End of Course Project: The Disaster Management System in Switzerland
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# SWITZERLAND

## 1 - Background Information

Switzerland is situated in the center of Europe bordering Germany, Austria, Italy, and France. It occupies an area of 4'128'476 $km^2$ and has a population of approximately 7.451 million people (July 2004 est.) including about 1.5 million (19.3%) foreigners from 190 nations. Around 100'000 people are refugees. Most foreigners come from the former Yugoslavia (24%), Italy (22%), Portugal (9%), Germany (8%), and Turkey and Spain (6% each). 5% come from Asia and 2.4 % from Africa. 68% live in urban areas, 32% in rural areas. The population density is 182.94 per $km^2$. In Switzerland four official national languages are spoken: German (65%), French (18%), Italian (10%), and Rhaeto-Romanic (1%). 6% speak other languages. The main religion is Christianity.

Switzerland is a confederation that was founded in 1291. In 1848 it became a federal state. It consists of 26 cantons (Figure 1), which have the majority of responsibility. The form of government is a direct democracy; the capital is Bern; the currency is Swiss Francs (CHF) (1 CHF = 0.86 USD, November 2004)

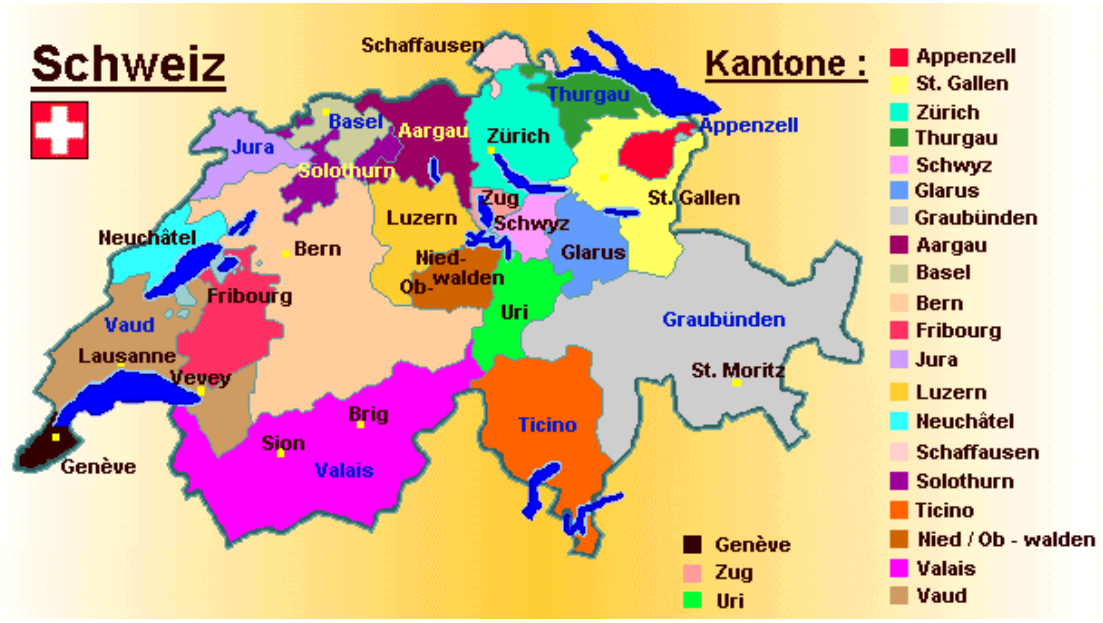



**Figure 1** The cantons of Switzerland

A large area of Switzerland is mountainous with the Alps in the south and the Jura Mountains in the northwest. In between lies a foreland basin, the Mittelland, a central plateau with rolling hills, plains, and large lakes (Figure 2a). The lowest point is the Lago Maggiore (195m), the highest elevation is the Dufourspitze with 4634m. The most prominent mountain is, however, the Matterhorn with an elevation of 4478m (Figure 2b). The Alps are a relatively young mountain range (< 65 million years) and result from the collision between the African and the Eurasian continental plates, which started around 65 million years ago. Even today, this tectonic activity is one of the reasons for the occurrence of earthquakes in Switzerland. (Seismicity related to this tectonic movement is, however, much more prominent in the eastern Mediterranean.) - The climate is temperate and varies with altitude. In general, winters are cold, cloudy (high-fog in the plateau), rainy (lowlands), or snowy (Alps) and summers are cool to warm, cloudy, and humid with occasional rain.

Total land use is 99.39% of which 10.57% is arable land. Permanent crops account for 0.61% of the land used. Switzerland's agricultural products include grains, fruits, vegetables, meat, and eggs. The agricultural sector is, however, decreasing (96% growth). Natural resources are hydropower potential, timber, and salt. Forested land corresponded to 30.3% in 2000.

Switzerland is one of the world's most advanced and prosperous modern market economies. With 36'170 USD, the GNI per capita income was the second highest in the world after Norway in 2004.[1] The GDP per capita amounts to 31'100 USD with 2% coming from the agricultural sector, 34% from the industrial, and 64% from the service sector. Reflecting the economy in Europe and the US, GDP growth dropped from 3% in 2000 to about 0.8% in 2001, to 0.2% in 2002, and to -0.3% in 2003. Unemployment rose from 1.6% in June 2001 to 3.9% in March 2003. This, however, is still far below the average unemployment rate in Western Europe (8.9%). The foreign trade balance is slightly positive due to the high amount of service exports and the external trade rate, which amounts to more than 40% of the GDP.






**Figures 2a and b**

**2a** (left) The topography of Switzerland and the location of places mentioned in the text (left);
2**b** (right) the Matterhorn (right)

Switzerland is a country of low to medium natural hazard risk. Natural disasters - even of catastrophic extent - have always occurred. As housing schemes became denser and material assets bigger and more valuable, the scale of damage has considerably increased over the past decades. Natural hazards in Switzerland are -to different degrees and frequencies- rockfall, debris flows, earthquakes, erosion, hail, floods, avalanches, fires, storms, heat and cold waves with floods, storms, landslides, and avalanches being the most frequent ones. Less frequent are droughts and heat or cold waves. Strong earthquakes are very rare, but they can occur, as history proved. The most devastating natural catastrophes in Switzerland have been (Figure 2a):

1356 **earthquake** in Basel (1500 dead)
1618 **landslide** in Plurs/Plurio (today Italy) (930 dead);
1806 **rockfall** in Goldau ( approximately 500 dead);
1868 **floods** in the whole alpine region (50 dead),
1876 **floods** in Central and Eastern Switzerland;
1910 **floods** in the Mittelland (11 dead);
1947 (summer) drought;
1951 **avalanche winter** in the whole alpine region (97 dead)
1987 **floods** in the whole alpine region (4 dead, 1.2 billion CHF/1 billion USD);
1999 f**loods** in the Mittelland (2 dead, 580 million CHF/500 million USD);
**avalanche winter** (17 dead, >760 million CHF/655 million USD);
**storm** Lothar (14 dead, 2 billion CHF/1.7 billion USD);
2000 **floods** in the Wallis/Tessin (16 dead, 670 million CHF/577 million USD);
2003 **heat** wave.

[1] According to the 2004 World Development Indicators, which are produced by the World Bank.

## 2 – "Avalanche Winter" 1998/99[2]

The winter 1998/99 was an exceptional winter in the European Alps. Heavy snowfall accompanied by a multitude of avalanches especially affected the northern slopes of the alpine regions in Austria, Italy, France, and Switzerland. In the following, we shall examine the situation in Switzerland during that time:

Between 27 January and 25 February 1999, three precipitation periods in succession caused a very high amount of snow in the Swiss Alps. As far as fresh falls of snow and the extent of their effect were concerned, the situation in February 1999 was exceptional. The recurrence interval of the fresh snow amount in 30 days was at some places of the northern slope of the Swiss Alps 80-100 years. At some measurement stations, the total depth of snow reached record levels: in Elm (Glarus, Figure 2a), for example, more than 4 m of fresh snow over nine days, and even more than 8 m over 30 days. The frequency of recurrence of such quantities of snowfall varies from region to region but is around 30-50 years.

The consequence of such heavy snowfall was a very high and large-scale avalanche activity. In Switzerland alone, a total of 1350 damage-causing avalanches occurred during that winter. The avalanches in February 1999 resulted in the death of at least 100 people in the Alps, mostly in Galtür (Tyrol/Austria) with 38 dead, in Evolène (Valais, see Figures 2a and 3) with 12 dead and Chamonix (France) with 12 dead. In Switzerland over the whole winter season 36 people died in avalanches (17 alone in February), 17 of whom were in houses or on roads. The total cost of damage exceeded figures for damage caused by other avalanches in the 20th century. In Switzerland, the avalanches in February 1999 damaged approximately 1700 buildings, vehicles, etc., including around 230 houses. The direct damage to property was estimated at around more than 760 million CHF (577 million USD). The direct costs as a consequence of avalanches, snow pressure, and snow load amounted to around 440 million CHF (380 million USD). The indirect costs through companies closing down and loss of earnings were estimated at being at least 300 million CHF (260 million USD). Mostly hit by the avalanches were the transportation lines. Large damage was caused to traffic axes and to electrical and communication infrastructures. The Gotthard motorway,[3] e.g., was completely closed to traffic for more than one week. The avalanche winter in 1999 was, however, not the worst avalanche winter during the last century. In the Swiss Alps, the most disastrous avalanche winter occurred in 1950/1951 and resulted in 98 dead and left 1500 buildings damaged. In February 1999, with a similar number of avalanches, approximately four times as many tourists and 1.5 times as many inhabitants were staying in the affected mountain areas. That the damage was not worse was not just a matter of luck. The targeted progress of an integral avalanche protection programme over the last fifty years is equally responsible.



**Figure 3:** On 21 February 1999 at 20:27h an avalanche, with a fracture width of 4 km hit the village of Evolène killing 12 people (for location, please see Figure 2a).

[2] This description of the avalanche winter is in large parts based on the very good summary of the events given by Mario Broggi, the director of the Federal Institute of Research on Forests, Snow and Landscape in Birmensdorf/Switzerland in: *Events of winter 1999 and the resulting consequences for the Alpine area,* http://www.sommets-tourisme.org/e/sommetsG/premier-sommet/actes/broggi.html; updated by Michael Bründl, Swiss Federal Institute for Snow and Avalanches Research, Davos, Switzerland

[3] The Gotthard motorway connects Northern Switzerland/Europe with Southern Switzerland/Europe and is, together with the Brenner motorway in Austria, the most important traffic axis in the Alps.

## 3 – Disaster Management System

In Switzerland, the main legal competence with respect to the protection against natural hazards lies with the cantons in terms of organization and structural measures. The task of the government is to edit guidelines and recommendations, which support the cantons in their task of protecting human lives and assets against natural hazards. Three levels of legal regulations concerning natural hazards can be distinguished: the constitutional level, the legislative level, and the bylaw level. The following natural hazards are covered by the legal regulations: floods, debris flows, avalanches, landslides, erosion, and rockfall. Others, like, e.g., earthquakes, are not covered. The relevant legal regulations with respect to natural hazards are the land-use law incl. the land-use bylaw, the hydraulic engineering law incl. the hydraulic engineering bylaw, and the forest law incl. the forest bylaw.

### DISASTER MANAGEMENT

#### Knowledge / prevention and warning phase

In Switzerland, the protection of the population is the task of the Federal Office for Civil Protection (FOCP), part of the Federal Department for Defence, Civil Protection, and Sports (DDPS). The FOCP comprises all areas of the DDSP, which specialize in civil protection issues. Until 2003, the main focus of the Civil Protection was on armed conflicts and in addition on other catastrophes and emergencies. Since 2004 its main focus has been primarily on catastrophes, emergencies, and terrorist attacks. Armed conflicts are now considered a secondary focus.

Disaster management is organized along federal, regional (cantons) and local (municipalities) levels. Correspondingly, responsibilities and tasks are divided between federal, regional and local authorities, and private organizations and persons. The operational responsibility for civil protection lies, however, first and foremost with the cantons and municipalities (“bottom-up”). Only in events with a national impact does the federal government coordinate the deployment of the relevant partners and take over responsibility for managing the situation. The following list gives an overview of the tasks of the different organizational levels:

The federal government:

- sees to the coordination of civil protection services and defines its fundamental aspects;
- takes part in the training of skilled labor;
- provides basic equipment for civil protection;
- analyzes the possible effects of storms and floods, earthquakes, nuclear power plant accidents, violence, and terrorist attacks;
- develops comprehensive baselines and studies, which it makes available to the cantons and civil protection partner organizations to help with their planning and preparation. Thus it supports the cantons and municipalities as well as the partner organizations in their civil protection activities;
- coordinates and takes over responsibility in case of large-scale emergencies.

(The National Emergency Operations Centre is one of the federal centers under the FOCP with an expertise for exceptional events. Foremost among these is the risk arising from increased radioactivity, whether this occurs as the result of an accident during transportation, in a laboratory or in a nuclear power plant. Further areas of responsibility include large-scale chemical accidents, dam ruptures and the threat of satellite re-entry. An involvement in other emergency situations is discussed, e.g. in case of an earthquake. However, the federal structure of Switzerland makes coordination on a national level difficult, as the cantons are often reluctant to give away responsibilities.)

The cantons:

- create cantonal law based on federal law. (The implementation is, however, not necessarily always complete)
- manage execution;
- provide training to those engaged in the civil protection process;
- carry most responsibility for civil protection together with the municipalities.

The municipalities:

- translate the guidelines of the federal government and the cantons into action plans; they are responsible for maintaining the civil protection organizations ready for action;
- carry most responsibility for civil protection together with the cantons.

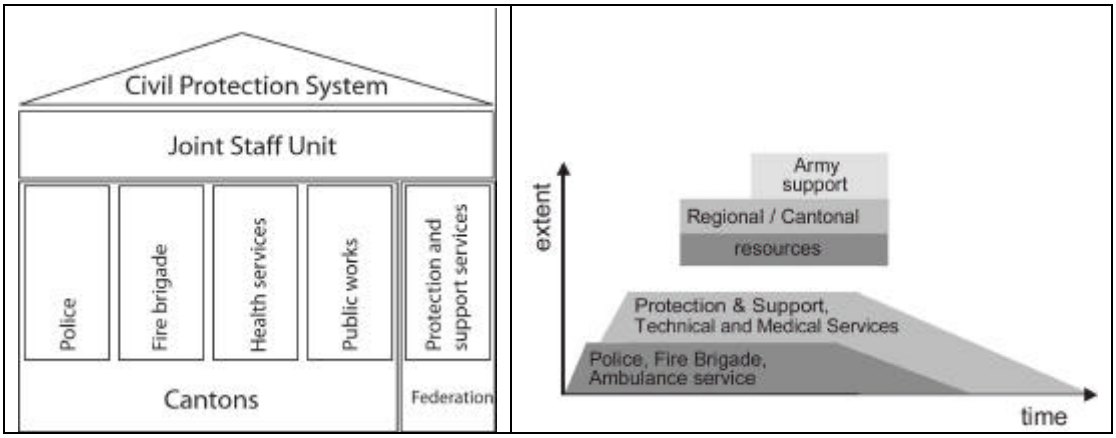
All three levels are supported by experts from various national and cantonal organizations. These are, e.g., the Swiss Meteorological Office, the Swiss Seismological Service, the Swiss Federal Institute for Snow and Avalanche Research (SLF), the Swiss Federal Institute for Environmental Science and Technology, the Federal Office for Water and Geology, the Swiss Agency for the Environment, Forests and Landscape, as well as the cantonal forest offices and cantonal geologists.

**Risk transfer**

Another important aspects of disaster management concerns insurance and the role of the people itself. Some insurance in Switzerland is obligatory. These are health insurance (national), old-age pension (national), and building insurance (mostly cantonal, some private: rate: 4:1). The cantonal building insurances cover –unlimited- damage related to weather-related perils[4] except groundwater, earthquakes, and volcanic eruptions (the latter is irrelevant in Switzerland). Coverage for earthquakes also exists. This coverage is, however, not unlimited due to the obligation to insure. Without any supplementary insurance, the coverage for earthquake related damage is up to 2 billion CHF (1.70 million USD) by the cantonal building insurance companies. The private insurers cover 200 million CHF (170 million USD) of damage related to earthquakes. - For larger companies, re-insurance is an option. It is also possible to effect many other voluntary insurances such as life insurance, private liability, household, hail, car, … That these options are intensively exploited is demonstrated in the fact that Swiss citizens are amongst the most extensively insured people in the world.

**The crisis phase**

The pillars of disaster management in Switzerland are fire brigades, medical services, police, public works, and especially the civil protection organizations (Figure 4a). Communities, either independently or together with neighboring communities, form a civil protection organization. Essential tasks of this organization are the preparation of protective, aid and rescue measures. Timely shelter occupation, care for the sheltered people, and efficient aid and assistance in mastering the consequences of disasters and emergencies of all kind are a great challenge to communal civil protection organizations.




**Figures 4 and b** (Source: Federal Office for Civil Protection)

**4a** (left) The pillars of civil protection in Switzerland;
**4b** (right) Scale of response to a disaster.

The scale of response will depend upon the nature and magnitude of the disaster, but assistance can be escalated from the initial response at local level through regional to national assistance (army) (Figure 4b). (It needs to be pointed out that the possibility of an

[4] Storm, hail, flood, avalanches, snow pressure, rock fall, landslide, and rock slide.

army deployment for national emergencies is not given in every country. Sweden, for example, which is politically in some respects very similar to Switzerland, does not allow such a deployment.)

In Switzerland applies a national official duty for all Swiss men between 20 and 40 years old who are military fit. This duty can either be performed in the military service, in civil protection, or, in exceptional cases, in civilian service. Currently the members of the armed forces are reduced from 360'000 to 220'000 men and women, civil protection organization dispose of 120'000 men and women (280'000 until 2004). Voluntary participation is possible for men and women, also for foreign residents in Switzerland.

## 4 – Strengths and Weaknesses of the National Disaster Management in Light of the Avalanche Winter 1999

The avalanche winter was primarily a local to regional event. On the national level almost no action was required during the event. The only exception was the deployment of the army's Super Puma helicopters for evacuation and supply. They were additionally supported by private helicopter companies. A comprehensive coordination of all helicopter deployments was, however, missing and would have been desirable. After the active phase of the event, a coordination center "avalanches and floods" was established with the Federal Office for Civil Protection in Bern. This center coordinated the aid requests by the communities and cantons that were affected by the event with those that offered help. Between the cantons and communities solidarity worked very well.

During and after the disaster, scores of local civil protection organizations were engaged in cleaning up and recovery efforts. The avalanche winter caused the so far largest and highly successful deployment in the history of the Swiss civil protection. Approximately 64 000 person days were required. As some of the regions have been cut off from the outside world the local civil protection organizations proofed to be very beneficial. During the main phase of the events approximately 4000 members of the civil protection in 16 cantons were active. They were mainly engaged with the observation of the avalanche slopes, the clearance of the traffic routes, supplemented the staff of the communal and provincial emergency operation centers, the planning and execution of evacuations, the care of the evacuees, and the provision of supply. Additionally, the army provided 200 all-terrain vehicles.

The avalanche situation in Switzerland is closely observed by the Swiss Federal Institute for Snow and Avalanche Research in Davos, Grisons/Graubünden. During winter and avalanche time, this institute issues a national and regional avalanche bulletin daily. This institute also issued the warnings in winter 1999. Figure 5 shows the avalanche danger scale map of 22 February 2003.

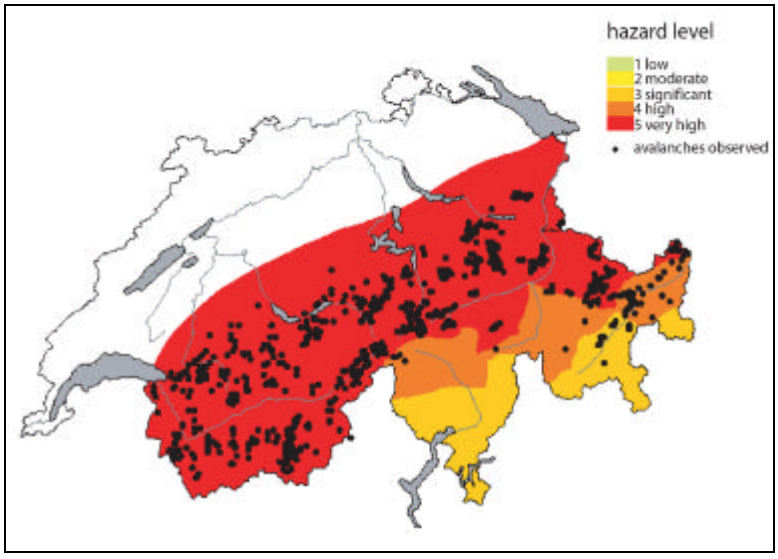
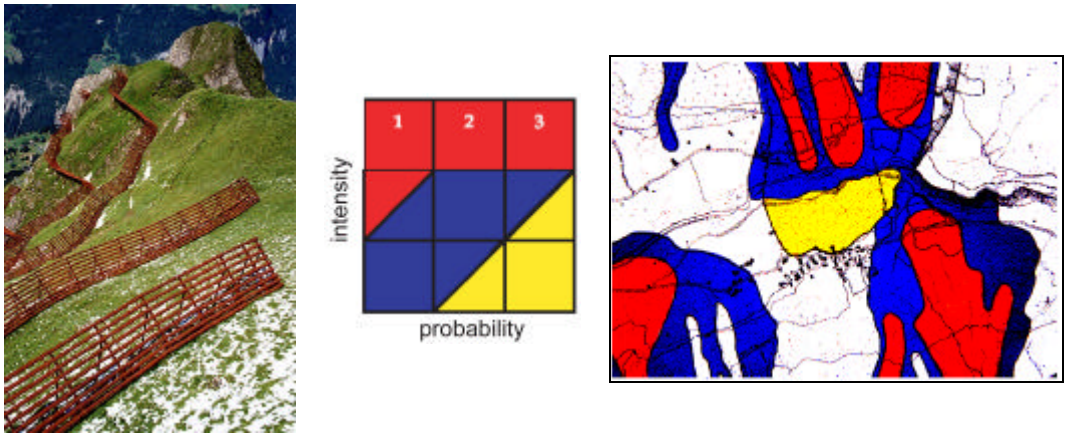



**Figure 5**
Morning Bulletin (Hazard Map) of the Swiss Federal Institute for Snow and Avalanche Research, 22 February 1999, 9.00h, showing the hazard levels as well as the total amount of avalanches registered on 21/22 February 1999.

These widely broadcasted bulletins and warnings together with other measures helped to keep damage significantly lower than damage caused by earlier events (e.g., the avalanche winter 1950/51). These other measures included the construction of more than 500 km of permanent avalanche-supporting-structures (Figure 6a) and other structural avalanche protection measures, totally worth approximately 1.5 billion CHF (1.3 billion USD) as well as reforestation as a natural avalanche protection measure (forestal projects cost approximately 50 million CHF(43 million USD) a year). Increasingly, also temporary measures are taken during the crisis situation such as roadblocks, evacuations, and artificial avalanche releases.

Land use measures are especially important in small countries such as Switzerland. Avalanche hazard maps help to define areas of increased danger (Figure 6b and c) and are thus an important base for settling as well as for evacuations and road blocks in times of crisis. During the avalanche winter 1999 it became evident that hazard maps are not available for all areas at risk, there are deficits and differences between the hazard maps of different cantons, and in many areas no avalanche register exists.




**Figures 6a-c**

**6a** (left) Example of an avalanche supporting structure at Männlichen (see also Figure 2a);
**6b** (center) Intensity-probability chart for the impact of avalanches (red zone: building ban; blue zone: constructions allowed with restrictions);
**6c** (right) Avalanche hazard map for Kandersteg (extract, see also Figure 2a).

While the crisis management system worked generally very well during the avalanche winter 1999, some shortcomings in the crisis organizations became evident. This concerned the training of the staff responsible and the communication between various services involved. By now, this has been taken care of by a comprehensive training concept for the local avalanche experts and the establishment of an Internet based measure information system which is based on a content management system (CMS). The goal of this information system is to better coordinate measurements of different safety services. The system is currently in use in four regions of the Swiss Alps and it allows a fast and mutual exchange of information between the different security services involved on the current avalanche and weather situation as well as on protection-, evacuation-, and rescue measures taken.

## 5 – Recommendations for Improvement

As already mentioned in the previous sections, overall, the avalanche winter 1998/99 was handled very well. This was mainly due to the fact that the lessons from the avalanche winter 1950/51 had been learnt and implemented in prevention and mitigation measures. Several issues, however, could nevertheless still be improved:

1. **Establishment of an integral risk management system**. Ex-ante as well as ex-post measures have to be equally considered, evaluated, and corresponding to needs, options, requirements (e.g., legislation), and cost-benefit analyses implemented and improved. These measures can be structural as well as non-structural measures (planning, technical, organizational, and biological measures) – O*n the way*;
2. On the national level the necessity of an **emergency coordination center** should be discussed. Even if an event is not a national event, as soon as many regions are

affected, coordination of aid (supply, rescue, etc.) and communication between the areas affected become necessary. This is also important as the cantons commonly dispose of different ways of managing an emergency and correspondingly apply different measures. During the avalanche winter, for example, a coordination of the helicopter deployments would have been beneficial. During the heat wave in 2003, adjacent cantons had different policies on how much water can be taken from a shared river (none vs restricted amounts). A national authority could facilitate coordination and communication (e.g., the National Emergency Operations Centre - NAZ? – see section 2) - D*ifficult as the cantons do not like to give away responsibility to the federal State*;

3. Improvement of **information (research)** and **early warning** systems (e.g., early warning for severe weather events, (long-term) weather forecast) - *On the way*;
4. Provision of **good education** for emergency personal – *On the way*;
5. Improvement of **flow of information/communication tools** amongst experts (local experts as well as scientists, e.g., SLF), communal and provincial emergency operation centers, and other responsible security organs - *On the w*ay;
6. Compilation of nationally consistent **hazard maps** and **hazard registers** – *On the way*;
7. **Sensitization of people** not to build (or continue to live) in areas of high risk. The law prescribes that hazard maps are directly implemented in the land-use: red zone: building ban; blue zone: constructions allowed with restrictions. The (cantonal) building insurance companies support prevention measures for example through financial incentives - *On the way*;
8. **Sensitive handling of buildings constructed in areas of high risk**. E.g., instead of forcing insurance companies to insure such buildings and pay compensation after destruction, alternatives should be considered (resettlement, dam construction, etc.) – *On the way*;
9. A **constitutional article** has been suggested by the parliament saying that *The legislation on the protection against natural hazards is the responsibility of the federal State*. Idea was to provide the federal government with the competence of becoming active in the field of earthquake protection. The national commission, however, rejected the article. Therewith the protection against earthquakes remains the responsibility of the cantons, meaning that the earthquake safety of buildings and the damage coverage related to earthquakes remains inconsistent within the country.

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