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WATERSHED MANAGEMENT AN INTEGRATED APPROACH TO ENVIRONMENTAL PROTECTION
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Summary

Since ancient times, forestry has contributed to watershed management (WM) in an open and evolving way, including broadening views on natural capital (soil, water, biodiversity, and land), human and social capital (skills and experiences), and environmental protection. The concept and practice of sustainability were indeed developed within the forestry framework, well before the Brundtland Report in 1987 (UN, 1987). For instance, archaeological evidence shows that the Etruscans applied rotation coppice systems to sustain their powerful metallurgy-based economy in the 9th century B.C. (Cambridge A.H., 1988; Bawden et al., 2001).

The FAO Forestry Department has always been active in promoting and implementing watershed management, including environmental issues, on a sustainable basis. Recent developments in watershed management have been reviewed by FAO through a number of mechanisms including evaluations, surveys and consultations. In Europe, the overall legally-binding integration between water, watersheds and environmental protection has been defined by the European Union (EU) within the Water Framework Directive (WFD): national achievements are in some cases well-advanced, as expressed by some countries in the 2003 survey of the FAO/EFC Working Party on the Management of Mountain Watersheds (WP-MMW). Nevertheless, when looking at the different national contexts, there is still a considerable amount of work to do, including carefully considering both the requirements (reliable information, quality of communication, and exchange of experiences, among others), and the perspectives (balancing societal and economic interests, developing environmental accounting and payment for environmental services, adopting adequate legislation and institutional arrangements, and applying eco-hydrological techniques, among others) of watershed management.

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1. Overview on concepts, developments and practices in watershed management in relation to environmental protection

Since ancient times, forestry has always contributed to watershed management (WM) in an open and evolving way, including broadening views on natural capital (soil, water, biodiversity, and land), human and social capital (skills and experiences), and environmental protection. The concept and practice of sustainability were indeed developed within the forestry framework, well before the Brundtland Report in 1987 (UN, 1987). For instance, archaeological evidence shows that the Etruscans applied rotation coppice systems to sustain their powerful metallurgy-based economy in the 9th century B.C. (Cambridge A.H., 1988; Bawden et al., 2001).

The third session of the FAO European Forestry Commission (EFC) (1 September 1950) examined issues related to **soil rehabilitation and conservation through rational use of water resources within basins** and established the Working Party on Torrent Control, Protection from Avalanches and Watershed Management. In view of the fact that it was forest services who had institutional responsibility for these issues in mountainous areas at the national level, the name of the Working Party from 1970 onwards has been “The Working Party on the Management of Mountain Watersheds (WP-MMW)”. For more than five decades, the core concerns of the Working Party have progressively included torrent control and protection against avalanche (1950-1960), socio-economic and agricultural aspects (1960-1970), environmental issues (1970-1978), and global development priorities in an exchange with countries beyond Europe (1978-2000).

From 2002 until recently, the FAO Forestry Department has initiated and co-ordinated a large regional-based consultation and stock-taking exercise under the title of “*Preparing the next generation of watershed management projects/development programmes*”. The preliminary background document puts forward the increasing degradation of natural resources as a relevant challenge. **It is in a further effort to integrate concepts, practices and sectors, including an improved and effective participation of stakeholders, that watershed management can be considered an approach to environmental protection with a solid technical forestry basis.**

A distinction should be made at this stage. **Forests ecosystems are necessary but not sufficient** to achieve most of the major watershed management goals, such as soil conservation and erosion control, hazard mitigation and risk reduction, water quality and quantity supply, including combating desertification. In the same vein, forestry techniques are often necessary in watershed management: they are based on ecological criteria, long-term economical considerations, and social expectations. **But forestry as a set of practices cannot do everything that is necessary in watershed management. Integration with other sectors is needed:** hydrology, biology, agriculture, animal breeding and fishery are some of the sectors contributing to overall watershed management.

Multifunctionality is another major concept that plays a crucial role in watershed management and requires clarifications. Forests provide, in fact, multiple benefits only if appropriately managed. This is particularly true in some complex, high-energy and fragile biomes like mountains, where a lack of management may increase instability of stands and loss of protection against natural risks and hazards. Stability, and the related protective function, requires management. When considering a watershed, forests are often appropriate tools for protecting the environment, preventing risks, supplying goods and services on a

sound economic way, and meeting social and cultural demands, if locally-adapted management is applied. Target-oriented forest management is therefore a prerequisite for the multifunctionality and watershed protection, conservation or rehabilitation.

As mentioned above, recent developments in watershed management have been reviewed by FAO through a number of mechanisms including evaluations, surveys and consultations. Major outcomes, with special reference to Europe are briefly reported in the following paragraphs. Further details are found in the references given at the end of this paper, including websites of interest.

In 2003, the FAO/EFC WP-MMW prepared, in collaboration with the European Observatory of Mountain Forests (EOMF), a questionnaire addressed to 32 member countries. The aims of this initiative were two-fold:

- to collect and consolidate basic information on institutional, policy, and technical issues related to watershed management, and
- to identify the main issues and problems to be solved in the management of mountain watersheds for the coming years in Europe.

Some of the main outcomes are summarized by in the paragraphs below, following the structure of the questionnaire.

Institutional, policy, legislation, and financing framework

Watershed management is unanimously considered of high importance by all countries. Recurrent reference is made to the main target and deadlines of the Water Framework Directive (WFD). Given the target of “*a good ecological status for surface and groundwater*”, all Member States are obliged to implement the following steps: elaborate an appraisal of the current situation (2005); analyse and establish river basin-, cross-border-management plans (2009); establish policy plans (2012); and implement plans (2015).

At present, the central government is very often the main entity jointly responsible for planning, financing and implementing watershed, water, and natural risk management. One ministry (agriculture or environment) can have a leading role but several others are involved. Although administrative and legislative integration is considered important it is often difficult to achieve. Besides the central bodies, decentralised tasks are given to regions, departments and local communities in the majority of countries. The position and role of the private sector are still considered too weak, with exceptions in a few countries (e.g. Switzerland) where it plays a role even in financing. Thus, financial means come primarily from the central or regional administration levels. Local communities are cited as key actors but their financial contribution so far appears rather limited and problematic.

Among the priorities raised, countries highlighted the following: the need for a better integration among institutions, policies and legislation with a view to accomplishing the WFD by 2015; an increased balance between development and protection (again with a view to a concrete catchment ecology requested by the WFD); an holistic approach bringing together water, forests, agriculture and civil protection; and economic compensation for the permanent natural handicaps found in mountains (slope, distances, climate).

Biophysical and socio-economic situation

In most cases, the information available (2003) provides an approximate view of the real situation and the ongoing changes in watershed management. Although the quality of information is considered of a high level, data are not complete or actually available (mainly because of the many institutions involved on a given watershed). Sometimes the situation is more clear at the national level -- though insufficiently detailed -- than at the regional or local levels (e.g. Spain). Progress in the definition of the situation through better information is highlighted. Economic factors can limit the progress in information development (Ireland). There is a lack of grouped data providing a view on integrated management and on some specific land uses (United Kingdom).

Research

With the exception of France, there are a number of different institutions dealing with watershed research within countries. Although the interdisciplinary approach is under development, more could be done (Poland). For example, Poland has developed environmental approaches to watershed management that are of high interdisciplinary importance, such as ecohydrology and phytotechnology (UNESCO). If some countries identify a lack of problem-driven research, others specify that all research on watershed management funded by public money implies practical aspects. Countries demand further research on flood control and management (United Kingdom), watershed and climate change (Ireland), and land uses related to floods and erosion (Switzerland).

Methods and means

There is a clear shift of methods from hydrology and civil engineering towards ecology and forestry, including the need for intersectoral, land-use, interdisciplinary and interministerial approaches. Participation and community involvement are in progress. France and Spain both underline the need for a more consistent approach to upstream preventive actions, rather than downstream ones. The WFD is recognized by countries as a methodological framework: water can be better managed by considering the whole watershed (Poland). Land use management is also a method to prevent risks (Switzerland). Concerning the means, especially financing watershed management, there is a general lack of adequate resources, although some countries consider that the WFD will raise the level of importance of funding to achieve the planned targets. Switzerland considers the current means adequate to the situation.

Communication and capacity-building framework

Communication and capacity-building are variable from one country to another. While limited communication is found in some countries, this is satisfactory in others, both at the central and local levels (Poland, Cyprus). In some cases communication is sectoral (Switzerland). Efforts are made to communicate with insurance companies in order to involve them in planned prevention (France).

Capacity-building activities also vary significantly. Some countries have not yet developed the issue. Others provide training to foreign countries, notably Spain with Latin American countries. Switzerland indicates that universities and associations should be further involved

in capacity-building for watershed management. Once again, the implementation of the WFD provides perspectives on this important issue (Ireland).

Concerning the means of communication, although websites are used they do need more links and development towards an integrated approach to watershed management. Publications exist but are either limited in number or sectoral in their approach.

Co-operation requirements

Requirements for co-operation are clearly stated by all countries, ranging from international co-operation (Denmark, Spain) to river basin co-operation at the local level (Ireland). International bilateral co-operation on concrete projects is mentioned by Spain. There is a need for co-operation among services, like forest or agriculture as well as among ministries, with a requirement for the legislative definition of the format and content of co-operation (Cyprus). One of the subjects identified as necessary for co-operation is data sharing and monitoring, including the sharing of experiences (United Kingdom). More co-operation should be developed to implement integrated and participatory approaches. There is a consensus on information exchange, although a selection of issues could facilitate the identification of priorities.

Gaps and priorities

Coordination is unanimously seen as a gap that needs to be filled by all countries. In the same vein, an integrated approach is seen as a priority, possibly linking the concept to the planning and to the final implementation (Switzerland).

Prevention is still, to some extent, more a technical perspective than a clear political position. This distance contributes to maintaining a gap between the aim of greater security, which requires prevention, and the means to achieve it, i.e. money (France). The watershed is an integrator and the territorial basis for prevention.

Integration is also considered necessary but still lacking, and one of the requirements identified by countries is an integrated expertise, which is at the same time specific and with a global view. Sustainability and replicability in projects are lacking, as well as adequate incentives to local communities (United Kingdom). Research is required to fill gaps in the different aspects of integrated watershed management (Ireland). Data sets for watershed management are a gap to be filled through coordination, efficiency and funding (United Kingdom). Poland highlights the lack of local infrastructures, especially in mountain areas. Involvement of the private sector, and particularly insurance bodies, is considered a gap (France). All countries expressed the clear consensus that watershed management is a strategic priority.

The FAO European Regional Workshop on the next generation of watershed management programmes and projects, held in 2002 in Megève, France, in collaboration with the EOMF, provided a view that complements the outcomes of the questionnaire. Environmentally sound orientation in watershed management based on better information, communication and involvement of civil society were clearly raised. Some of the examples reported in the following section ('National approaches and case studies in some selected countries') are extracted from the proceedings of this European Regional Workshop.

2. National approaches and case studies in some selected countries

In 2001 Norway developed a preliminary five-year Environmental Flows Programme aiming at improving and applying practical knowledge in watercourse regulation, taking into consideration seven main categories:

1. *Estimation of low flows*, particularly seasonal variations to incorporate into the modelling process
2. *Groundwater*, with a view to improving knowledge of the interactions between flows in the main channel and groundwaters in the floodplain
3. *Water temperatures*, being a critical factor for many of the processes taking place in rivers and for the river biota, there is the need to develop improved models for predicting them
4. *Sediment transport and erosion*, in order to improve knowledge of the relationship among reduced flows, groundwater levels and erosion and the importance of increased sedimentation for the frequency of damaging floods
5. *Biological effects*, in order to provide management with the necessary tools to determine environmental flows on the basis of biological criteria, for instance to develop methods to predict consequences of reduced flows on fish production and biodiversity
6. *Aesthetics*, considering that it is necessary to evaluate the effects of variation in flows in relation to aesthetics, as well as attitudes towards natural and impacted geomorphological processes
7. *Remedial measures*, reduced flows require possible remediation in order to maximise biodiversity and conservation of riverine landscapes.

The programme involves extensive cooperation within government bodies (e.g. the Norwegian Water Authority – NVE), power companies, and research institutions. It started with limited funding in 2001 with a preliminary 5-year time frame, although the complexity of the topic and the necessity for long-term studies may require an extension for a further 5 years. It should be noted that Norway fully endorsed the WFD of the EU, although it is not an EU Member Country.



Salmon fishing in Norway (Photo: NSF, 2005)

Since 2002, the Autonomous **Province of Trento, Italy**, has produced an analytical *social balance* (also called ‘*social audit*’ or ‘*social accounting*’) applied to its mountain watershed management service. The aim is to account in the most transparent way for the quality and quantity of work done on watersheds and the social, economic and environmental benefits provided. A total of 4 500 km of torrents and rivers, 322 employees, over 23 million Euros (budget 2004) are involved. The overall objectives in the watershed management of this area are: stability and security, environmental quality and – sustainable development (see Table 1). One can add multifunctionality to these objectives. The Autonomous Province applies multifunctionality not only to forest or other natural resources, but also to the whole of the territory, and refers to it as the goal of “*keeping the multiple values of the land*”. Environmental considerations are at the centre of their activities and social accounting. Ecosystem management, bioengineering, and rehabilitation with natural techniques are increasing investments re-orienting and complementing former hydrological approaches. Part of the Province’s activities are also devoted to a targeted communication strategy, defined as “*Communication over Danger*”, which aims at raising public awareness about the limits of the concept of stability of natural systems and management tasks involved.



The Sarca torrent control in the Municipality of Pinzolo, Val Rendena, Italy
(Photo: Servizio Sistemazione Montana, Autonomous Province of Trento, Italy, 2004)

Nine strategic specific objectives summarise the watershed policy of the Autonomous Province of Trento and its monitoring by the social balance annual report.

Table

Overall Objectives	Specific Objectives	Approaches
Security and Stability	<ul style="list-style-type: none"> - Keep functional efficiency of watersheds and ecosystems - Guarantee security to people and activities - Raise awareness by dialogue on dangers 	<ul style="list-style-type: none"> - Conservation management - Prevention - Monitoring critical situations - Continuity river-bed-and-slope management - Leave open space to water courses - Risk mapping - Risk mitigation - Combine forest and civil protection in emergency situations - Inform and educate on living with natural dangers
Environmental Quality	<ul style="list-style-type: none"> - Protect and improve the land and ecosystems - Contribute to quality of life - Protect the overall landscape 	<ul style="list-style-type: none"> - Develop forms of ecosystem efficiency monitoring - Contribute to the quality of air, water and habitats by multifunctional forest and land management - Improve good practices combining natural and economic resources (traditional agro-silvo-pastoral systems) - Protect and improve fauna - Protect the habitats of high nature value - Maintain and improve the natural features of the forest-river system - Promote the protected areas network - Improve the role of protected areas - Improve education, information, and communication
Sustainable Development	<ul style="list-style-type: none"> - Improve the functionality of forest - Maintain and promote the commercial products of forests - Improve and promote goods and services of public interest of forests and other ecosystems 	<ul style="list-style-type: none"> - Permanent monitoring of forests and forestry - Provide continuity, efficiency and effectiveness of management practices - Review the modalities of forest management with forest owners, enterprises, and associations - Reinforce the technical and administrative support systems - Improve competitiveness and integration in the forest-wood chain - Support a policy based on the demand of wood products - Promote and support economic initiatives linked to good practices - Promote public forests as management models - Promote the recognition and, if applicable, the payment of non-material values

Spain represents a complex case of watershed characteristics and management requirements: soil erosion processes found in a large portion of the national land area, torrential phenomena all along the hydrographical network, and widespread desertification processes, including many forest fires (20 000 annual average 1995-2005) and extensive forest fires (120 000 ha/yr; Spanish Ministry of Environment, 2006). A National Observatory on Drought has been recently established within the Ministry of Environment to urge all Spanish water administrative bodies to bring together their knowledge and activities in water and watershed management. Furthermore, the National Plan of Priority Actions in the field of Forest-Hydrology Rehabilitation, Erosion Control and Desertification Combat has been launched with the general aim of improving the role of forests in soil and water protection, erosion control, watershed regulation, and vegetation-cover rehabilitation.



Erosion processes are common on large areas of Spain
(Photo: Ministerio del Medio Ambiente, DGCN, 2004)

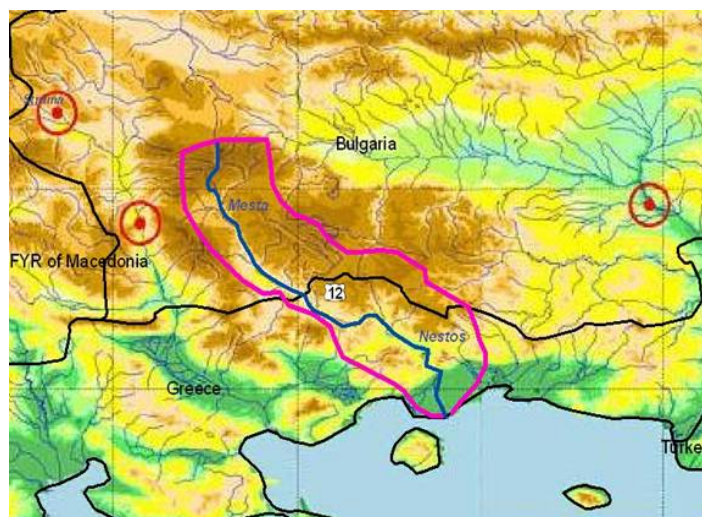
The Plan is based on the shared decisions between autonomous communities and the Ministry, a systematic survey field work, and connections with other major planning instruments, such as the Desertification Plan, the national Forest Plan, and the Basin Plans. The recent national Forest Law of 2003 (*Ley 43/2003 de Montes*) reinforces the protective role of woodlands by classifying of public interest (*art.13*) all those playing a clear anti-erosion role, those found in headwaters, those reducing landslides and rock falls, as well as those contributing to biodiversity conservation. The second chapter of the Forest Law is devoted to linking the different plans that give forest cover a central hydrological and ecological role. The third chapter of the Law on forest fires covers such issues, among others, as soil and vegetation rehabilitation under the responsibility of the “*comunidades autónomas*” (Spanish Regions).

Between **Bulgaria and Greece**, the transboundary basin of the river Mesta (BG) Nestos (GR) covers 6 280 km² along 230 linear km of the main axis starting at 2 925 m a.s.l. Granites and volcanic rocks are found in Bulgaria and gneiss, marbles, and Quaternary alluvia on the Greek side down to the sea. The average annual rainfall is 700 mm and the average flow is between 30 and 40 m³/sec. The total population in the basin is 170 000 on the Bulgarian side and 135 000 on the Greek one. Main land uses are forest, pastures, dry and irrigated agriculture, hydroelectricity, urban and scattered industry, fish farming and ponds, and coastal tourism. The Mesta River is regarded as one of the most natural streams found in Europe. Within the watershed, two national parks in Bulgaria, Rila and Pirin, are listed in the UNESCO Natural

Heritage List. Within the upstream part of the Nestos watershed in Greece, several protected forest and natural areas are included in the NATURA 2000 Network. The management of the water in these areas requires specific programmes that pay particular attention to sustainability under certain climatic conditions (e.g. droughts). The challenges of the Mesta-Nestos basin are twofold: on the Mesta side the question is how to minimise the increase in point and diffuse pollution, which will inevitably happen as the economy develops after Bulgaria enters the EU; on the Nestos side agricultural development is at a peak, and the challenge is the reduction of side effects on protected wetlands and coastal fisheries compatible with a further development of output. In order to reinforce the implementation of integrated watershed management, the Mesta-Nestos authorities joined the International Hydrological Programme initiative HELP (Hydrology for Environment, Life and Policy), launched in 2002 by UNESCO. The transboundary river basin is currently a pilot demonstration site with the following major aims:

- Mutual work among scientists and decision-makers, including local stakeholders;
- Improved solutions provided by science and practices, locally discussed, tested, adapted and implemented;
- Sharing and comparisons of experiences with a network of 67 sites in Europe and globally in 2004.

Special attention of the initiative is given to ecohydrology, water quality processes, extreme events knowledge, and surface water-groundwater interactions. In this particular basin, there is a balance between environmental protection (two national parks and several protected areas) and new economic development (Bulgaria as a new EU member country), and an international scheme of co-operation is providing the prerequisites to meet the goals set forward by the legally-binding WFD of the European Union.



Mesta (Bulgaria) Nestos (Greece) transboundary river basin
(Map from R. Arsov and J. Ganoulis, 2004)

In the **United Kingdom**, the protection of freshwaters and watersheds has become a priority in the sustainability of upland forestry. *“The protection of freshwaters is a key requirement of sustainable forestry and high priority has been given to the development of guidelines of best practice. These have been drawn up to tackle a range of water issues associated with forest development in the past”* (Neal C. & others, 2004). With its fourth edition in 2003, the “Forest

and Water Guidelines”, prepared by the United Kingdom Forestry Commission, advise private and public owners and managers how forest influences freshwater ecosystems. The Guidelines provide a systematic practical advice on how to design and plan operations in order to protect and enhance the water environment within catchments. Although the Guidelines have no legal status, in case of prosecution a failure to follow them would adversely affect the position of the owner or contractor. Guidelines are therefore fully harmonised with other forest management frameworks, such as the national and regional forest strategies, the biodiversity action plans, and the certification schemes. In practical terms, the Guidelines include the following elements:

- Descriptive patterns of the water pathways (land, riparian and aquatic zones)
- Ways of identifying values and uses through main requirements (fish and wildlife, drinking, hydroelectricity, agriculture and irrigation, industry, recreation)
- Identification of the effects of forests on the freshwater environment (siltation, acidification, chemicals, base and peak flows, among others)
- Planning bases on a watershed level (links with the EU WFD)
- Site planning and forest operations, including silviculture, wood debris, roads, fire, within a checklisting system
- Useful sources of information, including a glossary and guidance on the procedures for carrying out watershed-based assessments (critical loads and environmental impacts)

There is no doubt that these Guidelines are a powerful tool for including forests and forestry in a watershed management scheme with a clear and practical view of their strengths and limits.



Upland river basin in the Highlands, Scotland, United Kingdom
(Photo: P.C. Zingari, 2004)

3. Situation, requirements and perspectives

The implementation of an integrated approach to environmental protection at the watershed level is currently in progress in Europe. The EU WFD provides the main overarching principles and objectives based on the final target of **restoring the good ecological status of waters through an integrated approach to, and a long-term planning of, the watershed.** By the year 2015, watershed management will progressively become a consolidated policy and a recurrent practice in all European member countries and other associated countries (e.g. Norway).

But the EU WFD is essentially a water-related instrument and is only one of many possible instruments. As stated in the first section of this paper, forest ecosystems, forest-related vegetation (statistically assessed as “*other wooded lands*”), soils, and forestry have a key relational and multifunctional role to play in watershed management. **Forests and forestry actually and effectively contribute not only to the good ecological status of waters themselves within the basins but also, and primarily, contribute to their overall environment protection.**

When looking at the different contexts, there is still a considerable amount of work to do. FAO, through different initiatives, has contributed significantly to a better appraisal of the situations and requirements for watershed management, and has facilitated the definition of the various perspectives in environmental protection at the watershed level. In particular, the WP-MMW remains a relevant mechanism with a strong forest component that helps to bring together skills, experiences and discussions about the progress in implementation of good watershed policies and practices, as confirmed by the 2003 questionnaire to WP-MMW member countries.

Taking into account the main issues raised and the considerations made in the two former sections, the following remarks are presented to reinforce the need for watershed management as an integrated approach to environmental management.

Quality of information. Watershed management requires a considerable amount of quantitative data and qualitative information. The establishment of geographic information systems (GIS) on water bodies and watersheds is a requirement of the WFD as a basis for planning (River Basin Management Plans), as well as monitoring, evaluations and reporting. A Europe-wide database of river networks and basins has been developed by the EU Joint Research Centre (Vogt J. et al., 2003); it combines data layers on climate, soils, vegetation and habitats on a medium digital elevation grid of 250 m cell size. In order to reach a common EU intercalibration of geographical and geo-morphological mapping and data, a directive has been launched in the recent years under the acronym of INSPIRE (Infrastructure for Spatial Information in Europe) (EC, 2004). **Forest data and information should be harmonised with these new hydro-geological information bases.**

Quality of communication. Forest and forestry in relation to water resources, watershed and natural risks, require a better quality of communication. It is in fact commonly assumed by the general public that forests have an overall positive influence on rainfall, water yield and large-scale flood. Indeed, although research remains inconclusive and questions remain open, the media and politicians create misunderstandings and myths on these issues. Communication should remain simple but not simplistic. It should provide balanced messages, such as “forest and forestry are necessary but not sufficient to prevent floods”,

“environmental protection by watershed management is one approach combined with others” (education, awareness-raising, agriculture, industry, tourism), “sharing responsibilities, benefits and risks”, “living in my watershed”, “surf your watershed” or “adopt your watershed” (EPA, 2001). Efforts are also required to develop toolkits or guidelines for decision-makers in order to establish a direct link between knowledge, experience and practice. **The forthcoming FAO Forestry Conservation Guide on watershed management is a good example of a practical communication product** (Warren, 2006).

Exchange of experiences. Watershed management is a field activity and **exchanging experiences can help reorient people and institutions directly involved in watershed management tasks towards winning strategies and appropriate practices.** Such activities must be supported also by active research, which can codify and validate results, and raise issues to be addressed (Pezzini, 2001). Training and capacity-building greatly benefit from the exchange of experiences. A number of existing initiatives in Europe are based on the exchange of experiences in watershed management, e.g. the FAO/EFC WP- MMW, the UNESCO-driven HELP programme based on permanent pilot sites, the network of the International Office for Water, and a number of interregional and trans-national cooperation mechanisms within the EU.

Integration. Based on the ecosystem concept, environmental protection at the watershed level requires the attentive consideration of the interrelations between resources and among actors and institutions. Ecohydrology is for instance a valuable way to link ecology to water management. Watershed management allows also for the integration of views from people involved in watershed councils, each one attached to different and often divergent expectations, and all of them requiring common agreement and solutions. The FAO comprehensive exercise on the new generation of watershed management programmes provides two basic elements in implementing integration as a practice. One is a sound ecological component which includes environmental economics and a focus on the place and role of people in watershed ecology. The second element is integration as a process and not only as a concept that is to be applied. **A process can be complex, lengthy, involving changes, contradictions and political or cultural influences, but it must rely on the protection of vital resources such as water and its related ecosystems.**

Environmental Accounting (EA). Water is an environmental asset that can be valued in monetary terms. Watershed management, environmental protection, forestry and other land use practices all require money. In fact investments, revenues and employment opportunities make all watershed practices work. **Besides market goods, there is a need for valuating natural stocks and flows.** The UN Statistics Division (UNSD) developed a System of Integrated Environmental and Economic Accounting (SEEA), and in 2005 its three main objectives were set: (a) to mainstream environmental-economic accounting and related statistics; (b) to elevate the SEEA to an international statistical standard; and (c) to advance the SEEA implementation in countries. SEEA reports that accounts are calculated for a given geographical territory, which can be a country, a region or a river basin, or any relevant area of interest. Valuing watershed environmental goods and services is a necessary step towards the Payment for Environmental Services (PES).

Payment for Environmental Services (PES). This is a promising concept of increasing interest with concrete application schemes in watersheds. A recent consultation and a review of approaches have been promoted by the UN Economic Commission for Europe (UNECE, 2005). One of the examples reported can clarify the PES concept. Since 1996 the Swiss

National Constitution introduced PES through financial allocations by contracts to farmers. Voluntary programmes promoting extensification, integrated production, decrease of pesticides and fertilizers, and biological farming are compensated by different amounts from 130 to 520 euros per ha. Contracts are stipulated between farmers and local cantonal authorities. The PES is defined by the national federal authority on the basis of the drinking water accounting, corresponding to the value of 3 200 to 4 500 euros per ha of drinking water generated by overall annual precipitations. **Forests and forestry directly provide a number of environmental services that, when adequately payed by beneficiaries, could support sustainability.**

Legislation and institutions. EA and PES would be inapplicable without accompanying legislative measures and adequate institutional arrangements, as briefly demonstrated by the Swiss example. Among the measures to be considered (UNECE, 2006), the following can be cited:

- Recognition of the ecosystem approach as a holistic approach to water and watershed management;
- Removal of perverse incentives that subsidize overuse or adversely affect natural resources;
- Reduced fragmentation and improved coordination between government departments and institutions;
- Regulated and secured property rights in general, and on watershed areas;
- Adapted legislation to PES, including public-private sector involvement.

International commitments. The FAO/EOMF Conference on Watershed Management of (Sassari, Italy, October 2003) agreed on the importance of international commitments in watershed management. Besides recognizing watershed management as a sustainable practice, which was underlined by countries such as Cyprus, Ireland, Poland in the WP-MMW questionnaire, the fulfilment of international obligations and commitments, and the development of an international Watershed Management Partnership (Cyprus and United Kingdom positions in the questionnaire) have been recurrent requests all along the revision process. The Sassari Declaration also added the request for an international forum that focuses on integrated watershed management. The case of the European WFD is once again a valuable example of a regional, legally-binding instrument for an effective environmentally-based protection of watersheds. As suggested by Poland (questionnaire) and Kreček (2002), voluntary-based commitments and lighter mechanisms, such as the FAO/EFC WP-MMW could be supportive at the same time of larger-scale commitments and of locally-based actions in watershed-related environmental protection.

Conclusion on our ancestors' wisdom. We should return to the Etruscans, our old Mediterranean ancestors mentioned in the opening paragraph, and their sustainable forest management practices. It is well-known that the Etruscans were also sophisticated hydrologists. The Rome we live in and visit today owes them, among other things, three key water-related features:

- A draining network centred in the *Cloaca Maxima* (greatest sewer) situated close to the FAO main buildings. This network transformed the large swampy Forum area, the core of ancient Rome, into a civic, religious and political centre from the 6th century BC), and is still visible today near the Ponte Rotto bridge.

- The system of aquaduct-supported running waters from the upland watersheds of the Central Apennines to the urban area for daily public bathing for people of all classes. The cultural and intellectual side of the system was represented by the *thermae*, the thermal baths that incorporated libraries, lecture halls, colonnades, and promenades which assumed the character of the Greek gymnasia.
- The *centuriae*, a land unit that combined in larger mosaics different uses, values and administrative patterns: open fields, prairies, crops, woodlands, villages and roads.

By these ancient and modern examples mentioned above, watershed management appears as one of the most complex, environmentally-rooted, socially-organised, economically-based, and culturally-driven of human activities and a major water-related challenge for the future.

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