- The breaking of dams shall be prevented

In order to obtain this:

- Areas at risk for natural disasters such as landslide and flooding, should be included in the physical planning at different levels. The mapping of such areas should be carried out in municipalities with high risk of such disasters.
- The possibilities to predict natural disasters, for instance flooding, should be considered in connection with planning and carrying out of rescue operations.
- Down stream larger dams, warning systems shall be installed giving information about the condition of the dam as well as the safety of the inhabitants in the area.
- High dams (more than 100 m) should be monitored for micro earthquake activity around the water reservoirs.
- Measures taken against natural disasters with the help of state financing shall be well motivated and prepared. The effects of measures carried out shall be followed-up systematically.

#### Creation of a Swedish risk centre

The Swedish Rescue Services Board has pointed to the area of risk,

as one of its areas of priority in the years to come.

In order to create a general risk awareness the Board has run educational programs, acted as "consultant" towards municipalities and regional bodies and issued hand books and advice.

The next step ought to be the creation of a centre for research and training in the field of risk, vulnerability and safety.

Studies of the feasibility of such a centre have already been started up.

#### Internationally:

Sweden will continue to support programs that have a demonstrably beneficial effect on recipient countries' capacity to mitigate or respond to disasters.

The projects should be oriented towards the needs of the region in question. Preferably the regions should consist of natural, geographical areas of co-operation.

The Swedish Rescue Services Board estimates that in the future it will have an increased involvement in international rescue activities. The costs for stand-by amount to about 120.000 USD. The rescue activities as such are partly financed by UN, partly by special resources provided for by the Government on a case-by-case basis.

#### **Build-up of the rescue services organizations in the Baltic states**

The Swedish Rescue Services Board will systematically and step-by-step develop the co-operation with the Baltic states during the period 1994-1999.

#### **Export of services**

The Swedish Rescue Services Board considers the Board to have the capacity, together with other bodies within the Swedish rescue services, to export its services.

This could be:

- analyses, in order to improve an activity or organization and consultancy in developing projects,
- training of fire brigade and rescue services personnel in Sweden or in the country of the customer
- sale or procurement of equipment
- planning and designing of structures for prevention or rescue services and participation in construction

The other governmental agencies and institutions taking part in the Swedish IDNDR-work plan on continuing their work along the same line, as at present.

## II. RISK ASSESSMENT

- Hazard Assessment

- Meteorological Hazards
  - Floods

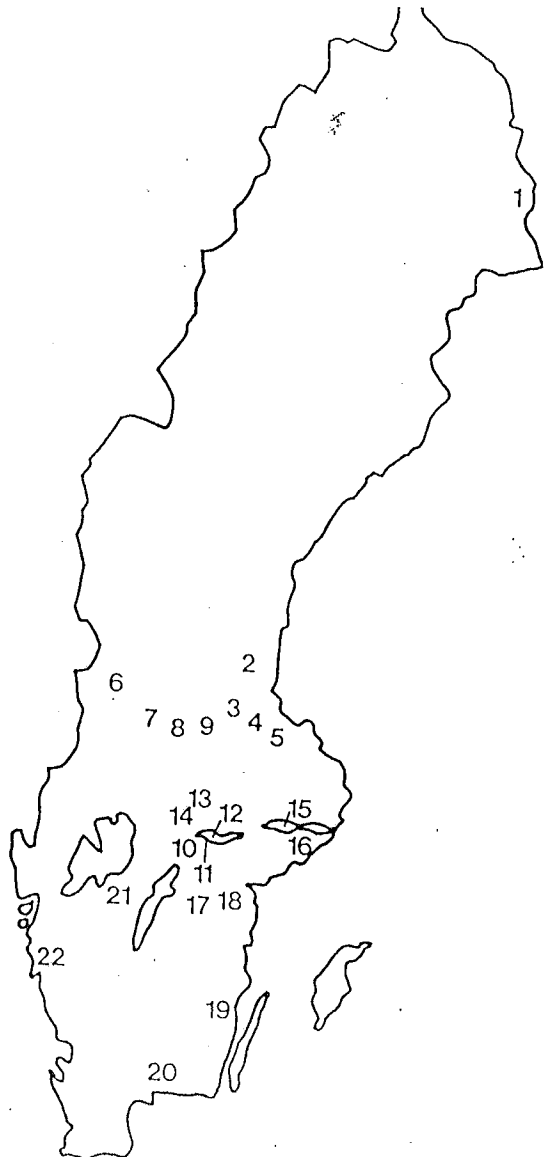
Floods are to a certain extent predictable, both in time and space. Methods exist for making prognosis as well as charts depicting areas at risk.

Sweden has a rather stable level of precipitation. The rainfall in the largest part of the country is 500 - 600 millimetres per annum. In the inland of Norrland and in the coastal zones of the Baltic, however, it is less, some 400 millimetres, but in western Götaland and in the mountainous districts at the Norwegian frontier larger, some 700 respectively 1 000 millimetres per annum.

The amount of water carried vary depending on the time of the year, but also between years. Large precipitation when lakes are already filled and the groundwater level is high can lead to high flows, which floods in recent years have shown. The consequences of the floods in 1977 and 1985 were major construction damages, but no casualties.

Areas surrounding the following rivers and lakes are frequently flooded:

1. Torneälven, Juoksengi - Haparanda
2. Voxnan, Voxna - mynningen i Ljusnan
3. Testeboån, Åmot - Strömsbro
4. Jädraån, Jäderfors - Sandviken
5. Gavleån, Forsbacka - Gävle
6. Västerdalälven, Transtrand - mynningen i Dalälven
7. Vanån vid Vansbro
8. Dalälven Borlänge - Avesta
9. Faluån och Runn
10. Svarten, Hasselfors - Örebro
11. Täljeån, Mosjö - mynningen i Hjälmaren
12. Hjälmaren
13. Arbogaån, Lindesberg - Kungsör
14. Dyltaån, Nora - mynningen i Väringen
15. Mälaren
16. Kilaån, Jönåker - mynningen i havet
17. Roxen
18. Glan
19. Emån, Målilla - Emsfors
20. Helgaå, Knislinge - mynningen i havet
21. Tidan, Tidaholm - Mariestad
22. Mölndalsån vid Mölndal



In Sweden there are about 10.000 dams of different sizes. About 140 are higher than 15 meters. Most of them have been built in connection with water power plants. Others are built to hold the waste water from mines.

- Storms, hail and lightning

Accidents due to storms, hail and lightnings make up a large proportion of all natural hazard "disasters". Sweden, in comparison with many other countries, really couldn't claim to have any disasters, what we experience on rare occasions amount to no more than accidents.

Coastal areas are more prone to get hit by storms than other areas.

The number of days of thunder in Sweden yearly vary from 10-16 in the south and less than 5 in the north of the country. (A day of thunder defined as a day when an observer at a meteorological station has heard the sound of thunder).

Perhaps a more accurate way of measuring the frequency is the automatic lightning detecting system. According to that, lightning is registered in Sweden almost every day.

In Sweden thunder appears during winter together with snow, as well as during summer. The number of lightning flashes in wintertime is low, but they are of a very high energy.

The high resistance of the ground in most parts of the country, moreover, results in larger radius of action than in many other countries - the low discharge capacity leading to the spreading of lightning surge in affected wires over a larger area and with higher amplitude.

A study conducted in 1989 by the Institute for High-Voltage Research, at the University of Uppsala shows the connection between lightning and an increase in number of fires, caused by electrical faults. The lightning damages the system and finally results in a fire, often a couple of days or weeks after the lightning occurred.

-Geological hazards  
- Earthquakes

Large, destructive earthquakes have occurred during the last 10 000 years also in the Fennoscandian Shield. There are geological evidence for this phenomenon. During the last two centuries, several large earthquakes have occurred in the Scandinavian area. Some of these earthquakes (e.g. the Oslofjord quake 1904 and the Bodö shock of 1819) have shown an intensity of ground shaking which on the intensity scale is clearly destructive.

Sweden is a comparatively stable geological area with shallow quakes that seldom surpass 4 on the Richter scale. Several seismic areas can be distinguished in Sweden, e.g.:

- the area around lake Vänern
- the coast of north Sweden

Locations of recorded and/or felt earthquakes in Sweden from 1375 to 1992 are exhibited in the attached map.



EV TOT: 312

EV SEL: 312

M = 3



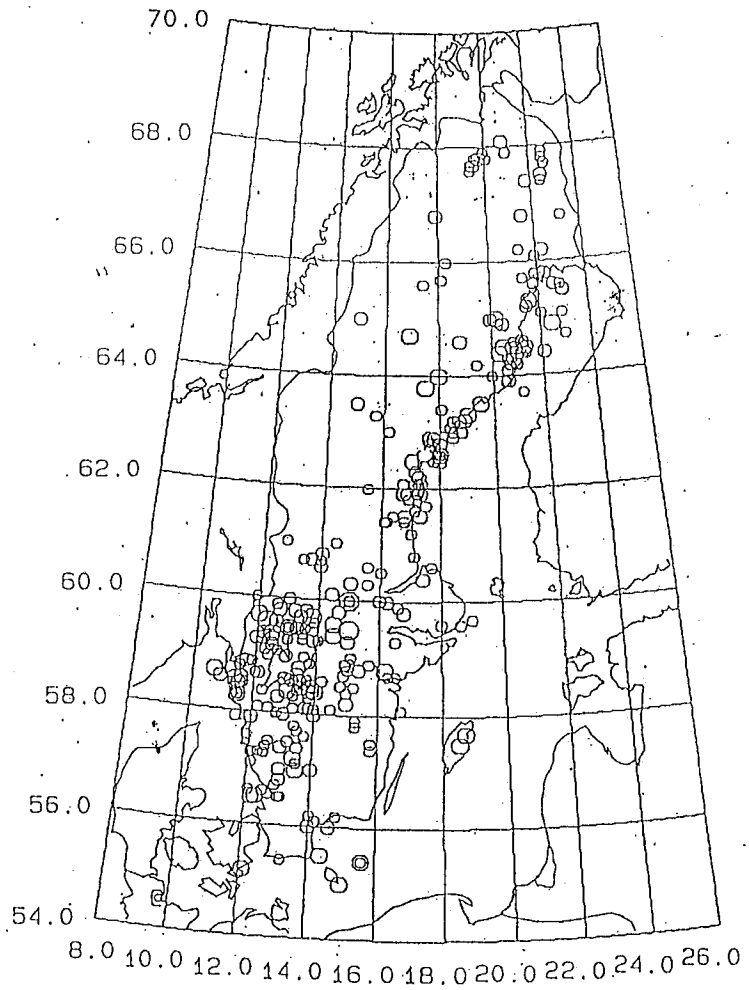
M = 4



M = 5



M = 6

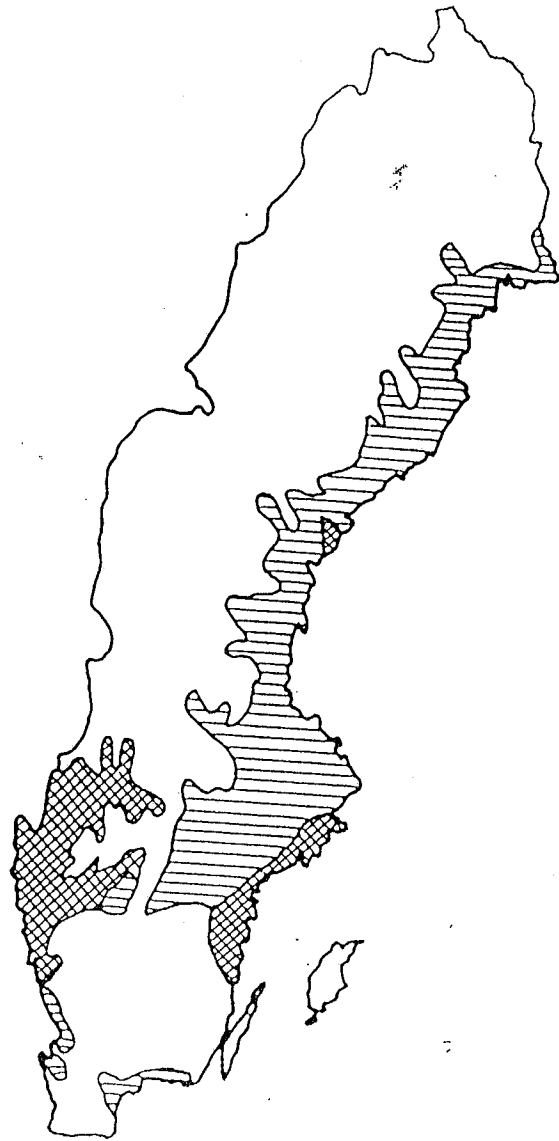


Earthquakes in Sweden 1375-1992 for magnitudes  $\geq 3.0$ . Total number of events equals 312.

## - Landslides

In Sweden there is approximately one major landslide every ten year (a major landslide defined as a landslide with an area of more than 10 hectar) and one large landslide (defined as having an area of more than one hectar) every other year.

Sweden can be divided into areas with a rather high frequency of land slides (checked areas) and areas with a relatively low frequency of landslides (striped areas)



(Source: Stål, Viberg, SGI)

Geological conditions for landslides exist in some 200 municipalities

The direct costs for landslides in Sweden amounts to around 6 million USD yearly. The indirect costs - production losses, depreciation of property values and costs for the society are difficult to assess. To that should be added psychological and

social consequences.

- Coastal erosion

A problem that has been recently acknowledged is coastal erosion. Even if the phenomenon is slow and cannot be described as an accident, it can cause sudden damage like slides. The factors behind the coastal erosion are hard wind and subsidence.

- wild fire

The area of Sweden totals 450 000 km<sup>2</sup> (175 000 square miles) of which 40 000 km<sup>2</sup> (15 600 square miles) is water. 55 % of the land consist of productive forest land.

The lakes of Sweden serve as good water reservoirs.

For about a century, in each decade there have been eight comparatively moist and cool summers, and two warm and dry with a heavy increase in number of forest fires. As a general rule the majority of forest fires occur in April-May. During dry summers there is generally a second period, with heavier damage in July-August.

Almost any part of Sweden can experience forest fires.

Forest fire statistics and damage

Both frequency and damage will vary within wide limits, depending on the seasons weather. Since 1975 there are no statistics available.

Year	Number of forest fires			Damage: Burned productive forest area, ha
	Total	Queched as incipient		
		Number	per cent	
1954	578	216	37	573
1959	7093	5462	77	4501
1964	3099	2074	67	2245
1975	5833	4725	81	2653

Both 1954 and 1964 come within the limits of a "normal" season.  
1975 was a "dry" year.

### **- Vulnerability assessment**

- The type and magnitude of the natural disasters that hit Sweden are relatively minor considered from an international perspective. As stated earlier in this report it is questionable whether these events that occur in Sweden really should be described as disasters. Accidents might be a better word.

The reasons for this are several:

- Geographical setting, climate and rock base
- Sparsely populated country
- Authorities at national, regional and local level are aware of the risks and take these into consideration when planning
- Information is given to regional and local authorities when there is a high risk for storms, forest fires or high water along the coastline
- Warnings are given out to regional and local authorities when there is a high risk of flooding from rivers

All these factors contribute to the fact that Sweden has been spared from large scale natural disasters. In 1977 there was a landslide in Gothenburg which killed nine people and destroyed 67 buildings. This is the largest natural disaster to have occurred in recent years.

Status of Mitigation Strategies and Measures including:

- Land-Use Planning, Water and Forest Management and Building Codes and Practices
- Preparedness and Planning
- Awareness and Training
- Land-Use Planning, Water and Forest Management, Building Codes and Practices

The Planning-and Building Act (PBL) is a very comprehensive legislation. It regulates the municipalities planning of housing and other uses of the land.

When the Planning-and Building Act is applied one should also take into consideration the general rules of the Natural Resources Act. The Planning-and Building Act forced all municipalities to endorse a key plan before the 1st of July 1990, which shows how the municipality plan to use it's land.

This key map is supposed to form the basis for the detailed plan and decisions concerning different areas, which are legally binding as opposed to the key plan. The municipality has to follow these detailed plans when they decide on building permits, among other things.

The county administrative board checks that the municipalities planning is in accordance with existing rules and what effects the ruling of one municipality has on the neighbouring municipalities.

The following paragraphs in the Planning-and Building Act are concerned with the issue of health and safety.

Buildings should be located on land suitable for the purpose considering:

1. the health of the residents and others
2. ground and water conditions
- 3 the possibilities to provide communications, water distribution and sewage system and other forms of public service
- 4 the possibilities to prevent water- and air pollution and too high noise levels

The general overview of the planning and building practices in Sweden is entrusted to the National Board of Planning.

The Natural Resources Act regulates the economizing on land and water. It is supposed to be used together with other regulations, for instance the Planning-and Building Act. It stipulates how different types of land and water areas can be best used and how certain areas of national interest, for instance certain coastal zones, rivers and river stretches, can be protected.

In order to prevent fire the opinion of the Head of Rescue Service in the municipality shall be taken into account when planning large scale timber felling or peat digging.

During the forest fire season the local Board of the municipality may decide on a general prohibition on lighting fires if there is a high fire-risk (fire hazard 4-5).

A person who by carelessness causes a forest fire in nature may be sentenced for carelessness, grave carelessness or causing public danger.

Everyone between 18-65 years old has to help with rescue work and fire fighting when ordered to.

The Swedish Rescue Services Board is the central authority responsible for civil protection and the rescue services in Sweden. Amongst other things the Board must:

- \* coordinate society's resources for civil protection and the rescue services
- \* follow technical developments affecting the rescue services
- \* monitor the growth of risks and work for the prevention of accidents
- \* develop a system for warning the civilian population in peace- and wartime
- \* plan and carry out training for personnel for the rescue services

The Board supports the municipalities in different ways in their duty to make an inventory of and evaluate the risks affecting the municipality.

A recent poll (1992) shows that 28% of all Swedish municipalities have done/are doing a complete inventory of all risk objects, 42 % have done/are doing an inventory of some risk objects, 18 % are planning such an inventory and 12 % are not planning such an

inventory at the moment.

Most of the municipalities use a handbook on risks, as a tool in their inventory work. The handbook was issued by the Board in the late 80's. In 1992 the Board also issued a sample of case studies to serve as a tool for continued analyses.

- Awareness and training

It is vital to create a risk awareness in the municipalities. The Board together with the regional authorities in six regions therefor run a special project, aiming at making politicians, employees working for the municipalities and civilians aware of the risks in their municipality and to promote a discussion of possible actions to reduce these risks.

Together with other authorities ( the Central Board of Real Estate Data, the Central Office of the Land Survey, the National Maritime Administration, the Geological Survey of Sweden and the National Board of Civil Emergency Preparedness) the Swedish Rescue Services Board is organizing a risk planning day open to all politicians and employees within municipalities and county administrative boards responsible for environmental issues, rescue services, social- and emergency planning.

This will take place in the beginning of 1994 and will show how you can reduce damages to man, property and environment before, during and after an accident with the help of landscape- and real estate information.

Another important task for the Board is to increase the knowledge of risks and how accidents can be prevented among the public in general.

In order to change behaviour you really need to start with the very young, who have not already established their own habits.

The Board is therefore working with the prevention of fire on local, regional and national level. The Board, together with the non-governmental organization SBF, put together a material to be used in the compulsory school - one package aimed at children in the second grade (8 year olds), the second aimed at children in the fifth grade (11 year olds). In the autumn of 1992 the material was ready for distribution and up till now about 40 % of the 8- and 11 years old in Sweden have been given lectures on civil protection.

What the children are being taught:

The material for the 8 year olds

- things you should not play with - chemicals, matches
- what to do if a fire breaks out - get out quick, stay below the smoke, close the doors thus smothering the fire, call 90 000/112
- if a fire breaks out at school - how to evacuate, where to find the fire extinguishing equipment
- if a fire breaks out in your home - how to get out
- important signs you need to know - emergency exit and others
- the rescue service - how does it work

The material for the 11 year olds:

- the same subjects as for the 8 year olds, only more elaborate

- alarm signals - in Sweden different types of signals are used to warn the citizens. Learn how to recognize the signals and what to do if any of these signals are sounded
- risks in the area where you live

There is also another type of school material, aiming at young people in the 8th grade (15 years old). This material deals with preparedness against all types of hazards. Among other things the students are asked to make an inventory of the risks in the municipality where they live and ask their politicians and civil servants what they have done or are planning to do in order to minimize these risks.

Everybody needs to know what to do in case of a disaster/accident. The Board together with several non-governmental organizations including the Red Cross, is educating the population during evening classes.

A special project is being run in sparsely-populated areas. These people must take on the responsibility of their own safety and must be able to help themselves, awaiting the arrival of the rescue service from the nearest municipality.

#### IV WARNING

##### - **Systems for Observing, Forecasting and Warning**

- Meteorological
- Geological
- Wildfire

The following measures have been undertaken in order to improve the systems for observing, forecasting and warning:

- Meteorological

Long-term preventive measures

Hydrological modelling of extreme floods in Sweden.

Status: Completed. Publication: Hydrological modelling of extreme floods by Joakim Harlin, The Swedish Meteorological and Hydrological Institute (SMHI), RH Report No 3, March 1992.

Participating institutions: SMHI, the Swedish river regulation enterprises, the Royal Institute of Technology in Stockholm

Costs: Approx. 100 000 USD

Sources: River regulation enterprises, SMHI

Land-use and risk management

Title: Floods in Sweden - Trends and Occurrence

Status: Completed

Participating institutions: Mainly the Swedish Meteorological and Hydrological Institute

Costs: About 50 000 USD

Sources: The Swedish applied research program for dam safety and floods during extreme hydrological conditions

Weather forecasting

Title: High Resolution Limited Area Model (HIRLAM). Development of an operational weather forecasting model. Application in this context: Warning for hazardous weather

Status: Project period: April 1992 - October 1996

Participating institutes: Swedish Meteorological and Hydrological Institute in cooperation with the weather services in Finland, Denmark, Norway, Iceland, the Neatherlands, Ireland, France and Spain

Sources: Participating weather services, Nordic Council of Ministers, CEC

Implementing agencies: Participating weather services

- Geological

Earthquakes

In Sweden, a national network is run by the Uppsala University. The network is analog and plans exist to build up a modern digital network for research and continuous monitoring of the Swedish and global seismicity to be used in hazard assessments and other studies.

The National Defence Research Establishment (FOA) also is active in the field of seismology and is operating 2 array stations in Sweden.

Landslides

In order to prevent landslides the Swedish Rescue Services Board has paid for key maps in fourteen municipalities during 1992/93. The maps provide information about which areas need to be studied further concerning stability.

13 different objects in twelve municipalities received support for preventive measures against landslides and other natural disasters



in 1993. The Swedish government in December -93 decided to invest some 3 million USD in the forthcoming year on preventive measures in 13 municipalities against landslides and other natural hazards. The decision is based on a risk evaluation based on material provided by the Swedish Rescue Services Board in cooperation with the Swedish Geotechnical Institute and the Swedish Meteorological and Hydrological Institute.

The same amount - 3 million USD - has been invested every year since 1987 as a part of the preventive programme against slides.

The Swedish Geotechnical Institute (SGI) has been working with landslide problems since its start in 1944. Safety questions in planning and the use of slide prevention techniques in construction are central duties for the institute. SGI is working in all phases of the municipality planning and building process regarding landslide problems with

- \* landslide risk mapping
- \* stability investigation and analyses
- \* design of stabilization work
- \* landslide warning systems

Advice to municipality planners and engineers and short term courses to different categories are also part of the SGI work in landslide risk management.

The Swedish Commission on Slope Stability - a commission of the Royal Academy of Engineering Sciences - was founded in 1988 for the purpose of handling research, development and information on landslide matters. The main task of the Commission is to initiate and coordinate research and give information about slope stability and land slides, as well as methods for preventive measures. The work of the Commission is financed by research grants and fees of the members and will continue up to 1996.

The Commission on Slope Stability will work in the purpose of the IDNDR declaration.

The work of the Commission will be concentrated on the following priority areas:

- \* Information and education to different parties concerned
- \* Slope behaviour (Stresses and strains in slopes and methods for analyses and calculations)
- \* Reinforcement measures ( Erosion protection, stabilization methods, environmental aspects)

The most important working tasks of the Commission are:

- \* to formulate Research and Development (R & D) programs and give priority to R & D efforts
- \* to initiate R & D or through the working groups accomplish R & D tasks
- \* to make sure that there are enough economical and personal resources to carry out the R & D programs
- \* to follow up and evaluate R & D in the various areas
- \* to make available R & D result and inform about them
- \* to ensure that the R & D results are put to practical use, i.e. supervision, advice and guidelines
- \* to disseminate information about slope stability to different appropriate National and Local authorities and other parties

\* to act as a discussion forum between different parties concerning stability matters

- Land-use Planning, Water and Forest Management

Many natural disasters are provoked by acid rain, pollution, waste and interference with nature. Modern society is putting strain on the environment. In order to prevent natural disasters it is important to understand this and to be aware of the natural conditions.

The Geological Survey of Sweden (SGU) produces national thematical maps in the areas of environment, health and physical planning. The purpose of the maps is to provide an environmental-geological decision basis for planning and actions. The work being done within SGU in connection with IDNDR could be described briefly as follows:

\* Radiometric maps. The measured results are used among other things for radon risk maps. In connection with the Chernobyl accident the radioactive fallout over Sweden was being detected with the help of radiometric maps.

\* Acidification sensitivity maps showing the resistance to acidification of the ground and the groundwater.

Vulnerability maps give information about where actions are needed and what type of actions are needed in order to protect the ground water and the water catchments in the municipality. The map can also be used when preparing road recommendations for the transport of dangerous goods and for preparing action programs for sensible sections of the road.

Geochemical maps provide information for judging the site quality class and for connecting environment and environmental related illnesses in human beings and animals. Moreover the maps provide information about registered large contents of heavy metals due to local geological factors or to human activities.

#### Wild fire

During the forest fire season the Swedish Meteorological and Hydrological Institute performs prognostic and warning services for forestry.

The latent forest fire hazard depends on a number of meteorological factors: the moisture of the atmosphere, soil and rainfall, solar-radiation, air temperature and wind. The SMHI estimates the fire hazard values and sends them to the SOS-centres, relating to the forty prognostic districts into which the country is divided.

The measurement of the temperature and relative air moisture is performed at 1 o'clock p.m.

The degree of fire hazard is indicated as follows:

- 1= very low fire hazard
- 2= low fire hazard
- 3= normal fire hazard
- 4= great fire hazard

5= very great fire hazard

Hazard values 3 to 5 can be followed by a warning for thunderstorms. A stands for risk for thunderstorm, B for great risk.

The SMHI issues forest fire warnings on the radio and television when required, in order to call the attention of the public to the danger of fire. They also provide help with forecasts during the fire fighting.

In addition to the forecasts regular airborne patrolling of forested areas are conducted.

The general directions for carrying out the patrolling are as follows:

By fire hazard 1: As a rule no patrolling

By fire hazard 2: As a rule no patrolling

By fire hazard 3: As a rule no patrolling

By fire hazard 4: Two overflights

By fire hazard 5: Three overflights

## V. INTERNATIONAL COOPERATION

### - Cooperation with other national IDNDR Committees

None so far

### - Projects implemented and assistance (technical, financial, training) provided to other countries

#### THE SWEDISH RESCUE SERVICES BOARD:

##### Education

Fire brigade personnel from Spain have received education in, among other things, technique and tactic in fighting wild fires on several occasions.

A similar education, though of a somewhat smaller scope, has been carried through with fire brigade personnel from Russia, Estonia, Saudi Arabia, Singapore and USA.

##### Co ordination of the rescue services in the Baltic States

The Baltic States after their indepenence have expressed a wish to make their rescue services more efficient. Sweden is helping Estonia, Latvia and Lithuania to create a national body corresponding to the Swedish Rescue Services Board.

##### SRV Rescue Team

The Swedish Rescue Services Board (SRV) has created a so called Rescue Team for operations at short notice abroad. The rescue force can be organized and equiped according to the type of rescue operation foreseen, for exampel earthquake, flood, wild fire or chemical accident. The rescue force consists of 5 to 100 men, depending on the scale of the emergency and can leave the country 10-12 hours after a governmental decision.

##### Emergency planning abroad

Deliberations on Swedish participation in setting up national emergency plans are under way.

### Wild fire mitigation in the Baltic States

During July 1992 large areas of Latvia were hit by wild fires. To help in the mitigation Sweden sent an expert team of 26 persons and material. The Swedish team above all helped out with command and co-ordination.

### Risk analyses

In order to help the municipalities the Rescue Services Board issued a handbook in risk analyses within the rescue services. The handbook is useful in the preventive work against natural disasters, as well as other types of emergencies.

The handbook has been translated into English and published by UNEP, thereby becoming available internationally. Translations into French and Spanish are under way.

### THE DEPARTMENT OF GEOPHYSICS

provides training on academic level in all branches of seismology. Several programmes in Natural Disaster Prevention are going on for Central America (CEPREDENAC), East Africa and other regions.

### THE ROYAL INSTITUTE OF TECHNOLOGY (KTH)

is at present engaged in two programmes related to natural disaster reduction in the developing countries.

The first programme is the Natural Disaster Prevention in Central America (CEPREDENAC), which is administered and co-ordinated by the Centre for International Technical and Educational Co-operation (CITEC) at KTH, and supported mainly by Sweden and Norway.

The second programme is called "Sustainable Use of Water Resources (SuWaR)". The programme does not directly address disaster reduction problems, but has a close relationship with water-related disasters in Southern Africa, South Asia and Nicaragua. Experience from the programme could in the future be utilized for a more pronounced regional water-related disaster reduction programme.

### Prevention of Natural Disaster in Central America

Due to particular climatological, tectonic and soil structure conditions Central America is one of the regions in the world most affected by natural disasters.

Natural phenomena like earthquakes, volcanic eruptions, landslides, floods and hurricanes often hit the region, collecting their toll of human lives and damaging property and social and economic structures.

The specialized Technical Institutes and the Emergency Organizations in Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama created a Centre for co-ordinated actions on Natural Disaster Prevention in Central America (CEPREDENAC) in 1988.

As part of its contribution to the peace and the integration process in Central America, Sweden has supported the Centre from the very beginning, through a Programme that includes technical and scientific assistance from different Nordic institutions.

The Programme is co-ordinated and administered by the Centre for International Technical and Educational Co-operation (CITEC) at

the Royal Institute of Technology (KTH), Stockholm and financed by SIDA and SAREC, from SWEDEN, as well as NORAD, from Norway. DANIDA, from Denmark, is also supporting a flood prevention programme with the Centre.

The Programme involves around 20 institutions from 6 Central American countries and 10 institutions from 3 Nordic countries

(SIDA - Swedish International Development Authority, SAREC - Swedish Agency for Research Co-operation in Developing Countries, NORAD - Norwegian International Development Agency, DANIDA -Danish Department of International Development Co-operation)

## Conceptual Framework and Projects

### Natural Disaster Reduction

The overall objective of the Programme is the reduction of natural disaster, that is, to take actions so that the impact of natural phenomena is less disastrous.

### Natural Hazard Assessment

As a point of departure, the technical and scientific aim is to define where and possibly when or how often a potentially destructive phenomenon can occur, through the application of well established technology to the assessment and delimitation of natural hazards. These activities include studies in Seismology, Vulcanology, Hydrology, Meteorology, Geotechnics. Consequently there are specific projects in the Programme that deal with these subjects.

### Vulnerability Analysis

The hazard maps produced allow the assessment of vulnerability; that is, to define whether there is population, infrastructure, lifelines, etc, located at places that have been assessed as hazardous.

### Risk Assessment

With the above material, risk can be assessed by calculating the probability of a destructive phenomenon to strike on elements that have been defined as vulnerable, and the estimation of resulting losses.

### Disaster Mitigation

These studies are necessary for the sanctioning of building codes, land use regulations, etc, and lead to the definition of criteria and recommendations to planning authorities, for the implementation of mitigating measures.

### Disaster Preparedness

In order to be better prepared when a disaster strikes, the Programme has projects on fields such as Geographical Information Systems, Radio Communications, Emergency Planning, Disaster Management and Mutual Assistance.

The following activities are carried out within the projects of the Programme:

### Earthquakes

The Central American Seismographic Network is being reenforced and densified thorough purchase and installation of equipment, in order to improve the data collection on seismic activity in the region. The instruments of the Network are calibrated regularly, in order to obtain reliable and meaningful data.

Regional and national Seismic Data Centres have been established and are in operation, for compilation and processing of seismic signals and digitalization of historical seismic data (Norwegian financing).

Seismic Zonation and Seismic Hazard Assessment are being performed, based on analyses of historical accelerograms and of soil response to strong motion (Norwegian financing)

Thanks to the Programme, the enhancement of the region's capacity in Seismology has been quite impressive. In order to ensure that there are personnel to make effective use of this capacity, an educational project of Seismotectonic Regionalization has started (SAREC financing).

#### Volcanoes

Seismic Monitoring of volcanoes - an effective way to predict volcanic eruptions - is being performed, Volcanic Hazard Maps are being produced for potentially dangerous volcanoes and a Vulcanological Data Bank has been established for information on the historical behaviour of the volcanoes.

#### Floods

Flood-prone basins in each country have been selected, for which detailed meteorological, hydrological and topographical studies are carried out in order to perform Flood Vulnerability Analyses. This project is closely related to two other regional projects, one on Stream Flow Forecasting and Flood Alert, financed by Denmark and another one with the World Meteorological Organization (OMS) financed by Finland.

#### Landslides

All six countries have compiled national landslide hazard maps and dangerous slopes are being monitored, particularly in populated areas. Risk maps will be produced. Equipment has been provided to strengthen the soil laboratories in the region.

#### Atlas of Natural Hazards

The result of studies on Natural Hazards are compiled in a somewhat simplified Geographic Information System, installed and operated by the Emergency Organizations in the country.

#### Emergency Planning

A uniform methodology on how small geographical units - such as neighbourhoods and villages - can themselves outline their own Emergency Plans, has been defines and implemented in pilot areas.

#### Mutual Assistance and Rapid Response

Mechanisms to diminish migration and customs obstacles were defined, so that countries can assist each other immediately in case of disasters.

#### Regional Co-ordination

Maintenance and Spare Parts Service, and asistance for more specialized operational routines are available to the institutes of the region.

### Regional Seminars on Natural Disaster Reduction

In order to provide the Central American Region with a forum on Natural Disaster Reduction, seminars for the authorities concerned are arranged periodically.

### Training Courses

The Programme puts strong emphasis on human resources development. Therefore, one of its most important components are the training courses, that deal on subjects directly related to the projects and are arranged both in Central America and in Scandinavia.

### Creation of mechanisms of co-ordination

The Programme has been very successful, contributing to peace and integration and to a new, creative working atmosphere, especially considering the difficult initial conditions when the CEPREDENAC Programme was started. The region was torn by armed conflict and co-operation for natural disaster prevention was non-existing. Besides the individual accomplishments related to the different projects, perhaps the Programme's main achievement has been the creation of mechanisms of co-ordination that make it possible for the institutions to give an integrated response to the severe natural hazards that afflict the region.

These mechanisms enable not only access to resources provided by external co-operation, but also a very active horizontal co-operation among the countries in the region. The Centre constitutes an adequate forum for the countries to jointly formulate strategies and policies in order to confront natural disasters more effectively.

The Project has strongly contributed towards improving the working capacity and in turn the results, as well as the relations and division of work among the participating institutions.

In a way the CEPREDENAC Programme constitutes an untried endeavour in the sense that there is no knowledge of a similar experience of tackling the problem of exposure to Natural Disaster from at least four different angles at the same time:

- \* The regional approach
- \* The inter-disciplinary approach
- \* The development of human resources approach
- \* The horizontal co-operation approach

This "model" has proved valuable, allowing a more rational and effective use of the resources and might be considered appropriate to similar cases of co-ordinated activities in other regions of the world, regardless of whether they deal with Natural Disaster Prevention or with other fields of knowledge.

### Water Resource Management and Disaster Reduction

Water is now recognized as an ultimate constraint to development. It is also one of the major causes of disaster. Draughts and floods together affect more people per year than any other type of disaster. Recent droughts in Southern Africa and floods in South and East Asian regions have attracted the attention of the donor communities on water related disasters in the developing countries.

Since January 1992, CITEC, has been engaged in a programme named Sustainable Use of Water Resources. The focus of the programme is on the drought vulnerable Southern Africa but it also include case studies on flood protection projects in Bangladesh and pollution of groundwater caused by industrial and sewage discharge in Southern India and Nicaragua.

Even though the focus of the programme is on water management, the following programme activities are intended to promote understanding of problems which are related to disaster reduction measures.

#### Water Scarcity in Southern Africa

Due to it's arid climate Southern Africa is highly vulnerable to drought. The prolonged drought period that recently afflicted the region has generated a great deal of attention of the international donor community towards water resource management problems to reduce impacts of future droughts.

CITEC recently completed a study on water scarcity problems and potential conflicts over sharing of the scarce water resources.

#### Flood Protection Projects in Bangladesh

Bangladesh is vulnerable to floods. After the severe floods in 1987 and 1988 a five year Flood Action Plan has been prepared and is now financed by different donors and co-ordinated by the World Bank. As a part of the action plan, CITEC was commissioned to make a study with recommendations to improve land acquisition and land registration systems in Bangladesh. CITEC also completed parallell studies on environmental impacts and operation and maintenance of flood protection embankment projects that are partly supported by SIDA.

#### Groundwater Protection Plan in Nicaragua

Groundwater is a major source of water supply in Nicaragua, especially for the capital city Managua. Pollution of groundwater due to discharge from industries, sewage and garbage dumps are rapidly becoming a serious threat to the urban population in Nicaragua. One of the worst affected areas is the southern watershed of the Lake Managua. CITEC is presently engaged in preparing a plan to protect groundwater from pollution. The objectives of the plan are to draw guidelines for general protection against pollution within a recharge area and to focus on areas that have special protection needs.

#### Inventory of Swedish Resource Base

CITEC has completed an inventory of Swedish institutes involved in water resource management in the developing countries. The main objective of the inventory was to document the fields of specialization and activities of Swedish institutes that could be utilized by SIDA and other aid agencies to implement water related programmes. The inventory indicates that it is possible to utilize favourably the Swedish resource base to design and implement water-related disaster reduction programmes in developing countries.

#### SMHI

A hydrological model has been adapted and used in the upper parts of Rio Cauca in Colombia. The aim of the project is to be able to



predict high flux and flooding along the river stretch. A similar project has been carried out in Rio Cauto on Cuba. SMHI recently got a request concerning the installation of a similar system in Rio Magdalena in Colombia.

#### Zimbabwe

SMHI is also engaged in a BITS-financed project in Zimbabwe, which aims at adapting a hydrological model to the Manyame-river. This will enable flooding prognoses, with the purpose of using the water as effective as possible during drought periods.

#### Meteorology - forecasting/warning systems

As a part of its regular activities SMHI also has embarked on a long-term project with the aim of supporting the Baltic States in the build-up of their hydrometeorological institutes. Among the duties of a hydrometeorological institute is the issuing of warnings when extreme events are imminent.

In this area the international co-operation is very important and SMHI actively work within the World Meteorological Organization (WMO).

#### Seismology - forecasting/warning systems

A project which has attracted a lot of publicity abroad deals with seismology and the possibilities of early warning. It is a joint Nordic project. The Swedish institution represented in the project is the Department of Geophysics at the University of Uppsala.

The idea behind the technique is to register movements in the ground within the magnitude 0-1 on the Richter scale, with the help of a seismographic net work. These minor earth movements always behave in a special way before a major earthquake, which means that these indications could be used in predicting a major earthquake.

Within the framework of the Nordic project a seismographic network has been built up on Iceland, which is a seismologically very active country. It is here that the method has been developed and where one has learned to interpret the signals, preceding major activities in the earth crust.

The method is now so well developed that plans exist to build up a new network focusing on the Kola peninsula in the former Soviet Union. On the Kola peninsula there are many nuclear reactors and plans for constructing a terminal storage for nuclear fuel. The combination of major risk objects and a seismologically active area necessitates for us to keep an eye on the Kola peninsula in the future.

#### THE GEOLOGICAL SURVEY OF SWEDEN

The Geological Survey of Sweden has established a co-operation within the area of environmental-geological questions with the Baltic States and this co-operation will be further developed during the decade.

#### SWEDESURVEY

Swedesurvey Ltd is responsible for the marketing and co-ordination of the activities abroad of the Central Board of Real Estate Data and the Central Office of Land Survey.

Swedesurvey organizes the production of maps and digital databasis from aerial photos or satellite pictures. Besides the satellite

pictures from Kiruna (SPOT, Landsat) Swedesurvey has access to Russian satellite pictures with very high resolution. By combining aerial photos and the production of other maps with Global Positioning System (GPS) for positioning basic data for the planning of an assignment can be produced at short notice. Aerial photo material and satellite pictures can be produced for different wave length areas, which enables interpretations suited to the needs.

Among the assignments carried out by Swedesurvey one can mention the settlement of international boundaries, for instance between Iraq-Iran and Iraq-Kuwait, as well as the delimitating of the lines of demarcation in Sinai. Material for analyses of the extension of and damages to natural resources, for instance forest inventories, estimation of crop and the spreading of deserts, have been produced.

#### Real Estate Data

By real estate data we mean information on land use, rights to land and inventory and valuation of land based on real estates. Swedesurvey has participated in building up systems of land information in several countries in Africa, the Middle East and Asia. Swedesurvey has thereby gained considerable experience when it comes to systems of rights in different countries. Among the projects one can mention are the valuation of farm land and buildings belonging to Iraqis, which as a result of the frontier decided by UN, had ended up in Kuwait.

In case there is a need to clarify present use of land, rights to land or valuation of land or buildings Swedesurvey can provide experts with international experience. By combining real estate information with landscape information the analyses and planning of assignments can be made easier.

## VI OVERALL EVALUATION AND FUTURE PROGRAMME OF IDNDR ACTIVITIES

In its program planning for the period of 1994-1999 the Swedish Rescue Services Board has decided, as an overall goal nationally, that:

- Damages caused by natural disasters shall be limited as much as possible
- The breaking of dams shall be prevented

In order to obtain this:

- Areas at risk for natural disasters such as landslide and flooding, should be included in the physical planning at different levels. The mapping of such areas should be carried out in municipalities with high risk of such disasters.
- The possibilities to predict natural disaster, for instance flooding, should be considered when planning and carrying out rescue operations.
- Warning system shall be installed down stream large dams, giving information about the condition of the dam as well as the safety of the inhabitants in the area.
- High dams (more than 100 m) should be monitored for micro earthquake activity around the water reservoirs.

- Measures taken against natural disasters with the help of state funds shall be well motivated and prepared. The effects of measures carried out shall be followed up systematically.

### **Position and problem**

Geological conditions for landslides are present in some 200 municipalities. Overview mapping of risks for landslides have been carried out/begun in some 40 municipalities.

Flooding is to a certain extent predicatable, both in time and space. Methods exist for prognoses as well as for illustrating the risks of flooding in form of maps. The latter possibility has only been marginally used up till now.

Swedish dams previously were built to withstand a 1 000-year flow. As the security has been raised and dams now must withstand a 10 000-year flow many dams need to be rebuilt. The installation of warning systems has started around the power station dams. The warning system will warn people who live or stay down stream of the dam. The system will also warn the staff in operation beforehand against for instance increased leakage of movements in the dam body.

The planning and preparedness of the rescue services must be strengthened.

Accidents due to hard winds or lightning make up a relatively large part of the total number of natural disasters. Methods to protect lives and property exist, but are not used to such an extent that might be wished.

In recent years attention has been drawn to the problem of coastal erosion. Even if the phenomenon in itself is slow and cannot be described as an accident, it can cause sudden events such as landslides. Several suggestions have been made on how to reduce the effect of erosion technically and work has begun along the southern coast line.

### **Measures**

As far as landslides are concerned the Swedish Rescue Services Board continues to work on several front-lines: within the Swedish Commission on Slope Stability, through key mapping and through the financing of preventive measures against landslides. Together with the National Board of Housing, Building and Planning, the Swedish Rescue Services Board propagate the use of information obtained from key mapping in physical planning, as well as measures aiming at limiting the damage caused by landslides and other natural hazards in the municipalities.

The follow-up and evaluation of projects carried out up till now will be intensified.

### **Prognoses**

Flood prognoses are constantly being developed by the Swedish Meteorological and Hydrological Institute.

With the help of the Swedish Rescue Services Board the system for issuing warnings for flooding is being developed as well as the relation to the needs of the rescue services.

**Public Education and Information**

The programs aiming at improving the knowledge concerning risks among the public and it's ability to prevent and limit the damage caused by natural disasters will be continued and improved.

**Warning**

The entire population shall receive warning messages, when necessary, through radio and television. In areas with dangerous activities (for instance nuclear plants or chemical industries) warning shall be issued with the help of outdoor sirens as well.

**Evacuation**

Preparations shall be made for evacuation as a preventive measure. The plans shall be co-ordinated throughout the country following the common rules agreed upon by the different authorities responsible for evacuation.

**International activities**

The Swedish Rescue Services Board estimates that in the future it will have an increased involvement in international rescue activities. The costs for stand-by amounts to about 120.000 USD. The rescue activities as such are partly financed by UN, partly by special resources provided for by the Government on a case-by-case basis.