

FINAL REPORT

**Oberstdorf,
Germany,
15-26 June
1992**

European Forestry Commission

**Eighteenth Session of the
Working Party on the
Management of Mountain
Watersheds**



**Food and Agriculture Organization
of the United Nations**

EUROPEAN FORESTRY COMMISSION

**WORKING PARTY ON THE
MANAGEMENT OF MOUNTAIN WATERSHEDS**

EIGHTEENTH SESSION

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I. INTRODUCTION

1. The Eighteenth Session of the European Forestry Commission's Working Party on the Management of Mountain Watersheds was held in Oberstdorf, Germany, from 15 to 19 June 1992 at the kind invitation of the Government of Germany. The working meetings took place at the Kurhaus Conference Centre in Oberstdorf from 15 to 19 June, and were followed by a study tour organized by the Host Government, illustrating integrated upland management, torrent and avalanche control, and forest hydrology in Southern Bavaria from 22 to 27 June. The agenda, timetable and study tour programme are given in Annexes A, B and D.

2. The Session was attended by 51 delegates and participants from 11 EFC member countries: Austria, Czechoslovakia, Finland, France, Germany, Israel, Italy, Norway, Portugal, Spain, and the U.K. and ten observers from China, Guinea and Japan. The list of participants is given in Annex C.

3. The Chairman of the Working Party, Mr S. Fattorelli, Italy, chaired the discussions together with the Second Vice-Chairman, Mr E. Pröbstle (Germany) and Mr L. Rojo (Spain). Mr T. Michaelsen of FAO's Forest Conservation and Wildlands Branch, as Secretary of the Working Party, ensured coordination of the meeting based on the efficient arrangements made by the Federal Ministry of Food, Agriculture and Forestry, and by the Bavarian State Ministry of the Interior. The study tour was organized by the Water Management Service of the Bavarian State Ministry of the Interior.

4. Mr S. Fattorelli, welcomed the participants from EFC member countries and overseas observers. He expressed his thanks to the Government of Germany for its willingness to host the Eighteenth Session and for the arrangements made for the conduct of the meeting. A special welcome was extended to the Federal Minister of Food, Agriculture and Forestry for being present at the opening ceremony. Although the Working Party was one of the oldest in FAO with the first Session having been held in France in 1952, the work of the Group had as much actuality as ever before. Mountain Watershed Management had to provide answers to growing environmental concerns, and the Working Party should commit itself fully to this task.

5. The Mayor of Oberstdorf welcomed the participants on behalf of the southernmost town in Germany. He expressed the hope that the meeting would show that Oberstdorf had been a good choice. Within only 230 km² there were 15 mountain peaks over 2 000 m above sea level. Tourism is of paramount importance with over 250 000 annual guests in a town with only 11 000 inhabitants. A balance is therefore essential between the conservation of natural beauty, the capacity of infrastructure, water management, and safety against torrential phenomena. The town therefore maintained close collaboration with Bavarian Water Management authorities. One of the most interesting present projects involves the building of a new hydroelectric power station, which, among other benefits, will enable the town busses to change to electric power by August 1992. The Mayor noted that the good international representation at the meeting reflected the global concern for the issues being discussed, reminding him of the Rio Conference (The United Nations Conference on Environment and Development) which had been concluded the precious week.

6. Mr El Hadji Sène, Chief, Forest Conservation and Wildlands Branch, welcomed the participants on behalf of the Director-General of FAO, and thanked the Government of Germany for the kind invitation to host the Eighteenth Session. A special welcome was extended to participants from overseas countries who were invited to participate as much as possible in the presentations and discussions during the meeting.

Mr Sène noted that no country, mountainous or otherwise was exempt from exposure to natural disasters, and reminded the Working Party of the priority given to natural disasters in recent international events such as the 19th IUFRO World Congress, the Strasbourg Ministerial Conference on Forest Protection in Europe, The FAO/Netherlands Conference on Agriculture and Environment, the Tenth World Forestry Congress, the 15th Session of Silva Mediterranea, and concluding only the previous week, the United Nations Conference on Environment and Development (UNCED).

The Strasbourg Conference had made a direct call for the Working Party to be the vehicle for follow up action related to Resolution 4: Adapting the management of mountain forests to new environmental conditions. This would have to be done in collaboration with IUFRO and especially, but not limited to, Subject Group 1.04 on Natural Disasters. There was still a need to strengthen national networks and improve between-session communication as agreed during the 17th session held in Vicenza.

7. The German Federal Minister of Food, Agriculture and Forestry noted that some of the proposed international activities as a follow-up to UNCED already form part of the mandate of the Working Party. He considered Oberstdorf an ideal location for the 18th Session and looked forward to the outcome. Tourism in the Alps is a blessing and a threat at the same time and the ecological balance is vulnerable. In Bavaria a new global concept, linking more closely causes and effects, is being developed for the formulation of protection programmes. The protective function of the forests can no longer be taken for granted. Forest soils, climate and excessive wildlife populations represent a threat, and forestry measures alone are not sufficient. An action programme to save the forests so that they can perform their functions is required, with the reduction of harmful emissions as a first priority. The programme needs to be long term and ecologically broad based, involving local populations as well as visitors.

The Federal Minister then declared the eighteenth session officially open.

8. The Working Party adopted the proposed agenda and timetable given in Annexes A and B.

II. NATIONAL REPORTS

9. Delegations of the following countries presented national reports (in chronological order): Czechoslovakia, France, Germany, Italy, Norway, Portugal, Spain, the U.K. and Israel. Guinea also submitted a report.

10. Mr M. Chalupa presented the national report of Czechoslovakia. This included mention of progress made in protection and amelioration of mountain forest ecosystems, as well as research and modelling work in forest hydrology and watershed management.

11. Mr B. Saillet presented the national report of France. In this he gave a brief historical overview of reforestation in mountain areas, and mentioned progress made on risk zoning and mapping, as well as recent important natural events. The long term programme of conservation and restoration of mountain areas includes the management of public lands, mainly forests and pastures, torrent control, and revegetation of mediterranean watersheds. On the institutional side it has become more evident that interministerial collaboration is needed in order to deal adequately with prevention measures against natural hazards.

12. Mr W. Kraus presented the national report of Germany. The protection against torrents and avalanches as well as erosion protection in the mountains in the Federal Republic of Germany is mainly the task of the Free State of Bavaria. It has developed a long-term programme to protect its Alpine region which sets out the existing, endangered objects and the necessary protective measures as well as the costs involved. The urgency of the measures outlined will depend on the future state of mountain forests, soils and climate. It will be determined by the results of the relevant scientific investigations into the future development. The concept of Bavaria which is now available thus shows in a dynamic way the future steps to be taken to protect against floods and mudflows, avalanches and rockfalls. It adapts to new developments. It is a dynamic programme to protect the Bavarian Alpine region and protect the Alpine habitat.

13. Mr S. Fattorelli presented the national report of Italy submitted by the National Forest Service of Italy by Mr S. Salvatici. During the last two years emphasis has been placed on the implementation of Law N° 183 concerning the institutional and organizational arrangements for land and water conservation. The principal activity has involved the institution of the National Water Authorities in the main river basins of the country, Po, Adige, Arno, Tevere, Piave, etc. Those Authorities are encharged to prepare a Master Plan for Water Resources to establish priorities amongst projects proposed by different entities at national and local levels and to solve possible conflicts of different uses of water resources. The last two years have been characterized by several floods of which the major ones were in northeastern Italy, Friuli-Venezia-Giulia, and occurred twice, in October 1990 and July 1991.

14. Mr H. Haga presented the national report of Norway. At the moment, management and legislation concerning water resources are important topics of discussion in Norway. As hydropower development until now has been the main issue as far as water resources are concerned, the "hydropower era" is drawing to a close and other user interests are of great importance. Today there is an integration of land-use planning and water-management planning. The laws regulating the hydropower development and the management of water resources in general are being revised to make them more suitable for modern water management. Study on possible climate change shows considerable influence on the hydrology in general and the flood patterns, particularly. No severe damages caused by floods or avalanches have occurred over the last two years, but heavy storms struck the western coast last winter, causing considerable damage.

15. The national report of Portugal was presented by Mr R. Silva. In this he gave a brief historical overview of torrent control activities in Portugal and a description of the components of implementation of the national policy of water management. The report also provides information on current research activities related to the management of forested watersheds in Portugal.

16. The national report of Spain was presented by Mr L. Rojo. Forest hydrological restoration in Spain continues at a satisfactory pace. The main problem consists of the lack of up-to-date regulations and financial incentives for the restoration of private lands. The National Plan for Forest Hydrology Restoration and Erosion Control was completed in February 1991. The Spanish Institute for the Conservation of Nature ICONA continues, in collaboration with FAO and UNEP, its leadership role in the Cooperative Project of the Mediterranean Erosion Assessment and Control Network. ICONA also signed an agreement in 1991 with the town of Malaga and the Andalucian Institute of Agrarian Reform concerning torrent and flood control measures. This document is the first of its kind and therefore constitutes an important first example of an agreement between the national forest administration and authorities at the municipal level.

17. The national report of the U.K. was presented by Mr M. Garforth. The United Kingdom has few truly mountainous areas, and although some of the problems experienced on Alpine regions are similar, they are small on scale. However, extensive upland areas do exist which present a number of problems to the forest manager. This report refers to two: water and landscape.

Water: Forestry activities may affect the quantity and quality of water entering river systems. Ground preparation for afforestation may cause increased sediment loads. Afforestation may, by the capture of airborne pollutants, lead to acidification of water systems. Afforestation may also cause a reduction on run-off because of higher interception and evapo-transpiration rates. Harvesting operations can damage water systems if badly planned and executed. To ensure that forestry operations do not impact on river systems, the Forestry Commission has produced a set of practical "Water Guidelines" which all state foresters, and all private forest owners receiving state aid, must follow.

Landscape: When new forests are created, and existing forests felled and regenerated, the landscape is changed. In planning and executing forestry operations, the forest manager must ensure that the value of the landscape is not reduced; rather that it is increased. To that end, the Forestry Commission has produced a set of "Landscape Guidelines" based on the following principles: scale, shape, unity, diversity, visual force, the "genius loci" (the spirit of the place). As with the Water Guidelines, these Landscape Guidelines are followed by state and private foresters.

18. The national report of Israel was presented by Mr D. Rosenzweig in the form of a video showing the impacts of the unusually high precipitation received during the last winter season. Watershed management in Israel is specifically characterized by problems of soil conservation and alluvium erosion on the one hand, and scarce water resources on the other. The Land Development Authority with the Ministry of Agriculture have adopted an integrative approach not only to watershed management but to planning, development, conservation and utilization of available land and water resources and also for environmental beautification and scenic landscaping. The winter floods of 1991-1992 were exceptional in terms of the quantity, intensity, duration, distribution and frequency of the precipitation. The total amount of precipitation for that year amounted to 100% more than the regular annual average. In most of the centre and north of the country, precipitation quantities surpassed 1 000 mm and the rushing waters destroyed everything in their path. The Land Development Authority is responsible for Israel's afforestation, according to a national master plan which is in the final planning stages. Forests constitute the principal surface vegetation covering the land of Israel and exercise an important role in watershed soil conservation, the

ecological benefits of forests are enormous, including soil erosion prevention, assistance in lowering atmospheric air and dust pollution and they are a source of oxygen. Over the years, a close and fruitful cooperation has been achieved between L.D.A. and the Ministry of Agriculture in the research and development of a broad range of subjects in the areas of land, water and environmental beautification.

19. In addition to national reports from EFC member countries, Mr T. Barry, submitted a report on watershed management in Guinea. Two regional programmes on watershed management are presently being implemented in Guinea. They are:

(1) The Regional Project for the Integrated Management of Fouta Djallon

The origin of this project can be considered to be the third Inter-African Conference on Soils held at Dalaba in 1959. This programme, discontinued for 20 years, was included in 1979 in the United Nations Plan of Action to Combat Desertification and Drought in Africa South of the Sahara. The first phase of the project (1984-1986) was financed by UNDP and executed by FAO.

(2) The Regional Project for the Integrated Management of the Upper Niger and the Gambia Basins

This programme is a result of recommendations of the European Council meeting in Milan in 1985 within the framework of the European Plan of Action to Combat Drought and Desertification in Africa, in which Guinea plays a key role. It is also a result of decisions taken by the Ministerial Conference on Desertification (COMIDES). The various contributions to the formulation and implementation of the two programmes has helped orienting them towards a "participatory approach to village level resource management". This is seen as a formula of an innovative and experimental nature, developed by the NGO's through a programme of "research and development". The Guinean delegation wishes to include the collaboration of IUFRO in research and collection of information on watershed management in developing countries especially in Africa. It should be noted that CORAF (Conference of Heads of Agronomic Research Institutions in Africa) already cooperates with IUFRO in the areas of management of closed moist forests and tropical silviculture.

III. WATERSHED SOIL MOVEMENTS AND EROSION PROCESSES

20. Ms M. Mössmer presented the special report: Restoration of mountain ecosystems with protective functions with special regards to mountain forests. In the Bavarian Alps ranging from peak areas of the sub-Alpine zone down to the sub-mountainous area, one finds a great number of different ecosystems depending on the altitude which partly developed from human uses, such as sub-Alpine grass communities, Alpine pastures, bush forests of mountain pine and mountain forests composed of different tree species. All these ecosystems fulfil soil protection and water protection functions for the people living in the valleys. The protection against snow movements and avalanches is ensured beyond that by the mountain forest only. In order to be able to fulfil these protective functions in the best possible way, the condition of ecosystems is of great importance. This is especially true for the mountain forest whose ability to prevent snow and erosion-related risks mainly depends on the following factors: canopy density, tree species combination, type of stocking, age

and vertical structure. In a great number of forest stands in the Bavarian Alpine region, however, the loss of old trees and the lack of dense growth regeneration lead to creeping snow movements and forest avalanches. The restoration of such protection forests and/or the sustainable regeneration of stands require biological and technical measures. Such measures start with the use of resistible tree species, ranging from the selection of favourable planting sites and the adequate arrangement of plants to the use of technical protective measures, such as roundwood ties, blocks and wooden snow rakes. The conservation of existing stocking, the protection of the soil and a graded intensity of the measures of restoration depending on the local situation are of special importance for the implementation of the measures of restoration.

21. Mr U. Ammer presented the document: Research on the protective capability of the mountain forest - soil research in the German Alpine region. The importance of the forest in high mountains for the protection of the population and the conservation of the landscape is undisputed. 60% of the mountain forest is protection forest. It protects its site against excessive erosion by water, snow and wind. It conserves human settlements and infrastructure in the valleys against avalanches, rockfall and mudflow and thus allows the settlement of the valley areas. It regulates the water regime, diminishes flood peaks and has a balancing effect beyond its site down to the lowlands. These general interactions are directly comprehensive, but strategies to conserve the protective functions going beyond declarations of intent are noticeable only in their initial stages. One of the reasons for it may be that the methods available to assess risks are not efficient enough. The project to be described in the paper therefore aims to improve the information about risk assessment in the mountain forest. Apart from investigating the characteristics of forest stands and/or their substitute communities, the characteristics of the soil cover are also investigated under the prevailing precipitation and run-off conditions as indicators of possible risks. For the assessment of possible risks, it is decisive how quickly, to what extent and at what stage of opening up of protection forest stands the profile decline (e.g. humus decline) occurs. The interaction between increase in precipitation reaching the ground, simultaneously declining transpiration and increase in run-off may lead to higher rates of erosion. In this connection, the question also arises to what extent remaining soil vegetation (brush, herb, grass and moss layers) can counteract such a development. Such findings would substantially facilitate and influence the decisions on the need for taking emergency measures if the loss in vitality continues in mountain forests.

IV. FAO/IUFRO SYMPOSIUM: NEW PROGRESS IN TORRENT HYDRAULICS

22. Mr G. Fiebiger, Deputy Leader of Subject Group S1.04 Natural Disasters chaired the symposium assisted by Mr H. Marui, co-chairman of Working Party 03 Landslides and Stabilization (Rapporteur) and Mr A. Göttle, co-Chairman of Working Party 01 Torrent Erosion and Control. Mr Fiebiger reported on recent events including the Regional Meeting held in Salzburg, Austria together with the Austrian Society for Geomechanics, Working Group on Ice, Snow and Avalanches 29 May 1991. The new name of Subject Group S1.04 "Natural Disasters" was introduced together with the names of Group Leaders and Working Party officers as published in the Newsletter of the Subject Group in April 1992.

Important activities promoted by the Subject Group include: New control structures; debris flows; control structures and environment; floating logs and wood debris in torrents; trees in and near torrents; mechanisms of sediment transport in steep channels; design of

riprap in torrents; design of channels in mountains; design of stilling structures; design of bridges, roads and culverts for torrents with sediments; and morphology of torrents.

23. Mr M. Meunier presented his special report on Advances in torrent hydraulics. This document gives a comprehensive overview of the present understanding of torrential hydraulics including classifications of torrential flows and the difficulties involved in translating terminology between English and French.

V. MANAGEMENT AND RESTORATION OF ARID AND SEMI-ARID ZONES

24. Mr J. Mintegui presented his communication Elements to be considered in the preparation of projects on forest hydrologic restoration in semi-arid zones - interim evaluation of indirect benefits derived from restoration activities. The document discusses the various traditional presentations of forest hydrology restoration projects in semi-arid zones of south-eastern Spain. The main innovation consists of the incorporation of a supplementary study in order to indicate the time frame in which suggested improvements will materialize as a result of the project.

25. The document Methodology for the determination of areas to be considered as protection forest - application on the historic territory of Bizkaia was also presented by Mr Mintegui. This seeks to analyze and estimate the benefits of major blocks of forest cover situated in headwaters in terms of their hydrologic behaviour and erosion rates. Forest cover in watersheds are shown to generate a favourable water regime, not only by increasing availability, but also by controlling its erosive energy. These are the principal objectives of Protection Forests in Spain where the concept has legal implication stipulated in the Forest Act of 8 July 1957 and in the Forest Regulations of 22 February 1962).

VI. BIOLOGICAL AND HYDROTECHNICAL MEANS OF WATERSHED RESTORATION

26. Mr A. Göttle presented his document Renaturation of Alpine rivers; example of Ostrach. The Ostrach is the most important affluent of the Upper Iller River. In terms of run-off and detritus, it has the characteristic phenomena of a torrential stream, large expansive bedload source areas, steep slope and distinct run-off extremes. Appearance and river dynamics are, however, characterized by drawing off water for power utilization, linear constructions for flood protection, a loss of renaturation area and shifting bed reaches as a consequence of facilities for settlement, industry and traffic as well as increasing impoverishment of river ecology. The richness of the river landscape which is still noticeable in some sections and the still largely unaffected spring and upper reach areas on the one hand and the importance of the river for landscape and tourism, the inadequate sediment discharge and the river ecological impoverishment on the other hand, were the reasons to investigate the possibility of renaturation.

On the basis of the river and fishery biological conditions in the areas where the water is drawn off an assessment was made of river morphology, condition of meadows, uses and flood areas. A conflict plan identifies existing disturbances and fringe conditions and assesses these issues with regard to desirable changes. This was the basis for the development of renaturation with the emphasis on an improvement of river dynamics, minimum flow rate, aquatic and amphibic areas, bedload transport, fishing, biological

passage and linkage with meadows and side rivers. The next step will be to develop a package of measures for the sections in need of restoration, while integrating existing uses and interests in the best possible way.

VII. SNOW AND AVALANCHE CONTROL. PREVENTION AND CONTROL OF LANDSLIDES

27. Mr W. Kraus and Mr M. Moser presented their paper Passive and active measures for large scale slope movements in flysch; example of the Jenbach area, Bad Feilnbach.

(1) Hydrotechnical Statistics

Catchment Area $A_n = 14 \text{ km}^2$; altitude 510 - 1 838 m;
Average Precipitation per Year $N = 2\ 100 \text{ mm}$;
Design Discharge $Q = 40 \text{ m}^3/\text{s}$; 100-year Flood $HQ_{100} = 65 \text{ m}^3/\text{s}$.

(2) Further Investigations

Detailed survey into the extent of mass-slide.

(3) Technical Measures

- ▶ Protection of the base of the slope against lateral erosion of the torrent.
- ▶ Raising the torrent bed by consolidating checkdams.
- ▶ Increase the sedimentation volume between gully and housing estates downstream by construction of new checkdams; these must always be dredged to keep the storage capacity empty.
- ▶ Construction of a sorting checkdam for a volume of 20 000 m³.

(4) Additional Passive Measures

Considerations to prepare a plan minimizing the effects of a disaster.

Apart from soil slips in a 100 m² area of artificial and natural slopes the flysch series in Upper Bavaria is also affected by large-scale movements which may cover areas of several hectares. As far as the kind of slope movement is concerned, they have chiefly to be classed as sagging of mountain slopes and earth flows. The latter type was also responsible for the disaster reports about Inzell in 1991. A large-scale movement of the type of mountain slope sagging will be taken to demonstrate the passive measures taken to draw up a useful checkdam project. These investigations will be demonstrated by the example of the Jenbach torrent in Upper Bavaria, where a chain of checkdams was damaged soon after completion by active mountain pressure and must be considered destroyed in view of their present state.

The passive measures include:

- (1) Large-scale engineering geological maps (1:2 500, 1:1 000)

Purpose: geotechnical formation of soils and rock masses, definition of deep-seated slope movement, recording and representation of surface deformations and sagging features, description of type and size of potential danger areas.

- (2) Large-scale engineering/geological longitudinal sections

Purpose: depth values of moving mass, type and starting points of shear surfaces, geometry of failure.

The maps and charts prepared under (1) and (2) allow us to define further, mostly more expensive passive measures (3) such as: setting up a geodetic measuring network, precise invarwire measurements, borings with inclinometer measurements.

On the basis of such a set of investigations useful torrent control work can be developed.

VIII. RISK ZONING AND WARNING SYSTEMS

28. Mr A. De Bona presented the special report prepared by Mr M. Crespi entitled Monitoring and early warning systems. Two parts are considered separately: Part 1 considers hydro-meteorological monitoring networks and systems existing in Europe, paying attention to flood forecasting and warning systems; and Part 2 analyzes integrations done or to be done in the future; the analysis is extended to economical aspect concerning data acquisition, data processing and data use; cost-benefit ratio is considered from qualitative point of view. Management and maintenance of the networks are also considered.

The latest technology has boosted the results obtained by using increasingly sophisticated model-building that can fully exploit the potential offered by computation systems. The aim is to define the specificities and possibilities of integration in terms of both national and international collaboration and of multi-purpose systems, particularly with regard to new or existing projects. In the absence of a joint code of rules imposing the technical standards to be followed, or of a consolidated range of experiments, this consideration must necessarily be confined to a certain number of components and functions which, when combined, can result in extremely diverse control systems.

29. The paper Snow movements and avalanche action in disintegrating mountain forests was presented by Mr B. Zenke. Avalanches from the mountain forest area are nothing unusual. So-called forest avalanches which start within the forest zone can be observed to an increasing extent. Investigations by the Bavarian Land Water Management Board show that the avalanches come from almost closed forest stands. Especially critical are mixed mountain forest stands rich in non-coniferous species up to an altitude of about 1 400 m. Most forest avalanches go down as ground avalanches. A heavily soaked snow cover as a result of rainfall or warming are mostly the decisive factors. Inadequate natural regeneration, grass growth and leaf cover of the soil contribute to snow movements. Apart from many already existing avalanche strips in the mountain forests, preliminary stages of

avalanche movements occur, above all intensive creeping snow in the Bavarian avalanche protection forests on several thousands of hectares. Technical and biological measures are necessary to safeguard the conservation of protection forests.

30. Mr H. Konetschny presented his document entitled Assessment of spatial and time dynamics of avalanche action. Comprehensive video material has been available since the winter 1986/87 on forest avalanche action in the Bavarian Alpine region due to systematic aerial observation. The complex interactions which have an impact on forest avalanche action were investigated within the framework of detailed field surveys and are available as bases. Experience shows that the greatly varying space-time parameters of avalanche action in mountain forests very quickly show the limits of the traditional methods of evaluation. Electronic Data Processing allows us to process the comprehensive data material in relation to space and to make the development of forest avalanche action transparent in terms of time. As an aid to analyze such dynamic processes the information system ARC/INFO is available. The paper is dealing primarily with the concept of obtaining space-related information about the present danger situation through forest avalanches by using GIS and of deriving ideas about potential danger priorities.

IX. PLANNING AND SOCIO-ECONOMIC ASPECTS

31. The special report on Geographical information systems and data management systems and their application in watershed management was presented by Mr L. Rojo. The report presents the possibilities of the Geographic Information Systems (G.I.S.) as a tool of the Watershed Management Services of the EFC Country Members. G.I.S. elements and main functions are explained as a basic introduction to those not familiar with the issue. The application of G.I.S. to watershed management national planning and to the elaboration of a watershed management project in semi-arid environment, are briefly described as typical examples of G.I.S. application in the context of Watershed Management Services. Advantages and disadvantages versus conventional means are underlined. Some aspects of the personal, data, software and hardware, as necessary elements of a G.I.S., are analyzed. Guidelines for software and hardware selection are provided.

32. Mr A. Bock presented his paper entitled Dangers arising from torrents and avalanches in Bavaria - analysis and long term concepts. Taking into account an integral concept and the special features of the ecosystem complex of the Alps, a new overall concept was developed in Bavaria to assess the development of torrent and avalanche action on a long-term basis. The overall concept consists of an area-wide survey of the whole Bavarian Alpine region and an assessment of a total of 29 test areas. The aim of this concept is to get findings about the dynamics, that means the development of processes in terms of time, allowing a better assessment of future developments in mountain areas. From that should be derived as area-wide as possible information about the causes and suitable protective measures.

33. The document Geological and geomorphological tests in selected test areas in Bavaria to assess the dangers of torrents was presented by Mr G. Bunza. A prerequisite for the assessment of torrential dangers is the knowledge of the multi-dimensional interaction of geo- and bio-factors responsible for the current processes. Important geogenic factors are geology and geomorphology which are important co-determinants for erosion and run-off within a torrential watershed. Thus type and properties of rocks as well as tectonic

conditions are causally responsible for erosion. In addition, geomorphology dealing with slope and torrential dynamics allows conclusions with regard to instability areas and the condition of water bodies. Moreover, it is possible to deduce basic data on the run-off behaviour from the composition of rock and the hydrologically important land forms.

Larger-scale surveys undertaken so far allow only inadequate conclusions with regard to the complex processes within a torrential watershed. This is due to the fact that the scales chosen are often too small and evaluations are made by means of aerial photographs. Relevant investigations are being undertaken in 22 test areas in the Bavarian Alps on a scale of 1:5 000. With examples from these test areas the geological and geomorphological investigations are demonstrated with regard to the problem areas mentioned. To exclude danger areas and to assess torrential dangers under the present general conditions, the assessments of sites with regard to slope instabilities as well as erosion and run-off are described. The aim is to develop bases for maps for torrential dangers by linking geogenic and biogenic factors with the aid of a Geographic Information System (G.I.S.).

34. Mr Th. Schauer presented the document prepared in collaboration with Mr R. Löhmannsröben, Soil and vegetation mapping to assess alpine processes. Important characteristics of the Alpine area are intensive hydro- and morphodynamic processes due to the high relief energy. This run-off and erosion action is influenced to a large extent by soil and vegetation conditions. So far, soil and vegetation mapping was carried out - if at all - mainly for agricultural and forestry or nature conservation interests in the Alpine area. Today, mapping is carried out within the framework of the project "Run-off and Erosion in Mountain Areas" by the Bavarian Land Water Management Board to analyze and assess the run-off and erosion situation in detail in selected torrential watersheds, that means on a large scale (1:5 000). The mapping results obtained so far show large-scale anthropogenic interference with vegetation and soils in the Bavarian Alpine region. These use-related changes may have a strong impact on the danger potential in a torrential watershed as signalled by comparisons of specific basic maps and danger maps with the aid of a Geographic Information System (see paper by P. Jürging).

35. Mr P. Jürging resented his paper on Morpho- and hydrodynamic processes in the ecosystems of the Alps - interrelations and methods of assessment. On the basis of the most important geo- and biofactors ascertained in the field (geology, geomorphology, soil and vegetation), shown on specific basic maps single dependencies of morpho-hydrodynamic processes (surface run-off, low and deep erosion) are developed by the example of the watershed of Hirschbach near Hindelang and visualized in evaluation maps according to subjects. These individual criteria, for example the influence of vegetation on surface run-off, were subsequently compared in relation to problems in order to allow an assessment of the local conditions with regard to surface run-off, shallow and deep erosion. A further comparison of these problem-related analysis maps finally leads to a map of the danger potential related to the actual situation. On the basis of the causality of the respective overall danger potential model situations can then be tested with the aid of the Geographic Information System. The simulation results provide the basis for drawing up a package of measures for the integral restoration of problem areas caused by anthropogenic activities which can be implemented step by step according to priorities.

X. INSTITUTIONAL ASPECTS OF WATERSHED MANAGEMENT

36. Mr T. Michaelsen presented the Report on FAO's activities in watershed management and upland conservation. The period since the 17th Session of the Working Party in Vicenza, Italy in March 1990 has seen increasing demands on FAO for participation in the formulation of strategies for forest watershed protection and sustainable economic development of mountain areas on the regional - including European - and worldwide scale, rather than within national boundaries of FAO member countries. Global concerns about the role of forests in providing goods and services includes concerns for their role in watershed protection. This has been reflected in Resolution 4 of the Ministerial Conference for the Protection of Forests in Europe "Adapting the management of mountain forests to new environmental conditions"; in the Tropical Forests Action Programme (TFAP); and in the preparations for the United Nations Conference on Environment and Development (UNCED).

However, FAO's involvement in national level watershed management programmes continues with technical assistance project presently being executed in seventeen countries. In addition, a new FAO/Italy trust fund project on participatory watershed management is being initiated in five countries in Asia, Africa and Latin America.

37. Watershed management in China was presented by Mr Wang Lixian.
38. Torrent control in Beijing was presented by Mr Yu Zhimin and Mr Yu Xinxiao
39. Mr A. Gioda presented his paper Fog and vegetation in mountain areas - an example.

XI. FOLLOW-UP TO RESOLUTION 4 OF THE STRASBOURG CONFERENCE ON FOREST PROTECTION IN EUROPE

40. Resolution 4 of the Strasbourg Ministerial Conference on the Protection of Forests in Europe, "Adapting the management of mountain forests to new environmental conditions" is of direct relevance to the programme of work of the Working Party. The Working Party is furthermore suggested directly in the Conference Proceedings as an example of an international working party suitable for coordinating follow-up and pooling expertise on the subject, together with the Commission of the European Communities and IUFRO. In the Follow-up Committee, Portugal has been identified as the country responsible for this Resolution. The Second Ministerial Conference is scheduled to be held in Helsinki in June 1993.

A panel discussion on this agenda item took place during the morning session of 18 June. The panel consisted of Mr R. Silva, Portugal (coordinating country), Mr C. Rupé, France (host country of the Strasbourg Conference), and Ms K. Korhonen, Finland (host country of the Helsinki Conference). Following a brief presentation of the three panellists the Working Party agreed to formally accept responsibility for supporting follow-up to Resolution 4 and to prepare a report to the Helsinki Conference. Further details appear in the Programme of Work of the Working Party.

XII. PROGRAMME OF WORK OF THE WORKING PARTY

The Working Party agreed on the following activities to be carried out in preparation for the 19th Session in June 1994.

- (a) Prepare a follow-up report on Geographic Information Systems and their applications to mountain watershed management and torrent control. Special attention should be given to modelling applications, as well as for the preparation of special programmes such as the Bavarian Programme 2000 and to case studies (report to be prepared by Mr Rojo, Spain, in collaboration with colleagues in Germany, France, Italy and others).
- (b) Prepare a special report as a follow up to the excellent presentation by Mr Meunier on torrent hydraulics. The title of the report should be Mechanics of Torrent Hydraulics and Methods of Calculation (report to be prepared by Mr Meunier, France).
- (c) The Working Party decided to accept the proposal of the Strasbourg Ministerial Conference on Forest Protection in Europe to use the Working Party for the implementation of Resolution N° 4. The Working Party recommended that in preparation for the Second Ministerial Conference to be held in Helsinki, June 1993, a special Working Group consisting of representatives from Portugal, France, Finland and Poland, be established under the leadership of Mr Silva (Portugal) and that three overview documents be prepared to cover the needs for technical measures, network arrangements, special activities and follow up in three scenarios (i) Mediterranean zones (to be prepared by Mr Silva, Portugal), (ii) Alpine zones (to be prepared by Mr Rupé, France), and (iii) Eastern and Northern European zones (to be prepared by Ms Korhonen, Finland, in collaboration with Poland and Czechoslovakia).
- (d) A special half-day FAO/IUFRO Symposium should be included in the agenda for the 19th Session, with the following title: "Flash Floods in Mountain Areas, Methods of Calculation, Management and Mitigation of Effects". (Focal point for this symposium would be Mr Fiebiger, Austria. A special report on the forecasting and management of flash floods should be prepared by Mr Fattorelli, Italy).

The heads of delegation met to elect the officers of the Working Party. The delegates regretted the non-availability of Mr Pröbstle (Germany) to be elected as its new Chairman, but welcomed and unanimously elected Mr Sallet, head of the French delegation, as its new Chairman in recognition of his outstanding contribution to the Working Party. Mr Rojo (Spain) was elected as First Vice-Chairman and, Mr Kraus (Germany), as second Vice-Chairman of the Working Party.

The Working Party welcomed the offer by the Government of Spain to host the 19th Session of the Working Party in Jaca, Aragón, from 13 to 17 June 1994, followed by a study tour in the Pyrenean regions of Aragón and Cataluña. The Working Party also welcomed an offer, in principle, of Norway to host a session in the near future.

The outgoing Chairman recommended that the Working Party look into the possibility of holding future sessions and symposia in an Eastern European country.

ANNEX A

AGENDA

1. Opening of the session
2. Adoption of the agenda
3. National reports
4. Watershed soil movements and erosion processes - cartography, research results, evaluation, mathematical models, torrential and sediment erosion
5. Vegetation cover influence on erosion and water balance - cartography, evaluation, research, mathematical models, the effects of environmental factors on the hydrological role of vegetation cover
6. FAO/IUFRO Symposium: New progress in torrent hydraulics
7. Biological and hydrotechnical means of watershed restoration and torrent control
8. Management and restoration of arid and semi-arid zones
9. Snow and avalanche control; prevention and control of landslides
10. Risk zoning and warning systems
11. Planning and socio-economic aspects - planning methodology, socio-economic development and intersectorial relations, economic evaluation
12. Institutional aspects of watershed management
13. Follow-up to Resolution 4 of the Strasbourg Conference on Forest Protection in Europe
14. Programme of the Working Party
15. Election of officers of the Working Party
16. Date and place of the 19th session and special symposia
17. Other matters
18. Adoption of the report
19. Closing of the session
20. Study tour on mountain watershed management

ANNEX B

TIMETABLE

Sunday, 14 June

14.00-18.00 Registration

Monday, 15 June

08.30 Registration

10.00 Opening of the 18th Session of the Working Party

10.45 Adoption of the Agenda - Secretariat Information

11.00 National Reports and Special Cases

12.00 LUNCH BREAK

14.00 National Reports and Special Cases (cont'd)

15.00 Watershed Soil Movements and Erosion Processes - Cartography, Evaluation, Research, Mathematical Models, the Effects of Environmental Factors on the Hydrological Role of Vegetation Cover

Special Report: Restoration of Mountain Ecosystems with Protective Function with Special Regard to the Mountain Forest (Mößmer)

Research on the Protective Capability of the Mountain Forest - Soil Research in the German Alpine Region (Ammer)

16.30 End of Day's Session

17.30 Departure by Cable Car to Mittelstation Fellhornbahn

Reception by the Authorities of Oberstdorf

Tuesday, 16 June

09.00 National Reports (cont'd)

09.30 FAO/IUFRO Symposium: New Progress in Torrent Hydraulics (Fiebiger)

Tuesday, 16 June (cont'd)

Special Report: Advances in Torrent Hydraulics (Meunier)

- 11.30 Management and Restoration of Arid and Semi-Arid Zones
- ▶ Elements to be Considered in the Preparation of Projects on Forest Hydrology Restoration in Semi-Arid Zones - Interim Evaluation of Indirect Benefits Derived from Restoration Activities (Mintegui)
 - ▶ Methodology for the Determination of Areas to be Considered as Protection Forests - Application on the Historic Territory of Bizkaia (Mintegui)
- 12.00 LUNCH BREAK
- 14.00 Excursion to Forggensee (Lake) and Neuschwanstein Castle
- 19.00 Return from Excursion

Wednesday, 17 June

- 09.00 Biological and Hydrotechnical Means of Watershed Restoration
- Renaturation of Alpine Rivers; Example of Ostrach (Göttle)
- 10.30 Snow and Avalanche Control. Prevention and Control of Landslides
- ▶ Passive and Active Measures for Large-Scale Slope Movements in Flysch; Example of Jenbach Area, Bad Feilnbach (Moser and Kraus)
 - ▶ Extensive Slope Movements in the Warmatsgund Valley South of Oberstdorf (Völk)
 - ▶ Video (Israel)
- 11.30 Risk Zoning and Warning Systems
- Special Report: Monitoring and Early Warning Systems (Crespi, presented by De Bona)
- 12.00 LUNCH BREAK
- 14.00 Planning and Socio-Economic Aspects
- Snow Movements and Avalanche Action in Disintegrating Mountain Forests (Zenke)

Wednesday, 17 June (cont'd)

Assessment of Spatial and Time Dynamics of Avalanche Action (Konetschy)

- ▶ Planning Methodology, Socio-Economic Development and Intersectorial Relations, Economic Situation

Special Report: Geographical Information Systems and Data Management Systems and their Application in Watershed Management (Rojo)

Dangers Arising from Torrents and Avalanches in Bavaria - Analysis and Long-Term Concept (Bock)

Geological and Geomorphological Tests in Selected Test Areas in Bavaria to Assess the Dangers of Torrents (Bunza)

Soil and Vegetation Mapping to Assess Alpine Processes (Löhmannsröben and Schauer)

Morpho- and hydrodynamic Processes in the Ecosystems of the Alps - Interrelations and Methods of Assessment (Jürging)

17.00 End of Day's Session

19.00 Reception by FAO

Thursday, 18 June

09.00 Institutional Aspects of Watershed Management

- ▶ Report on FAO's Activities in Watershed Management and Upland Conservation (Michaelsen)

Watershed Management in China (Wang)

Torrent Control in Beijing (Yu)

Fog and Vegetation in Mountain Areas. An Example (Gioda)

10.30 Follow-Up to Resolution N° 4 of the Strasbourg Conference on Forest Protection in Europe

12.00 LUNCH BREAK

14.00 Excursion to Falkentobel and Pumping Station at Warmatsgund

19.00 Return from Excursion

Friday, 19 June

- | | |
|-------|---|
| 09.00 | Programme of Work of the Working Party |
| 10.00 | Election of Officers of the Working Party |
| 10.30 | Date and Place of the 19th Session and Special Symposia.
Future Sessions |
| 11.00 | Presentation by the Delegation of Guinea (Barry) |
| 12.00 | LUNCH BREAK |
| 14.00 | Adoption of the Report |
| 15.00 | Closing of the 18th Session |
| 16.00 | End of Day's Session |
| 19.00 | Dinner by the Federal Minister of Food, Agriculture and Forestry |

ANNEX C

LIST OF PARTICIPANTS
LISTE DES PARTICIPANTS
LISTA DE PARTICIPANTES

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Président
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Secretary
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ANNEX D

PROGRAMME OF STUDY TOUR

Monday, 22 June

08.30	Depart from Oberstdorf
09.15-11.15	Oberjoch Kaltenbrunner Brooks (windthrow problems, torrent control)
12.30-13.30	Vordersulzberg - Lunch
14.15-15.15	Visit the Wieskirche (Church)
16.30-17.30	Farchant (bed whipped pitching)
18.00	Garmisch-Partenkirchen Stay overnight

Tuesday, 23 June

08.30	Departure
09.45-11.00	Water Discharge Krün (low water problem)
11.15	Obernach Project Benediktbeuren (Testing Station for Water Engineering)
13.00	Lunch
13.45-14.30	Benediktbeuren (flood control)
14.45-16.00	Visit the Monastery of Benediktbeuren
17.50-18.45	Measuring Systems for Forest Damage Near Bayerwald (Research)
19.00	Bad Wiessee Stay overnight

Wednesday, 24 June

08.30	Departure
08.45-09.45	Rottach
10.00-10.45	Weissach (sustainable torrent control)
11.15-12.00	Mangfall
12.30-14.00	Lunch, Landhaus Eggstätt
14.30	Wasserburg
15.00	Wasserburg Town Hall
16.00	Visit the Old Town of Wasserburg, Old Town Renovation
17.00-18.00	Wasserburg (flood control on the Inn River)
	Stay overnight at Wasserburg

Thursday, 25 June

08.30	Departure
09.15	Chiemsee Tour by Ship Prien/Stock-Fraueninsel
09.45	Torhalle
10.15	Visit of the Cathedral
11.15	Lunch at Frauenchiemsee
13.15-13.45	Tour by Ship Fraueninsel-Feldwies
14.45-16.45	Weißwand (avalanche control)
17.15-18.30	Berchtesgaden, Tour of the Town
	Stay overnight at Berchtesgaden

Friday, 26 June

08.30	Departure
09.00-10.00	Grünstein (traditional construction measures, biological construction measures, toboggan-run)
10.15	Königssee Tour by Ship St. Bartholomä Lecture on National Park on Ship

Saturday, 27 June

08.30	Departure
11.00	Arrival at Munich Airport
12.00	Arrival at Munich Central Railway Station
	End of Excursion

