THE RELEVANCE OF ACTORS' RISK KNOWLEDGE AND ITS INTEGRATION INTO FLOOD RISK MANAGEMENT

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ABSTRACT

This paper analyses the knowledge related to flood risks and its integration into risk management. Knowledge about flood risks is a key-factor in risk management. Still, its forms and distribution are very complex since they may vary significantly from one group of actors to another or even within one particular group. The analysis of two case studies in Switzerland has shown that the classical distinction between experts and lay people does often not reflect reality. Different forms of expert knowledge – shared by various actors – may coexist within a relatively small spatial area. Furthermore, even though today's risk management demands the participation of all concerned actors, local non-institutional actors – as well as their knowledge about flood risks – are not always integrated actively. However, this could be of great importance for risk management. As a result, knowledge transfer often follows a one-way path, i.e. from public to private actors.

Keywords: floods, risk management, actors, risk knowledge, Switzerland

INTRODUCTION

Despite the efforts made to control river flooding for over a century, Switzerland is not safe from hydrological hazards. Since 1990, floods caused loss of more than 4 billion Euros, mainly due to intensive land use and the sophistication of flood prone terrains (PLANAT 2004, Bezzola & Hegg 2007).

During the last thirty years, Swiss flood prevention policy has experienced an intense change of paradigm. The strategy of pure hazard defence has been replaced by a more pluralistic risk approach (Zaugg 2002, Ammann & Schneider 2004). This change of paradigm is due to insufficiencies in security and ecology concerns of "conventional" flood protection, which have become apparent during the last decades (Zaugg 2002, Ammann & Schneider 2004).

According to the Swiss federal strategy against natural hazards, all concerned actors have to be considered when taking measures against hydrological hazards (Ammann & Schneider 2004). Thus, there is a wide range of potentially concerned actors. They include representatives of the public administration as well as private actors such as the population, NGOs, consulting engineers, etc. (Zaugg et al. 2004). Given this diversity of actors, communication and coordination is of great importance. However, the involvement of actors is possible only if they have some basic knowledge about flood risks, their impacts and the way measures work. Thus, knowledge about hydrological risks is a key-factor in risk management. Is it absent, sketchy or based on false assumptions, actors may not be able to respond adequately to risk.

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This paper analyses the different forms of knowledge actors posses as well as the integration of knowledge into risk management. First, risk management and the role of actors in the implementation of flood protection policies will be discussed from a theoretical point of view. Then, research layout and methods will shortly be described. Two cases in Switzerland are analysed in detail. They serve as a basis for the following discussion of the major findings. Finally, some conclusions will be drawn.

THEORETICAL FRAMEWORK

Risk Management

Risk is often defined as the product of the probability of occurrence of a hazard – a potentially dangerous "natural" process – and the expected extend of damage. The latter is a function of vulnerability, i.e. the susceptibility of an exposed element to the impact of a hazard (e.g. Renn 1992, Ammann & Schneider 2004, ISDR 2004, Kienholz 2005). This definition has been criticised for being too simplistic and restrictive. Since risk has to be considered as a social construction, it includes representations, perceptions and personal experience. Thus, it is not only objective and value-free, but involves inherently subjective elements (Slovic 1987, Kasperson et al. 1988, Renn 1992, 1995, 1998). However, some scholars emphasize the necessity of overcoming the dichotomy between technical and social sciences by developing a more holistic approach that integrates technical as well as psychological, socio-political and cultural issues (Kasperson et al. 1988, Brown & Damery 2002).
We use the term risk for an event that has not yet happened but that – when occurring – could potentially be harmful to an individual or a community (compare Saner 1990, Renn 1992, November 2002). Thus, it is inherently associated with insecurity.

Risk management is a process of decision-making leading from the detection to the mitigation of a given risk. With regard to the controversy about the concept of risk, risk management has to bring together technical as well as more socio-political and psychological aspects (compare Geipel 1992, Renn 1998, 2005). According to Renn (1998:57), it is important to consider not only the different elements of risk, but also all actors concerned: "The objective is to design cooperative planning processes in which uncertain outcomes are discussed with representatives of the affected public and the evaluation of options is performed in an active dialogue between experts, stakeholders and members of the general public."

In the field of natural hazards, the *Integral Risk Management (IRM)* is a frequently applied concept. Embedded in a general risk dialogue involving all concerned actors, the IRM links together three main components in a so-called risk concept, that is risk analysis, risk evaluation and the integral planning of measures (fig. 1). While risk analysis investigates the hazardous process, the exposure of vulnerable elements and the damage potential in an objective and scientific way, risk evaluation consists of more socio-political and economic issues about the acceptability of a given risk and about resource allocation. Thus, it explicitly involves subjective judgment as well. The integral planning of measures[2] defines what should be done to reduce risk before (preparedness), during (response), and after (recovery) a disaster (Hollenstein 1997, Ammann & Schneider 2004, Kienholz 2005, Keiler & Fuchs 2007).

[2] The step of measure planning is sometimes called risk management (compare Hollenstein 1997, Renn 1998).

Fig. 1: The Integral Risk Management (IRM) (according to Ammann & Schneider 2004).

The IRM combines technical and social sciences as it links together the steps of risk analysis and risk evaluation. Nevertheless, the integration of socio-political and psychological aspects is still partial. Risk analysis stays a mainly technical task even though practice shows that some issues, such as damage potential and vulnerability, have a strong social, political, and economic component (Blaikie et al. 1994). Furthermore, there might be the temptation to carry out risk evaluation exclusively by applying mathematical models (e.g. for calculating collective risk or risk aversion).
However, a holistic approach is crucial for ensuring a successful risk management. Therefore, risk management should be considered as a discursive process of decision-making during which all concerned actors participate actively (compare Renn 1998, 2005, Duchêne & Morel Journel 2000). The International Risk Governance Council (IRGC) has proposed an alternative concept of risk management. The *risk governance framework* (Renn 2005) is inspired "by the conviction that both the 'factual' and the 'socio-cultural' dimension of risk need to be considered if risk governance is to produce adequate decisions and results" (Renn 2005:12). Furthermore, the importance of including all stakeholders is emphasized.

Actors

According to Knoepfel et al. (2001), an actor may be an individual, several individuals, a corporation or a social group. Everyone who is concerned by the collective problem of a public policy is considered as a potential actor. Actors may be public – i.e. politico-administrative actors, such as governmental, administrative, and judicial institutions – or private (Knoepfel et al. 2001). Within the framework of flood protection policies, the range of potentially concerned actors involves politicians, members of the public administration, emergency services, NGOs, citizens, etc. (Zaugg et al. 2004). Given the large number and the heterogeneity of these actors, there is a need of coordination and mediation in order to structure and conciliate the large number of potential interfaces. However, the attitude of actors regarding the management of hydrological risks is dependent on how they perceive them and on the relevance they attribute to protection measures (Zaugg Stern 2006). Thus, negotiation and decision-making processes may be complex and subject to conflicts.

In Switzerland, the Confederation[3] designs the flood protection policy by developing concepts and strategies. Since the 1990ies, Switzerland has been applying a prospective and integrated flood protection policy including the IRM. Strategic guidelines are implemented by the cantons (States), which may edict own implementation and execution rules. Coordination, financing, and realisation of flood protection measures are usually the duty of the cantons and communes (Zaugg et al. 2004, Thomi 2005). During a disaster, the event has primarily to be managed by the commune. Subsidiary help can be requested at the cantonal and federal level.

RESEARCH LAYOUT AND METHODS

This paper aims to analyse knowledge related to flood risks and its integration into risk management. Knowledge about flood risks is far from being trivial and one-dimensional. Indeed, several recent studies (e.g. Barrué-Pastor & Barrué 1998, November et al. 2006, Reynard et al. 2006, Siegrist & Gutscher 2006) have shown that it consists of a lot of different facets: it may be precise or confuse, explicit or latent, objective or subjective. Knowledge may strongly vary between different groups of actors and even within one single group. Personal experience, emotions, and basic attitudes as well as education and information play an important role. In addition, a wide range of different forms of knowledge may coexist in a limited spatial area such as a commune.
Actually, risk management and risk communication are often implemented according to a top-down scheme. Schematically spoken, public actors – such as members of public authorities – manage flood risks and transmit information; local, non-institutional actors "bear" risk management and receive information. Thus, knowledge transfer is often a one-way flow. As a result, knowledge of all actors is not considered in the same way. Especially non-institutional actors such as the population do not actively share their knowledge. However, they are part of the system as well: they are the ones who are directly affected by both flood events and potential measures. Furthermore, they may have precise local knowledge, which could be of great interest for risk management (compare National Research Council 1989, Barrué-Pastor & Barrué 1998, Duchêne & Morel Journel 2000, Brown & Damery 2002).

Three aspects will be discussed in this paper: 1) In which way is knowledge similar or different from one actor to another? 2) How is the knowledge of different actors integrated into flood risk management? 3) How would it be possible to improve knowledge transfer between actors, especially between non-institutional ones?
Two cases have been studied in detail: the village of Saillon and the city of Berne. Analysis has been based on written sources and, primarily, on 50 semi-structured interviews (35 in Berne, 15 in Saillon) lasting one to two hours each. The interviews were recorded on MiniDisc and written down integrally. In total, the transcriptions represent about 1000 pages of text. Actors to be interviewed have been selected in order to cover all groups, which are concerned by flood risks, i.e., representatives of the local and cantonal public administration (dealing with hydraulic engineering, spatial planning, and nature protection), emergency services as well as politicians, residents, citizen associations, and private consultants (hydraulic engineering, communication, etc.). These actors were questioned about their knowledge about flood risks (former floods, factors leading to hazardous processes, potential damages) as well as about potential measures (public and private).

[3] The Swiss political regime is organised according to the principles of federalism and subsidiarity.

CASE STUDIES

The Case of the Village of Saillon (Canton of Valais, Switzerland)

The commune of Saillon with its about 1'700 inhabitants is located in the Rhone Valley in the south-western part of Switzerland (canton of Valais). While the medieval part of the village is located on a small hill, the newer and larger part – built during the last 50 years – lies in the flood prone plain of the river Rhone.
In October 2000, a 100-year-flood of the river Rhone caused a dike burst some kilometres upstream of Saillon. Some of the water, which inundated the adjacent flood plain, reached Saillon by a complex drainage system some six hours later, where it flooded the newer part of the village (OFEG & WSL 2002).

Even though there has been no inundation caused by the Rhone river for about 50 years, the region was flooded several times during the decades and centuries before. Almost until World War II the flood plain consisted partially of marsh land – as local names such as "sandy moor road" still remember today. Two large river training campaigns in the late 19th century and in the first part of the 20th century and a sophisticated drainage and canal system made the flood plain habitable. Today, the village of Saillon is protected from floods of the Rhone river by a dike overtopping the plain by three to four meters.
Between the late 1980ies and the early 1990ies, several floods in the canton of Valais revealed the necessity of a systematic readjustment of the Rhone river watercourse (Third Rhone Correction). Preliminary studies by the cantonal administration afforded an insight into the risk of flooding by dike burst or by the insufficient hydraulic capacity of the river channel. However, this kind of knowledge has not reached the commune of Saillon. Table 1 resumes the coexisting characteristics and forms of knowledge before 2000.

Tab. 1: Characteristics and forms of knowledge before the inundation in October 2000.

Actor	Characteristics	Forms
Cantonal administration	complete, scientific, explicit	Precise knowledge about floods of the Rhone river due to detailed studies carried out in the 1990ies. However, this knowledge is less precise and complete in services, which are not working in the field of hydraulic engineering.
Communal administration	very fragmentary, vernacular	Almost no knowledge of potential floods of the Rhone river. Some basic knowledge about other sources of inundations such as an increasing groundwater level or a dam failure.
Fire brigade (communal)	fairly complete, rather vernacular, explicit	Some knowledge about a possible burst of the Rhone river dike near Saillon.
Residents	very fragmentary, vernacular, rather latent	Especially younger residents have almost no knowledge about flood risks due to the Rhone river. However, some elderly residents remember not only the marsh land and past inundations, but they have also precise knowledge about the micro-topography of the flood plain.
Farmers	quite complete, vernacular, explicit	Quite precise knowledge about the former marsh land and inundations caused by the Rhone river.

In general, the 2000 flood has improved risk knowledge as well as risk awareness. For the majority of the interviewed actors, the experience of the flood has become an important source of knowledge. Nevertheless, there are some nuances. Especially members of the cantonal administration as well as elderly people and farmers have already had precise knowledge before 2000. Their knowledge has been confirmed, but not modified profoundly. On the other side, fundamentally new knowledge has been generated within the communal

actors and the residents. Based on studies and expertises, the communal administration has enlarged its knowledge making it more explicit and complete as well as less vernacular. However, as the village of Saillon grows rapidly (about 250 supplementary residents between 2000 and 2006[4]), there are more and more inhabitants that have not experienced the inundation. Even though the commune and the canton keep the population posted about flood risks and measures, there is no systematic plan for providing information to new residents.
The inundation also reactivated knowledge about the micro-topography – i.e. small scale elevation and depressions – of the flood plain, a knowledge that was only shared by some elderly people before 2000. Indeed, sectors, which are still called "Les Îlots" (small island), were less inundated than others.

At the communal level, there were no particular measures against flood risks before 2000. After the inundation, a local crisis management group was created and building regulations were adapted in order to allow the construction of slightly higher houses, a change that permits now to build houses on an earth bank, i.e. above the water level of an inundation. Even though this possibility has been seized immediately after 2000, most houses, which are currently in construction, are directly built on the ground level. At the cantonal level, measures mainly concentrate on improvements in organisation and communication during a flood event, on the training of local crisis management groups, and on the Third Rhone Correction.

The case of Saillon shows that knowledge about flood risks was very heterogenic and its distribution unequal. Obviously, there was a lack of knowledge transfer both from the cantonal to the communal level and within the commune itself. For instance, knowledge of elderly people and farmers was not taken into account. The flood enhanced knowledge at all levels and it improved knowledge transfer, especially between the cantonal and the communal administrations and within them. However, knowledge transfer among private actors as well as between residents and the public administration is still insufficient. Furthermore, it seems that the integration of all relevant knowledge keeps to be incomplete. Even though getting regularly informed, the population does not actively take part in a risk dialogue or even in risk management.

The Case of the City of Berne (Canton of Berne, Switzerland)

The city of Berne (127'000 inhabitants) is located in the western central part of Switzerland. While the major part of the city is not flood prone, the historical quarter called "Matte" (1'150 inhabitants) lies directly on the river Aare (Stadt Bern 2007). During centuries, workshops used the river water to drive machines. Today, the quarter is primarily a residential zone, but there are still numerous offices as well as trading and workshop facilities. The Matte quarter has regularly been inundated either by the river Aare or by an increasing groundwater table. Since 1918 the discharge of the river has reached or exceeded the limit of damage (380 m^3/s) for 26 times (IC Infraconsult AG 2006), in general without causing high loss. Since the beginning of the 1990ies, frequency and magnitude of flood events seem to increase. The case study essentially concentrates on the impacts of the two major floods in 1999 and 2005 (fig. 2). During the last decade, there were also two minor floods in 2004 and 2007.

In May 1999, heavy rainfall and coincident snow melt were at the origin of the highest discharge of the river Aare since the beginning of systematic measurement in 1918, having a

[4] According to the website of the Swiss Federal Statistical Office, www.bfs.admin.ch (accessed on 18.9.2007).

statistically return period of more than 200 years (Aschwanden 2000). The flood and the increased groundwater table caused a static inundation in the Matte quarter.
Given the number of flood events during the last decades, almost all actors interviewed had some knowledge about flood risks in the city of Berne. However, before 1999, this knowledge concerned more the risk of flooding in general than the precise magnitude of a particular inundation. Thus, after 1999, existing knowledge about flood risks was adapted, incorporating especially the new quality of magnitude (depth of inundation). However, the flood was rapidly qualified as a very rare event. Therefore, a repetition of a similar flood was thought to be almost impossible at short- and medium-term.
Before hydraulic engineering measures could be planned, knowledge about hydrologic characteristics, bed load discharge, and ecological parameters had first to be generated. Knowledge has not only been improved by the public administration, but also by residents, e.g. within the local citizen association. The latter used this newly generated knowledge for claiming its interests at the municipal administration. For instance, the association warned of a possible clogging of the regulation weir, which lies upstream of the Matte quarter. It was argued that such an obstruction could deviate the water through the streets. However, it seems that this scenario has not been considered as a real risk outside the local population.
Between 1999 and 2005, long-term hydraulic engineering measures were studied, but none was realized. It was only in early 2005 that the planning was intensified. Nevertheless, some improvements have been made by the emergency services: they slightly adapted scenarios and they prepared material for future interventions. Finally, several residents protected their buildings by sealing up entrances and windows as well as by installing water-pumps.

In August 2005, intense and long enduring precipitations rapidly increased the discharge of the river Aare again. This time, driftwood clogged the regulation weir and the water flew through the streets of the Matte quarter reaching a maximal depth of about 2 m (Schudel 2005, Bezzola & Hegg 2007).
Instead of several days as in 1999, the increase of discharge lasted only some hours (fig. 2). Since emergency services assumed that the flood would develop in a similar manner as it did in 1999, response could not cope with the event during the first hours. It was neither quick enough nor adequate. Many residents underestimated the situation as well: instead of clearing cellars and removing cars immediately during night, they waited for the morning – but in the morning, it was too late and the quarter flooded.

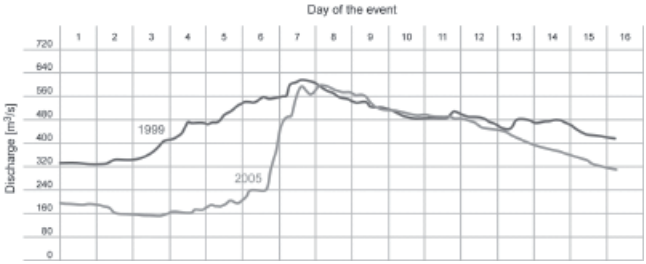

Fig. 2: Hydrograph of the floods in 1999 and 2005 (according to Schudel 2005).

The 2005 event fundamentally changed knowledge about flood risks, which, before, was thought to be quite good. Beside the type of event (static versus dynamic inundation) and its temporal evolution (slow versus quick), this change of knowledge also concerns season:

floods of the river Aare may not only occur in spring time when rainfall coincides with snow melt, but also during summer.
This new insights were at the origin of several adaptations. Whereas the planning of long-term measures was fostered, immediate measures improved warning systems and emergency intervention. Furthermore, many inhabitants have enhanced their own protection equipment (mobile barriers, sandbags, water-pumps, etc.). In August 2007, these immediate measures proved to be effective, although the flood was minor.

The case of the city of Berne shows how knowledge about flood risks has continuously been adapted in accordance with several consecutive flood events. It demonstrates that experience always has to be combined with other forms of knowledge in order to prevent false assumptions. On the other hand, the case study queries the classical conception of lay people (i.e. local population) and experts (i.e. public administration, consultants, etc.). Several residents proved to have precise scientific knowledge about flood risks. Furthermore, by the means of the local citizen association, they generate, share, and transfer knowledge within their neighbourhood and they try to influence risk management by manifesting their interests. However, different kinds of knowledge interpretation may lead to severe conflicts during negotiation and decision-making processes.

DISCUSSION

With regard to the forms of knowledge, the cases of Saillon and Berne differ significantly. In Berne, knowledge distribution is almost independent of the type of actor. Even though there are some differences due to their background and working field, almost all actors have basic knowledge about the origin and the impact of floods as well as about possible measures, at least after 1999. This is not the case in Saillon where characteristics and forms of knowledge vary a lot between actors.
Especially the knowledge at the population's level is very heterogenic. In Saillon, there is an important division between younger inhabitants on the one hand and elderly people as well as farmers on the other hand. A similar distribution of knowledge could not be found in Berne. On the contrary, within the citizen association vernacular and local historic knowledge is enlarged by scientific knowledge. Both cases show that there is no simple dichotomy between lay and expert people. Indeed, "lay" and "expert" knowledge is less dependent on the type of actor, but more on the perception of flood risks and on the socio-political relevance attributed to risk. However, the way of interpreting knowledge as well as different perceptions and priorities may lead to severe conflicts. Finally, "expert" knowledge is not homogenous.

Experience is a central element of knowledge about flood risks (compare Siegrist & Gutscher 2006), but its role is double-edged. Is it absent, management of flood risks lacks of a reference point. It has therefore to be based on imagination, models, extrapolations, etc. and its results may be uncertain. On the other hand, experience-based knowledge may lead to false assumption about future events (see the case of Berne) and, therefore, to an inappropriate response. This is due to the fact that experienced events are often considered as a universally valid reference. Alternative scenarios are not seriously taken into account. Thus, although knowledge has to consider experience, it must also be based on other sources. Nevertheless, consecutive experience of floods helps constituting a collective memory since it refreshes knowledge.

Risk management primarily involves public actors as well as some selected external experts. Local non-institutional actors are not (Saillon) or only partially (Berne) involved. The situation is quite similar in matters of knowledge since, in general, knowledge of non-institutional actors is not explicitly integrated. However, this would be of great importance as shown by the cases of Saillon and Berne.

The following paragraphs review the three components of the Integral Risk Management (IRM) with regard to the actors' configuration and the integration of knowledge (fig. 1). Carried out by the public administration and their external consultants, risk analysis produces analytic knowledge using scientific methods. Knowledge about natural processes and their impacts indeed has to be objective and scientific. However, the case of Saillon shows that vernacular and experience-based local knowledge might complete analytic findings.

In practice, the step of risk evaluation seems to play a subordinate role. Neither in Saillon nor in Berne it is conceptualized as an individual component of risk management and considered as an inevitable element. Of course, questions referring to risk evaluation are not completely omitted. They are generally answered by public actors, without explicitly integrating local non-institutional ones. Nevertheless, precise conceptualization and implementation of risk evaluation would be of great importance. Indeed, risk evaluation defines the acceptability of a given risk and it allocates limited public resources. It is a societal task and needs therefore the participation of all concerned actors, whether they are public or private, institutional or non-institutional. However, this presupposes that these actors have some basic knowledge about the dangerous processes and their impacts (risk analysis) in order to be able to participate.

Divergent objectives reflecting different perceptions and (socio-economic and political) priorities make it difficult to find solutions likely to be accepted by a majority. Since risk acceptability and resource allocation are often not negotiated within a specific risk evaluation step, these issues have to be treated during the planning of measures. This complicates decision-making processes and, in extreme cases, it can lead to a complete blockage of the whole measure planning process. In the city of Berne, such divergent priorities about the protection level have led to severe conflicts between residents – i.e. the citizen association – and the municipal administration. A clearly conceptualized and implemented step of risk evaluation involving all concerned actors may facilitate the planning of measures since the level of protection as well as the available resources would be defined more precisely.

Knowledge about dangerous processes and their potential impacts is inevitable for taking appropriate measures. The case of the Matte quarter shows that, with precise knowledge about potential floods, the population can take effective small-scale measures. However, knowledge and risk awareness are extremely volatile and may rapidly get lost. This has an immediate impact on the likeliness that residents take measures on their own initiative as revealed by the case of Saillon. Therefore, it is essential that knowledge is regularly refreshed – both at the public and private actors' level – and that its transfer is guaranteed.

There is a double lack of integration: risk management does not consider all actors concerned and all knowledge is not taken into account in an equal manner. There are several reasons for this situation. Risk management and knowledge transfer is still seen as a top-down task: public administration manages and private actors such as residents, entrepreneurs, etc. receive. This conception leads to a false assumption of a universally valid dichotomy between experts and lay people. Even though this dichotomy may exist in some cases, it is too simple and does not reflect reality in the field of flood risks. Finally, risk management is conceptualized as a purely technical approach. This might explain the marginal position of risk evaluation in today's risk management. According to the risk governance framework (Renn 2005), the conception of dealing with flood risks has to be enlarged by non-technical aspects such as socio-economic, political, or cultural issues. This conception presupposes that

local non-institutional actors have personal responsibility. However, this is in contradiction with the attitude of a part of private actors, which expect from public authorities that they guarantee total security without any contribution by the population.

In conclusion, it is important to integrate systematically all actors and their knowledge at every step of risk management. This means also that conceptualization and implementation of risk evaluation have to be improved, namely by providing the needed structures.
The clash of knowledge interpretations – as well as the underlying risk perceptions and socio-political and economic priorities – may lead to conflicts. Due to the plurality of knowledge interpretations, these conflicts risk to be more violent and complex when the number of considered actors increases. Nevertheless, such conflicts are part of the negotiation and decision-making process in risk management and they have to be argued out. In this sense, dealing with flood risks has to be seen as a socio-political process of problem definition and solution finding.
Often, responsibility of risk management is incumbent on one particular service of public administration. However, this service is not neutral: it represents public authorities and makes its own knowledge interpretations. In some cases, this may create conflicts and, in the worst case, its authority in directing risk management may be queried. As an alternative, risk management – or a part of it – may be leaded by an external neutral mediator, which is accepted by all actors.
In order to foster knowledge at the private actors' level, communication should not only follow a top-down path, but should take place in all directions at all interfaces between actors. Knowledge can be exchanged in numerous ways. For instance, there may be talks or excursions held by a member of public administration or by a private person having some particular local knowledge; annual events may be organised in order to remember a flood event; or children may be taught at school about local flood risks. The crucial point is that local residents having precise knowledge about flood risks are actively integrated, even if their knowledge is more vernacular than scientific.
Such local residents might play an important role in risk management. On the one hand, they are integrated in the local community. On the other hand, they have precise local knowledge about flood risks. Thus, local "experts" could constitute a linking element between public and private actors. This would allow to improve the integration of local, vernacular knowledge. At the same time, these persons could transmit information and knowledge of public actors towards local people.

CONCLUSIONS

Three main conclusions can be drawn: 1) Although some literature leads us to assume that there is a dichotomy between experts (i.e., members of public administrations, scholars, etc.) and lay people (i.e., population having no particular knowledge about a specific topic), reality is different. So-called lay people may have very precise knowledge about flood risks and past events. This knowledge is of great importance in risk management as well as in risk communication. 2) At the institutional actors' level, types and characteristics of knowledge vary a lot. This is especially due to the working field of the actor (hydraulic engineering, spatial planning, emergency planning, etc.) and the administrative level (commune, canton, Confederation). Thus, even "experts" do not share *one* general and global knowledge and, therefore, it is not possible to talk about *the* expert knowledge. 3) To improve knowledge transfer, local people with some knowledge about flood risks may play a role as an intermediary between the authorities and the population. The advantage is that they have some knowledge about flood risks, but, in contrary to the authorities, they are physically and

psychologically closer to the population. They have personal contacts, they know the local circumstances and they are part of the civil society.

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