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EFC/FAO working group « Hazards and Disaster Risk Management in Mountains »

Internationaler Austausch von Knowhow und Methoden

Zusammenfassung:

Die Working Group 2 (WG2) der EFC Working Party on Management of Mountain Watersheds (WPMMW) veranstaltet seit 2014 jährlich Praktiker-Workshops für Expertinnen und Experten für Alpine Naturgefahren aus ganz Europa. Diese Working Party wurde vom französischen National Forestry Office – Restoration of Mountainous Areas (ONF – RTM) und dem österreichischen Forsttechnischen Dienst für Wildbach- und Lawinenverbauung gegründet und wird von der Food and Agriculture Organization of the United Nations (FAO) unterstützt. Das Hauptaugenmerk lag dabei auf dem Austausch und der Diskussion von Naturgefahrenprozessen anhand von konkreten Fallbeispielen. Darüber hinaus konnten unterschiedliche Herangehensweisen in den verschiedenen Ländern zur Problemlösung kennengelernt und ausgetauscht werden.

Dieser Artikel beschreibt das Workshop-Format und präsentiert die wichtigsten Ergebnisse, und ist zu diesem Zweck in 4 Abschnitte unterteilt: 1) Überblick des institutionellen Rahmens der Workshops; 2) bearbeitete Fallbeispiele in den Workshops von 2014–2019, darunter Alpine Forstbewirtschaftung und Naturgefahrenmanagement; 3) Ergebnisse und Empfehlungen für die Themenschwerpunkte; 4) Ausblick auf zukünftige Themenschwerpunkte und Anknüpfungspunkte an andere internationale Arbeitsgruppen.

Stichwörter:
FAO, WPMMW, Internationaler Erfahrungsaustausch

International exchange of know- how and practices

Abstract:

The Working Group 2 (WG2) of the EFC Working Party on the Management of Mountain Watersheds (WPMMW) has organised annual technical workshops for European experts on natural hazards in mountains since 2014. The organisation, supported by the Food and Agriculture Organization of the United Nations (FAO), was initiated by the French National Forestry Office – Restoration of Mountainous Areas (ONF – RTM) department and the Austrian Service for Torrent and Avalanche Control (WLV). The main target lied on the exchange and discussion of natural hazard related issues based on concrete case studies. The goal is further to identify and share good technical practices between countries, as such building capacities of practitioners.

This article describes the format of the workshops and presents the main results achieved. It is divided into four sections: 1) review of the institutional context within each workshop, 2) presentation of case studies between 2014 and 2019 including forest management and natural hazard management in mountains, 3) identification of main results and recommendations for the topics addressed, 4) perspectives for topics to address and exchange with other working groups.

Keywords:
FAO, WPMMW, international exchange

A European working group on forests serving the prevention of natural risks in mountainous areas

The « Working Party on Torrent Control, Protection from Avalanches and Watershed Management » was established in 1950 by the FAO European Forestry Commission (EFC). In 1970, this technical body was renamed into « Working Party on the Management of Mountain Watersheds » (WPMMW). As the oldest international working group on natural hazards, it brings European mountain stakeholders together to promote sustainable development in mountain watersheds and the renewable utilization of forest, soil and water resources.

After a review process of its mandate and "modus operandi", a new structure of the WPMMW was decided in 2013. Since then, its activities are mainly organized between two working groups (WG): WG1 addresses issues related to forests and water, and WG2 focuses on hazards and disaster risk management in mountains. In 2019, the new working group WG3 on protective functions of forests was created. Its focus will include mountain forest management in a changing climate, forest fire risk and game policy.

The leading partners of the WG2 are France and Austria. The objectives of WG2 are 1) to identify and spread good practices and techniques for hazard and disaster risk management in mountain areas, and 2) to build capacities of technical practitioners through joint analysis of specific issues related to natural hazards and forests. Moreover, these thematic and training workshops aim at practical solutions for specific problems.

Country	Institution	attended workshops	Number of participants	
Albania	Ministry of Environment; National Federation of Communal Forest and Pasture; CNVP	1	4	
Albania	Ministry of Environment; National Federation of Communal Forest and Pasture; CNVP	1	4	
Austria	WLV	5	11	
Czech Republic	AON Impact Forecasting	1	1	
France	ONF-RTM; ONF International	5	9	39
Germany	Bavarian Environmental Agency	4	4	
Italy	Autonomous Province of Bolzano – service of torrent and avalanche control	1	2	
Switzerland	Federal Office for the Environment	3	1	
Turkey	OGM – Soil Conservation and Watershed Rehabilitation Department	4	7	

Tabelle 1: Anzahl der TeilnehmerInnen bei den Workshops nach Institutionen

Table 1: Number of participants and attended workshops by institutions

Therefore, European specialists for mountain risk engineering work on case studies for knowledge exchange and comparing methods. The workshop follows three stages: 1) each country gives a general presentation on the workshop topic; 2) the study case is presented by the hosting team; the practitioners work in transnational groups on the certain case to discuss and find a group-solution; 3) the group-solutions are presented in a debriefing to discuss common results. The workshops have shown that the best way is to make two consecutive workshops on the same topic in different countries. English reports from all workshops are available on the website of the WPMMW.

All member countries of the FAO-EFC are invited to participate in, or host the activities of the working group. Eight countries and 39 practitioners took part in one or more of the five workshops organized since 2014 (Table 1). They took place in France and Austria (Table 2).

The five workshops carried out between 2014 and 2019 focused on natural hazard management, mainly torrential hazards, at the level of watersheds and integrating the effects of the forest (Table 2). The whole spectrum of risk management has been addressed, starting with hazard mapping (workshop 1) up to analysis of different control strategies against torrential hazards: acting on heavy sediment transportation (workshops 2 and 3), and acting on sediment producing areas (workshops 4 and 5). The inclusion of the protective function of forests was compared (workshop 1). The consistency of forest management with civil engineering control measures was addressed: maintenance of the level of protection (workshops 4 and 5); management of potential woody debris (workshops 2 and 3).

N°	Date	Country	Municipality (case study)	Natural hazard	Topic
1	Oct. 2014	France	Sixt Fer-à-Cheval (2 sites), Morzine (3 sites)	Rockfall	Hazard zone mapping and the integration of the forest protection function
2	May 2016	Austria	Altenmarkt (Zauch river)	Torrent	Woody debris – Questions and answers
3	June 2017	France	Argentine (La Balme torrent)	Torrent	Sediment and woody debris transport regulation in torrential catchments
4	June 2018	Austria	Bad Ischl and Ebensee (Kesselbach Valley)	Torrent	Effect of forest and check dams on water surface, bedload input and debris earth flow in Alpine watersheds
5	June 2019	France	Meylan (La Ruine torrent)	Torrent	

Tabelle 2: Titel der Workshops

Table 2: Workshops and topics

Workshops 2014 – 2019

Hazard zone mapping and integration of the protective functions of forests (workshop 1)

At Sixt Fer-à-Cheval, the forest is not integrated in the Risk Prevention Plan (RPP) hazard map from 1987. The surroundings of the two villages Frénelay (case 1) and Nambride (case 2) are exposed to rockfall (Fig. 1). The forest (private and communal-owned) covers a large part of the area, but is ageing. The workshop participants agreed on the need to define a protective status for these forests with the necessary involvement of specific forest management and the integration of their protective effects in hazard maps.

In Morzine, the Tassonières hamlet (case 3) is protected against rockfall by an ageing forest situated above control structures (nets). However, with local authrisation a house was built on the road used to access both the forest and the protection structures for maintenance purposes. There are also houses exposed to moderate hazards without protection upstream. This situation contributed to an appreciation of the different countries' approaches to the roles of elected officials and the state in view of decision-making in those two areas: construction and protection.

The landslide site (> 100 000 m³) in the Ardoises valley, that is taken into consideration in hazard mapping (case 4), clearly showed that the effect of the forest is not considered for this type of natural hazard.

The Rockfall Hazard Zone Mapping Method (MEZAP), used in France for RPPs, was presented for a house hit by a rock (24 m³) in the Manche valley (case 5). The participants highlighted the practical benefits of the method, which is based upon Lidar methods and the principle of the energy grade line.

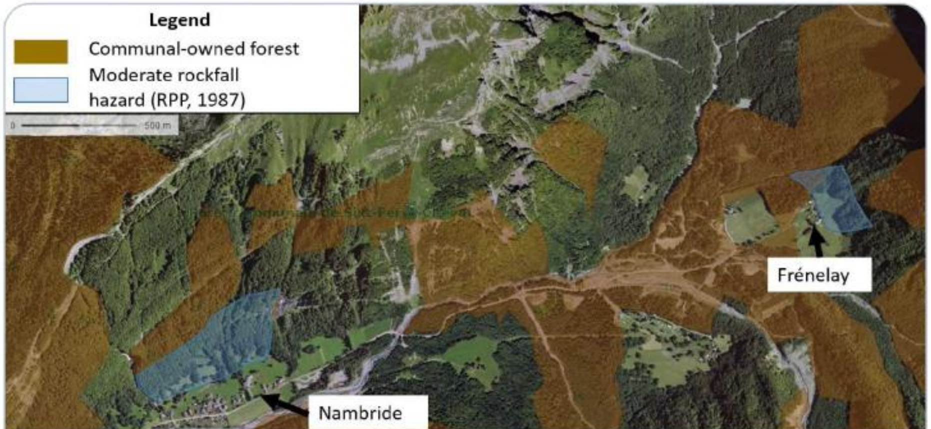

Abbildung 1: Die zwei Fallbeispiele in Sixt Fer-à-Cheval.

Figure 1: The two case studies at Sixt Fer-à-Cheval

Torrential watersheds description (workshops 2 to 5)

Workshops 2 to 5 focused on torrential risk management. Main characteristics of the four case study watersheds, all of them well forested, are summarized in Tables 3 and 4.

Watershed	Area Altitude Average slope	Forested coverage	Watershed phenomena	Torrential floods and/or debris flows	
				main events	design event
River Zauch	36 km² 840 m–2350 m ≈ 11 %	> 60 %	Erosion, landslides, avalanches	Great flooding in 1884	Q_{ref} = 95 m³/s Debris load = 56.000 m³ + woody debris
La Balme torrent	6,6 km² 340 m–2700 m ≈ 12 %	65 %	Active rockslides (Fig. 2), landslides	1776–900: 10 events 1900–1940: 7 events 1970–today: 5 events	Q_{ref} = 70–130 m³/s Debris load = 40.000 m³ + woody debris
Kesselbach Valley	3,5 km² 460 m–1840 m ≈ 170 %	> 40 %	Erosion (upper catchment), avalanches	2002, 2010, 2013: debris flows 2007, 2008: storm events 2009: major avalanche	Q_{ref} = 32 m³/s Debris load = 40.000 m³
La Ruine torrent	0,24 km² 210 m–880 m ≈ 17 %	> 40 %	Massive rockslide, little landslides	1880–1970: several events 1987: debris flow	Q_{ref} = 4 m³/s Debris load = 5.000 m³

Tabelle 3: Einzugsgebietscharakteristika

Table 3: Geomorphological and hydraulic description of torrential watersheds

Watershed	Hazard description	Existing protection structures	Exposed elements
River Zauch	Clogging of bridges Erosion and concentrated floodings along with deposition of sediment and woody debris in settlement area	*Upper catchment:* torrent control check dams (since 1884) *Tributaries:* Sediment retention basins *Main river:* A filter dam (Fig. 3)	Settlement area (Altenmarkt) single road to Zauchensee
La Balme torrent (Fig. 4)	Mainly debris flows and bedload transport with woody debris (clogging bridges?) Sediment deposition with overflowing in the lower part (railway)	*Upper catchment:* torrent control check dams (1950-2000) *Alluvial fan:* rebuilt riverbed, channel, old ineffective dikes	Settlement area (Argentine), water pipe, railway, main road
Kesselbach Valley (Fig. 5)	Mainly debris flows and sediment transport	*Upper catchment:* torrent control check dams (since 1901), reforestation *Alluvial fan:* inclined rake barrier (20.000 m³), rebuilt riverbed	Scattered settlement, Austrian railways (ÖBB)
La Ruine torrent (Fig. 6)	Bed load transport, sediment deposition along alluvial fan, very small channel limited to liquid flow	*Upper catchment:* torrent control check dams (since 1895) *Alluvial fan:* sediment traps (450 m³), embankments, channel	Settlement area (Meylan), water pipe, main road

Tabelle 4: Ereignischronik und Verbauungsgeschichte in den Einzugsgebieten

Table 4: Description of torrential hazard and existing protection measures for each watershed

Abbildung 2:
Aktive Rutschung im oberen Einzugsgebiet (La Balme Wildbachs)

Figure 2:
Active rockslide in the upper catchment (La Balme torrent)

Management of woody debris and sediment transportation in torrential watersheds

The comparison of case studies at the Zauch river and Balme torrent is the basis of a better international understanding of woody debris and sediment transportation management in torrential watersheds. In order to analyse floods with woody debris, one is required to take a variety of processes into account such as sources (bank erosion and lateral landslides along the torrent – Fig. 2, avalanches, storms…), transportation (type, volume, log jam release) and obstacles to stream flow in key areas (bridges, networks, etc.). Some countries do not take into account this last point in their torrential hazard zone mapping.

The Austrian project on the Zauch River, with a total cost of 8 million Euro, consists of improving the already existing system by implementing combined woody debris flow breakers and filter dams in the main river (Fig. 3) and in the two tributaries and maintenance of existing structures in the tributaries. The debris flow breakers and filter dams are situated as close as possible to the settlement area.

Two options were presented for the Balme torrent (Fig. 4). The first one was the creation of a woody debris and sediment filter dam (20,000 m³; 700.000 €). The second solution was the restoration of the old dike at the level of the village of Argentine by widening the stream channel and the woody debris and rock filter dam, without upstream retention.

The proposed solutions are based on civil engi-

Abbildung 3:
Workshop-Teilnehmer vor einer Wildholzfiltersperre im Zauchbach

Figure 3:
Participants in front of a woody debris filter (river Zauch)

Abbildung 4:
Einzugsgebiet des La Balme

Quelle:
www.google.at/maps/
[Abfrage 21.09.2020]

Figure 4:
La Balme torrent watershed

Source:
www.google.at/maps
[Query 09/21/2020]

neering structures implemented downstream: for the Zauch river, in the main river or the alluvial fans of the main tributaries; for the Balme torrent, on the alluvial fan. The implementation of silvicultural measures in these substantially forested watersheds has been a fruitful discussion topic between the participants: feasibility, substantial cost, real protective effect and choice of target areas are fundamental decisions. An interventionist approach in this field has been observed in Turkey and in Albania.

Effects of forest and check dams on bedload input and debris earth flow

In the upper catchment, the Kesselbach torrent is split into two main tributaries (Fig. 5) in the same way as the Ruine torrent (Fig. 6). In the two torrential watersheds, the historic protection strategy based on limiting the bedload input, afforestation, riverbed- and land-stabilization and consolidation measures. Subsequently, other measures were added, such as solid transport management (filter dams, sediment retention basins, stream channels, etc.). As the forest and stabilization structures are ageing, maintenance steps into the focus of upcoming projects.

All the participants agreed that the implementa-

Abbildung 5: Einzugsgebiet des Kesselbachs

Figure 5: Kesselbach torrent watershed (work document for workshop 4)

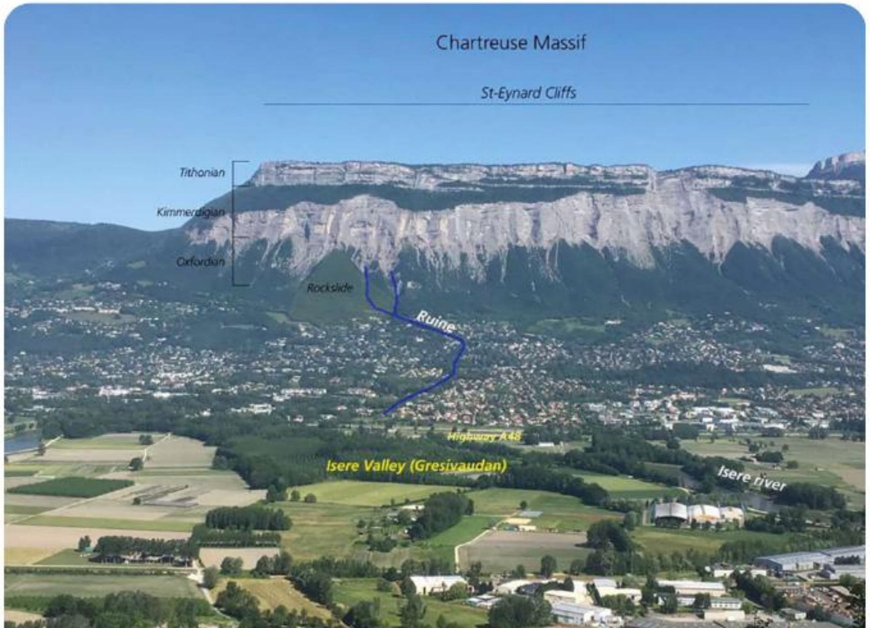

Abbildung 6: Einzugsgebiet des Ruine- Wildbachs

Figure 6: The Ruine torrent watershed

tion of silvicultural measures must be based on preliminary stabilization of the riverbed by site-specific structures (Fig. 7). Further processes must be taken into account when choosing silvicultural techniques: for example, avoiding reforestation of straight growing trees in the avalanche paths, because it will increase the risk of woody debris in the main torrent.

In the case of the Kesselbach torrent, priority was given to the measures for the Sulzgraben tributary, such as nets, wooden structures, concrete structures in areas of easy access, since it potentially supplies substantial solid material due to the riverbed´s incision and the bank erosion of the instable slope. The Raueckgraben tributary should be subject to limited treatment by way of adapted bioengineering measures in the slopes: regrassing, slow-growing shrubs, small protection fences. The structures situated at the junction of the two tributaries, stabilizing the whole torrent, must be maintained.

Abbildung 7: Sedimenteintrag und Tiefenerosion im Sulzgraben (Teileinzugsgebiet des Kesselbachs)

Figure 7: Bedload input and incision in the Sulzgraben (tributary of Kesselbach torrent)

It has already been widely recognized that all existing structures need to be maintained in the Ruine torrent. Moreover, in order to protect the city of Meylan against the design event, the downstream retention capacity must be increased. Several solutions have been considered: adaptation of an existing check dam to convert it to a dosing barrier, new deposition area, and capacity increase of the existing deposition area.

Abbildung 8: Alternde Konsolidierungswerke und forstliche Maßnahmen im Ruine- Wildbach

Figure 8: Ageing stabilization structures and a forest in the upper catchment of the Ruine torrent

Main results and general recommendations

Forests and structures for protection: hazard mapping

The potential protective function of the forest depends on the process type. For rockfall, it limits to propagation of rocks sized less than 2 m³. For torrential processes, source areas of sediment may decide. There is a limited protective function for heavy landslides or rockslides. Effects that are more obvious are observed on areas of superficial erosion, even though this effect depends more on the plant cover than on the forest. The existence of a vegetation cover in the slopes is closely linked to stabilization and consolidation measures in the riverbed (Fig. 7).

The effect of the protective function of forests may be considered within rockfall or avalanche hazard zoning. However, if the process´s scope requires (for example, rock size > 2 m³), complementary technical structures have to be considered. Regarding torrential floods, scenarios involving woody debris (bridge clogging, logjam release) should be taken into account in order to establish hazard mapping.

The level of protection provided by forests and associated structures depends on their maintenance, the continuous monitoring of processes and the functioning of structures. Adapted silvicultural management and structure maintenance play an important role, including accessibility. However, local authorities oftentimes do not grant the financial means required for these maintenance operations, unless it allows the construction of new buildings and infrastructure. In many countries, such as France, the construction of new housings below of protection structures is prohibited. This is a limiting factor for protection infrastructure for local authorities.

The handling of building permits in hazard zones depends on the specific context in each country (legal framework, institutional implementation framework, and financial means). The main goal of new measures is to reduce the hazard risk. When more houses are built in a risk zone after taking technical protection measures, the total risk might increase. The general feeling expressed by the participants was that in view of the potential local conflicts of interest, decisions should not be taken solely at a local level.

Protection strategies against torrential floods and debris flows

In order to determine torrential protection strategies, preliminary analysis of the watershed must consider the whole catchment with all relevant factors of the natural environment, leading to an integral protection concept.

In spite of a number of uncertainties, this analysis

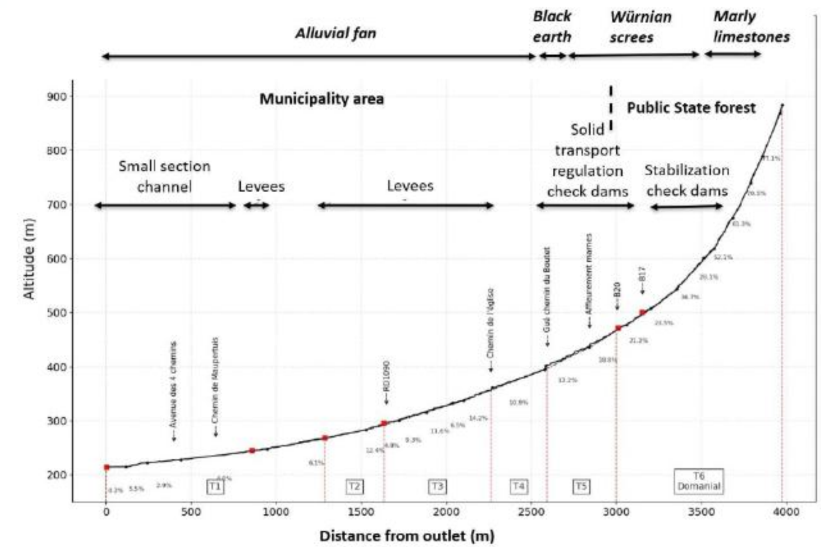

Abbildung 9: Längsprofil des Ruine- Wildbachs

Figure 9: Longitudinal profile of the Ruine torrent

shall provide for:

a. the identification of source zones (type, volume, torrent connection);
b. the analysis of the profile along the torrent (Fig. 8 – zones of supply, extraction and deposition in the riverbed);
c. the description of reference scenarios, with or without woody debris (Table 2);
d. the identification of potential flooding zones and conditions (Table 3). This analysis shall take into account the forest and existing protection structures, while assessing their potential effect on the decided scenario and that they are operational.
e. the dialogue and interaction with other stakeholders in the catchment, for instance from forestry, hunting, and tourism.

Based on this, several, and non-exclusive strategies, might be considered:

a. take no action (zero alternative)
b. maintain existing systems
c. treat a potential solid material source zone, including woody debris, by favoring silvicultural techniques (preferred approach in Turkey or Albania, and former approach in France)
d. combine forestal and technical systems of sediment and woody debris management in water discharge (preferred approach in Austria, and considered complementary in France)
e. give a space of liberty back to the torrent on the alluvial fan (substantial land-use constraints)

The choice of strategy depends on the parties involved, possibly several for a watershed (Fig. 8). Included in decision-making criteria are the frequency at which events occur, operation and maintenance costs, the level of stakes protected and the associated residual risk, and ecological and social impacts.

Each chosen protection measure must be planned in detail prior to implementation. To this end, each country uses its own technical guides and standards to design torrential protection structures and to define silvicultural operations. However, one would be well advised to consider the potential negative effects, from the design phase of sediment deposit structures, i.e. downstream riverbed incision, ecological impacts, and land-use impacts. Rules for designing woody debris management structures need to be elaborated. There is a lack of specific guides and standards, i.e. in the assessment of woody debris volumes, and capacity sizing of structures, such as nets.

Different «schools» within the group

Different general approaches were identified amongst the different countries. In Turkey and Albania, silvicultural management in large areas is a preferred method. In Austria, many forestry measures were already implemented in the late 19th century after heavy deforestation due to the industrial revolution. Recently a combination of technical structures, hazard zone mapping and forest management has been in focus, for which it has developed internationally recognized skills and rules of design and monitoring. One may consider the Turkish or Austrian approaches as more proactive than the French approach, in which prevention strategies do not include protection measures to the same extent. Moreover, risk definitions and their level of social acceptance are specific to each country.

These workshops have enabled the comparison of institutional, legal, financial and technical frameworks of the different participating countries. Further, they provided for the elaboration of hazard mapping integrating the protective function of forests and structures, as well as for the management of woody debris in torrential watersheds. Details of this comparison are available in the report tables from workshops 1 and 2. These differences play a key role in the decision-making strategies and implementation methods in each country.

Exchanges between practitioners: main output of the workshops

At the end of every workshop, the practitioners were asked for their feedback and evaluation. The unanimous feedback was a sentiment of great interest in the workshops and appreciation of the way they are organized, i.e. exchanges revolving around hands-on practice on a given topic.
The main elements that stand out are: lively discussions, methods and solutions on the level of designers (between practitioners); question the own and other practices; gain and evolve input for possible solutions for the daily work of engineering; improve the common technical understanding of the practitioners; expand the technical horizon on the management of natural risks in different contexts.

Conclusions and perspectives

The WG2 workshops of the WPMMW of the FAO-EFC are a platform of fruitful technical exchanges between European practitioners on natural hazards management in mountain watersheds. They meet the aims stated by the WG2: identify and promote good practices; participate in continuous training of practitioners; contribute to thoughts and ideas related to a case study, to share with the local department in charge. In consequence, all the participants and WP members share a common interest in these workshops. Technical recommendations developed on each treated topic are available online.

Even though four out of five workshops have addressed protection against torrential phenomena, other subjects may be approached, such as avalanches, rock falls, and socio-economic aspects. The first five workshops took place in France and Austria. The aim is to open up the horizon and Turkey offered to host the upcoming workshop in 2021.

Moreover, a link with other international working groups could contribute to the dissemination of results achieved and to integrate thoughts and reflections. For instance, it would be beneficial to foster the exchange with academia and research, as science-practice dialogue is crucial for sustainable results. A possible platform would be the INTERPRAEVENT network. Another important synergy could be with the thematic working group on natural hazards of the Alpine Convention PLANALP, which also works on risk assessment, natural hazard management and analysis. Lastly, the exchange with other Working Groups of the WPMMW on forest and water in mountain watersheds (WG1) and protective forests (WG3) can be strengthened.

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Akronyme Institutionen / *Used acronyms for institutions:*

CNVP: Connecting Natural Value and People (Non-Governmental Organization)

OGM: General Directorate of Forestry – Turkey

PLANALP: Platform on Natural Hazards of the Alpine Convention