

Impact of Large Landslides in the Mountain Environment: Identification and Mitigation of Risk



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Management guidelines for the relationships among decision-makers, scientists and the people exposed to risk

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Jean-Louis Durville
Christophe Bonnard

Before the occurrence of the major failure itself, during the period of known risk exposure, a large landslide hazard may cause a strong perturbation in the local life:

- psychological impact due to the danger for life and for property,
- constraints brought by prevention measures: diversion of a road, temporary or permanent evacuation of people, suspension of development projects, etc.
- additional expenses due to these measures,
- decrease of income and investments, mainly for commercial and tourist activity.

During the crisis period, the main problem is the management of the safety measures and rescue if necessary, as well as the protection of essential services and maintenance of lifelines.

After the event, there begins the relief period with a lot of social, political, technical and economical problems.

In this report we are dealing mainly with the pre-failure period, corresponding to the situation existing in the selected sites of IMIRILAND: Cassas and Ceppo Morelli in Italy, Séchilienne in France, Sedrun and Conters-Gotschnahang in Switzerland, Oselitzenbach in Austria, Encampadana in Andorra.

The authorities have to manage their relationships with the other partners involved in the landslide risk, in order that the perturbations related to the potential consequences of the risk remain as low as possible. Typically we can say that three main partners are present in the management of a large landslide risk (figure 1):

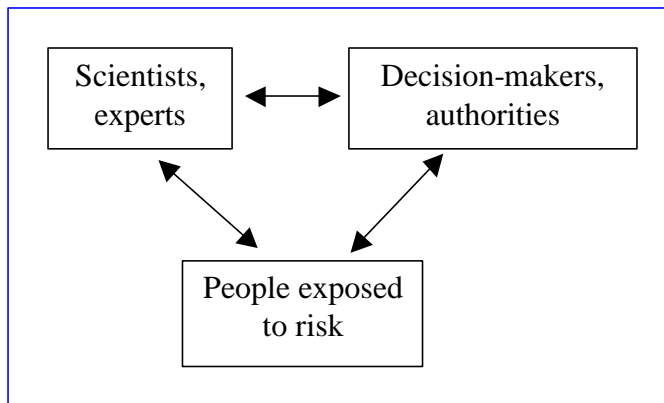


Figure 1: Main partners implied in the management of landslide risks

The situation is often far more complex (figure 2): there may exist several scientists (or pseudo-scientists!) that do not necessarily agree about some aspects of the problem; the local authority may not have the same point of view as the regional or national authority; some exposed people may form an association (which considers itself more efficient than the elected representatives) defending against the national authorities, etc. In some cases the media (newspapers, radio, television) may invite themselves in the debate...

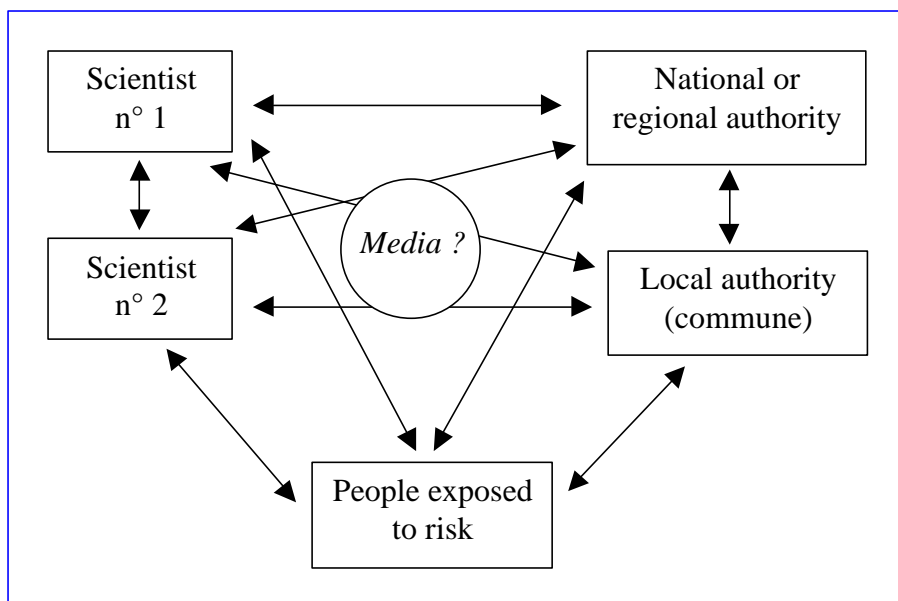


Figure 2: Complex relationships between directly and indirectly implied persons

Moreover, if the indirect consequences extend far away from the landslide itself (for instance, due to a possibility of damming the valley, followed by flood risks), each category of partner may subdivide into several elements (for instance, the commune that is directly endangered by the slide, the ones located upstream in the valley, the ones located downstream in the valley) and other partners may appear such as railway or highway companies, large industrial plants, etc.

The main questions that arise (and for which there may exist no easy immediate agreement between the partners) are as follows:

- the actual level of danger: is there any? is it acceptable?
- the potential consequences of the natural danger: are they properly foreseen?
- the mitigation strategy: which one is the most adequate? which reliability of the solution (residual risk)?
- the financial aspect (who will pay? which compensation will be granted?).

Why do the different partners not agree in general? It is a human reality that everyone is influenced by his/her position and implication in the risk situation. Each partner will have a tendency to adopt more easily some particular attitudes:

- *the exposed people*: to ignore the problem (they do not want to evacuate, they are afraid that the value of their house or land could significantly decrease) or to exaggerate it (in order that the authorities give a large amount of money for preventive actions);
- *the experts*: to exaggerate the problem (they will be requested for further investigations and surveys, or they are afraid of their legal responsibility in case of catastrophic failure);
- *the authorities*: to minimize the problem (if they have to pay for preventive measures, or if they don't want to damage the attraction of their village) or to exaggerate it (if they hope to receive money from another authority); to overestimate the level of necessary protection (they fear that they may be considered responsible in case of victims or damage).

The main difficulties that the experts have to face are the following ones:

- to overcome proper scientific difficulties (we are at the border of scientific knowledge),
- in case of emergency, to give a diagnosis or report in the short time available,
- to explain the diagnosis with simple words (we insist on the fact that, in a written report, the used terminology is highly important, in order not to be misunderstood),
- to explain what they know and what they do not know (maybe to suggest to ask some experts in another field to join the committee), which are the main uncertainties,
- to avoid to go further than the scientific field (it should be clear that the decision relies on the political level): the experts may give their point of view about the definition of scenarios of failure and secondary phenomena, the evaluation of physical damage and economical consequences, the efficiency of different mitigation strategies, but they don't have to give their personal preferences or to suggest a particular decision,
- to avoid to be influenced by the answers that the authorities are waiting for.

We could finally give some general management guidelines:

1. Necessity of periodic information towards the exposed people: this information should be sincere, as clear as possible, avoiding too alarmist or too comforting attitudes.
2. A clear management strategy should be decided after a comprehensive analysis of the problem, so that the future actions are oriented towards the same objective and show a good coherence.
3. Necessity of coordinated communication from the authorities: it is quite prejudicial that discrepancies between official people at different levels come to light: one should appoint one spokesman that is in charge of the communication.
4. The experts which are commissioned by the authorities should not express themselves in public, they have to give their point of view only to the authorities who commissioned them.
5. The questions which are asked to the experts should be clearly formulated by the authorities. Experts should draw attention on specific aspects that might have been omitted but they should not give answers to questions that were not asked. The decisional level should be correctly separated from the scientific one.
6. The large landslides are not so well understood that experts can have overall certainties and uniform opinions; it is recommended to gather an expert committee which will give his opinion as a group (it will avoid the public exposition of conflicting views between experts).

The management system should therefore follow the diagram of figure 3.

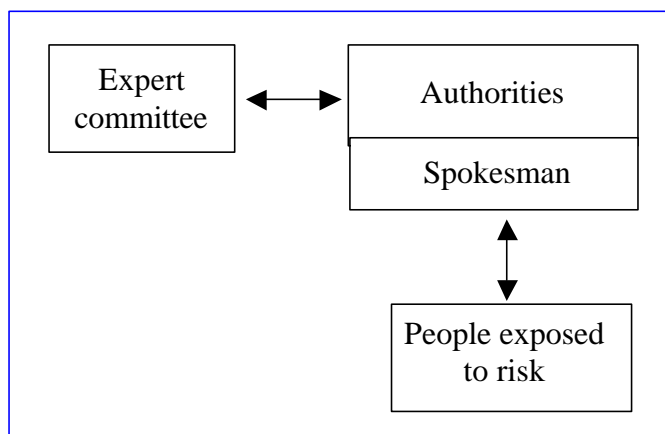


Figure 3: Flowchart of information during the management of the crisis or pre-crisis.

ANNEX

Example of Séchilienne (Isère, France)

Since 1990, great efforts have been made by the préfecture of Isère in order that the exposed population be informed: meetings in the commune, periodic bulletin of information. The main results of the scientific surveys and of the monitoring data have been presented. Despite of this communication plan, an association of inhabitants was created and opposed the main decisions (mainly because of potential economic losses induced by the expropriation procedure).

At the end of the 90's, the situation was as follows: some divergent diagnoses between the experts; differing opinions concerning preventive solutions between the local authorities (the mayor of the communes and the association of inhabitants exposed to risk) and the governmental authorities (the ministry of the environment, in charge of the hazard prevention). The expropriation of 80 houses located in the most exposed zone had encountered severe opposition from some inhabitants.

In 2000, an international group of four experts (Italy/Switzerland/France) was assigned the mission of defining the most probable scenarios and the corresponding levels of hazard. The conclusions may be summarized as follows:

- short term hazard (within 10 years): rockfalls and failures from 0,1 hm³ to 3 hm³,
- mid-term hazard (in the period 10 to 50 years): possibility of larger failures.

It is very important that the corresponding scenarios have distinct occurrence probabilities in the next years, because the preceding analyses relied on one unique scenario of large volume (7 to 10 hm³, even more).

The report of the expert group has been circulated and is now available on the website of the ministry of the environment. The decisions of the prefect that followed from this diagnosis were:

- to take into account the 3 hm³ scenario hypothesis for the emergency plan and the preventive actions,
- to carry on with the monitoring of the slope.

It seems that the conclusions of the report were well accepted by all the partners.

In 2003, as new divergences appeared concerning the level of hazard (particularly related to the run-out of debris) and the necessity of a diversion gallery for the river, a new committee of experts was appointed in order to get a unique and unquestionable opinion related to the most probable scenarios.

The Séchilienne case also shows us the difficulty of the risk management induced by the (more or less progressive) changes in the hazard level evaluation from the experts. Since 1984, when Séchilienne was "discovered", it is not surprising, as for most of the large landslides, that the knowledge about the phenomenon has increased, resulting from the investigations on site and the development of new methods of analysis (modelling of run-out, for instance). In a simplified manner, we could say that the risk evaluation has increased during the 80's, remained stable during the 90's and has somehow decreased in the last years. These fluctuations are not easily understood by the inhabitants most concerned by the risk or affected by the preventive measures which may be taken.

Example of La Clapière (Alpes-Maritimes, France):

The failure of this large landslide (about 50 hm³) would have dramatic consequences: direct destruction of some buildings, damming or the valley of the River Tinée, flooding of the lower part of the village of Saint-Etienne-de-Tinée, flooding downstream reaching the village of Isola. Moreover the construction of a new road leading to the ski resort of Auron, avoiding the foot of the landslide, but not going through Saint-Etienne-de-Tinée, was considered *a priori* as an economical disaster by the inhabitants of the village.



Figure 4: The La Clapière landslide in 1998.

The landslide has been monitored since 1983 by the CETE-Méditerranée and, despite the progressive and clear acceleration of the slide, it is only a provisory diversion of the road that was built in an emergency situation, before a permanent diversion road two years later.

In 1987, a significant acceleration has been observed, which lead to the decision of driving an emergency diversion gallery for the River Tinée, which should operate only in case of damming of the valley.

There was at that time a situation similar to the diagram of figure 1 or 2, with the following partners:

- the exposed people, who were mainly denying the reality of the danger,
- the CETE-Méditerranée, in charge of the monitoring, upon which the main responsibility was in fact relying,
- some individual experts who took the initiative in announcing a catastrophic failure in a short term,
- the national and regional authorities who tried each one to minimize their financial participation to the gallery.

It should be mentioned that the final decision of driving the gallery was taken by the minister H. Tazieff himself. Moreover the local development plan of Saint-Etienne-de-Tinée duly considered the exposure to a large landslide (including a possible air-blast effect, following the observation of the Valtellina landslide which occurred in 1987 in Italy).

At the beginning of the 90's, it was decided to create a permanent committee of experts. This committee has to produce every year a diagnosis or the landslide evolution and, in case of acceleration, to help the authorities to take the proper decisions. The committee has been set up by the préfet of Alpes-Maritimes and is in relationship only with the prefecture.

During a (moderate) crisis in the winter 1999-2000, due to heavy rainfall, some people (authorities, geologists) at the local level were quite afraid. The influence of the expert committee lead to properly assess the hazard at a moderate level, considering in particular that the velocities of the landslide were significantly lower than in 1987.

Presently the velocity of the landslide has decreased and the danger is considered to be at a lower level than in the recent years. The committee helped to reach the decisions connected with the decrease of evaluated danger, resulting in a simplified monitoring. The committee should also soon validate the new hazard map (less pessimistic than the preceding one, particularly because the hypothesis of an air-blast effect has been abandoned).

Example of Randa (Switzerland): crisis management

The well known Randa Rockfall which occurred in Switzerland in April and May 1991 (Noverraz and Bonnard, 1992) is interesting on the point of view of the crisis management, for three main reasons :

1. Early detection of a possible event at first preventive measures

Two weeks before the first catastrophic failure which induced a fall of some 20 mio m³ of rock, the local authorities had perceived some strange signs at the toe of the cliff:

- limited block fall,
- jets of dust and water,

so that, as a preventive measure, the houses directly below the cliff were evacuated upon order of the mayor. Unhappily animals which had stayed in the barns perished, but no human victim was recorded.

2. Organisation of the crisis management committee

Immediately after the first failure, a crisis management committee was set up under the direction of the mayor of the commune of Randa, who is the first responsible for the safety measures related to natural hazards as rockfall and floods. In this committee were included representations of the cantonal authority, in particular the cantonal geologist of the federal authority, for the considerations of flood risks downstream, and of the cantonal police and federal army, who were first present to ensure the safety of the area. The army did also contribute officially to install the first pumps enabling to limit the raise of the water level of the lake behind the rockfall dam, as well as it installed a floating bridge allowing the road traffic even when short flooding periods occurred.

3. Management of the second phase of the rockfall

Due to the very early installation of several monitoring systems, it was possible to detect and follow the acceleration phase of the second rockfall, so that all protection measures were taken in due time by the crisis management committee to block the road traffic some hours before the failure.

The scientists and consultants appointed by the cantonal geologist to back up the crisis management committee supplied the necessary information to anticipate the second failure. Nowadays, studies are still underway to explain the failure mechanisms and understand the potential development of a new failure phase.

As far as the population is concerned, its experience in living with risks, especially as far as snow avalanches and debris flows are concerned, induced a large comprehension of the required safety measures taken by the authorities. Apart from two flooding episodes, most of the inhabitants of the village of Randa were little affected by the rockfall itself and even the safety of their village has been increased due to the construction of a diversion tunnel 3.8 km long allowing the river to bypass the eventual closure of the valley following either a new rockfall or a large snow avalanche.

Reference:

Noverraz F. et Bonnard C. (1991). *L'écroulement rocheux de Randa, près de Zermatt*. Proc. Int. Symp. Landslides, Christchurch, p. 165-170.