Working Party on the Management of Mountain Watersheds
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SLOVAK NATIONAL REPORT

Geography and hydrology

Slovakia is a landlocked country in of Central Europe with a population of over five million (5, 424, 925 to 31 December 2009; population density 111/km^2) and an area of 49, 036 square kilometres. It is located in the Western Carpathians and their peripheral lowlands.

Majority of its territory belongs to the Danube catchment basin (96% of total area); the remaining 4% are drained to the Baltic Sea through the Vistula River tributaries. Perhaps surprisingly, the *main European divide* does not follow the highest ridges of the Carpathians, but it rather follows lower ridges and flat landscape of the foothills of the the High Tatras Mts., the Slovak highest mountain range.

The long-term average water balance can be best illustrated by the equation: precipitation (753 mm) = evapotranspiration (492 mm including other minor losses) + runoff (261 mm). The equation entries can considerably vary between the years.

Table 1 Water balance 2008

Water balance	
Precipitation	40 049 mil. m^3
Annual inflow (the Danube, Morava, Uh, Tisa, etc.)	69 005 mil. m^3
Annual outflow	73 387 mil. m^3
Slovak contribution to outflow	10 146 mil. m^3

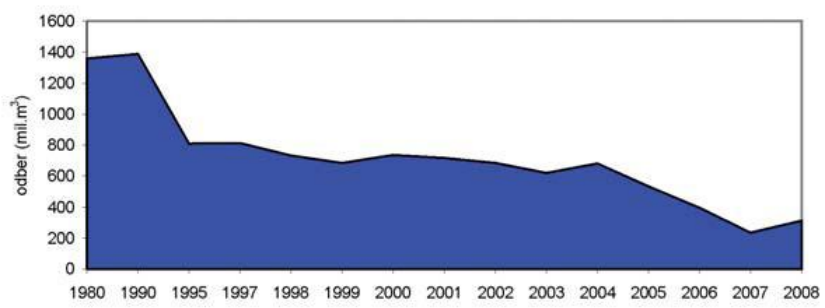
Source: Slovak Hydro Meteorological Institute

The majority of inflow is generated by the Danube River bringing water from the Alps. The second most important inflow resource is the River Tisa, albeit a very short border watercourse, bringing water from Romania and Ukraine.

The year 2008 was considered water balance positive. Compared to 2007, all major water parameters (precipitation, inflow and outflow) increased. Water volume stored in reservoirs and dams went up from 798 million cubic metres (69% of total capacity) to 809.4 million cubic metres (70% of total capacity).

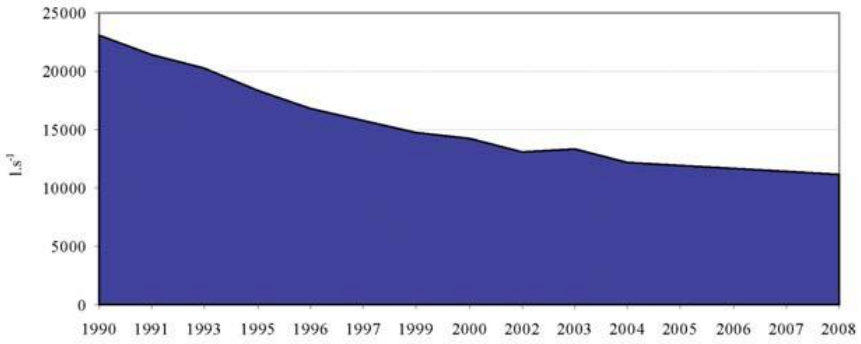
The withdrawal of surface and ground water has been long-term decreasing. The main driving forces behind a slump in withdrawal have been identified as declining industrial and agricultural production (irrigation in particular) and, from 1989 onwards, also downward household water consumption contributed to increased water bills. Despite this fact, temporary problems with water supply to major urban agglomerations occasionally occur.

Figure 1 Volume of withdrawn surface water 1980 - 2008



Source: Slovak Hydro Meteorological Institute

Figure 2 Volume of withdrawn underground water 1990 - 2008



Source: Slovak Hydro Meteorological Institute

Table 2 Surface water withdrawals (million m^3)

	Human supply	Industry	Irrigation	Other agricultural uses	Total
1998	68.370	621.858	42.447	0.0400	732.707
2008	52.057	251.797	9.133	0.0040	312.991

Source: Slovak Hydro Meteorological Institute

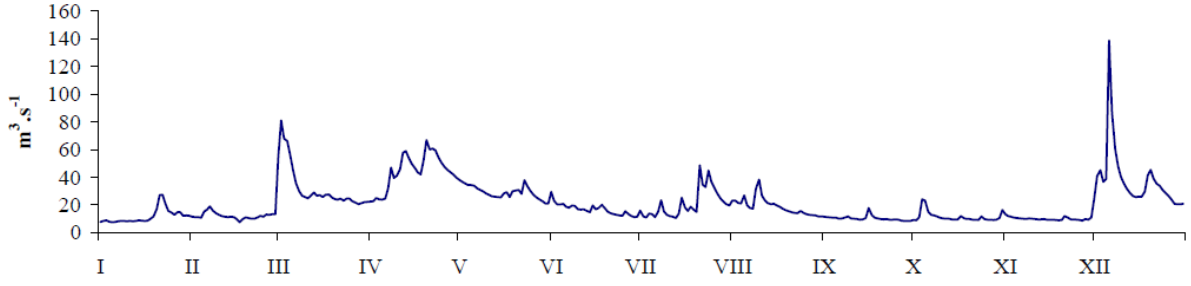
Table 3 Groundwater withdrawals ($L.s^{-1}$)

	Human supply	Industry	Agriculture (including irrigation)	Other
2008	8468.82	1108.00	320.81	1224.46

Source: Slovak Hydro Meteorological Institute

Owing to a limited national territory, climatic variability is mostly a result of altitude – the higher altitude, the higher precipitation and lower evaporation. Lowland soils are water saturated only during winter and spring months. In the vegetation period, available water is fully used up by the vegetation. On the contrary, in mountain locations precipitation permanently surmounts evaporation; part of precipitation is thus available for aquifers recharge and runoff. As a result, majority of watercourse discharges is sourced in mountain watersheds. In an average year, precipitation exceeds evaporation in altitudes over 500 m. Nonetheless, watercourse discharges are most dependent on mountains with ridges exceeding 1000 m altitude. The border between mountain and other watersheds is not abrupt since it is determined by the location of particular mountain ranges, prevailing direction of their ridges and other attributes. Owing to this fact, only watersheds in central and northern Slovakia can be considered a truly mountain type. Majority of Slovak watercourses has a combined snowmelt and rain dominated hydrologic regime (with primary spring and secondary autumn peak flows) except for lowland watercourses which are rain dominated. In spite of flowing through southern Slovakia lowlands, the Danube River is the only Slovak watercourse with snowmelt dominated hydrological regime typical for summer peak flows resulting from the Alps snowmelt.

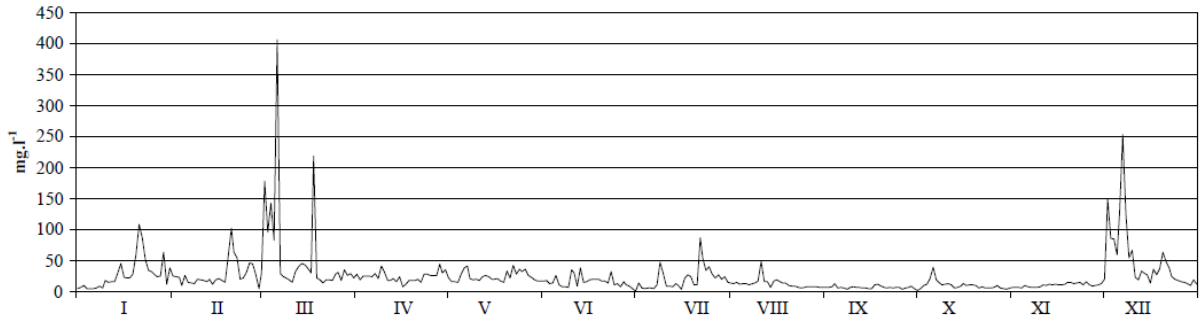
Figure 3 Average daily streamflow of Hron River at Banská Bystrica gauge 2008



Source: Slovak Hydro Meteorological Institute

The year 2008 was noted as rather discharge atypical. The Hron River statistics did not show a traditionally distinct spring peak flow - instead a substantial increase of stream flow was observed in late autumn months. This peak flow surprisingly resulted from moderate rainfall (some 35 mm) which followed the period of relatively light rains. Peak flows on other watercourses were synchronised though level different; in some instances, maximum levels were reached in summer months owing to intense storms. Majority of mountain watersheds is rather densely forested, i.e. the watershed of the Hron River, the second longest Slovak territory sourced river, has in its upper part 75% forest cover. On the other hand, it is important to note that Slovak mountains are relatively densely settled and majority of Slovak watercourses are settled almost to their heads. The only unsettled short 5 – 15 km sections of watercourses are found in deep valleys of particular ranges. Despite considerably high forest cover, intensive anthropogenic activities (agriculture, transportation, urban infrastructure, etc.) strongly influence long stretches of Slovak watercourses.

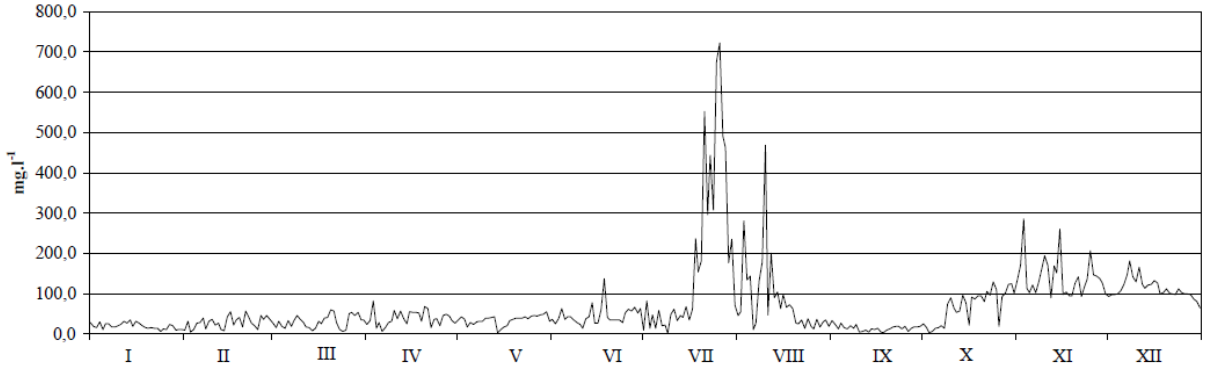
Figure 4 Average daily sediment load of Hron River at Kamenín gauge 2008



Source: Slovak Hydro Meteorological Institute

The graphics shows increased sediment loads during spring and autumn peak flows when vegetation cover of arable land is at its lowest. It suggests forest land contribution to sediment yields be less important than contribution of arable land, high forest cover of the watershed notwithstanding. Nevertheless, particular sediment loads often more depend on soil properties and slope gradient than actual vegetation cover. Figure 5 shows that watersheds on flysch rocks with heavier soils display generally higher sediment load than other watersheds including summer periods with high intensity storms.

Figure 5 Average daily sediment load of Ondava River at Horovce gauge 2008



Source: Slovak Hydro Meteorological Institute

Land use

Table 4 Land use recent changes

Land use (Cadastre records)	1 January 2008	1 January 2009	Annual change	Change factor		
				State border changes	Map improvement	Land use conversion
Agricultural land	2 428 899	2 423 478	-5 421	32	-294	-5 156
Forest land	2 007 142	2 008 257	1 115	-1	231	883
Water bodies	93 656	94 575	919	-2	21	902
Built up areas	227 931	229 059	1 128	0	-36	1 166
Other areas	145 945	148 335	2 390	0	208	2 180
∑ Slovak Republic	**4 903 573**	**4 903 704**	**131**	**29**	**127**	**-20**

Source: National Yearbook on Land Resources

2009 cadastre records indicate an annual decrease in agricultural land area and increase in all other land use categories. The change readily confirms long-term trends (see also text below). The continually increasing area of water bodies is a direct result of the establishment of new water reservoirs whilst the increase in build up area is related to development activities. In the process, both agricultural and forest land are being lost; nonetheless, the forest land loss is more than generously compensated for by forest expansion to non-forest land. Current deforestation is mostly associated with the development of ski resorts and highway infrastructure.

Forest cover

The pressure on the agricultural use of available land accelerated in early decades of the 20th century. From the 1920s onwards, lower demand for agricultural land resulted in a gradual increase of forest area. The increase has been to a certain degree associated with the afforestation of non-forest land. In the past, such efforts were partially or fully supported by the Government (e.g. Government Decree No 550 from 7 June 1994 on afforestation of abandoned agricultural land between 1994 and 1996 with view to 2000). Despite the Government supported scheme, majority of new forest has originated from natural forest expansion to abandoned land. The rise has been so rapid that cadastre records are not able to reflect actual forest cover. The results of first national forest inventory (2005-2006) based on a statistical survey confirmed considerably higher forest cover than previously reported. The inventory surveyed only the actual forest crop land rather than cadastre reported forest land which also includes forest nurseries, certain forest roads, cleared tracts, firebreaks and other small open areas within the forest. These plots currently account for more than 3.5 % of forest land. In view of the abovementioned facts, staggering 270 000 ha of forest is currently situated on officially non-forest land.

Table 5 Forest cover of the territory of Slovakia since 1920

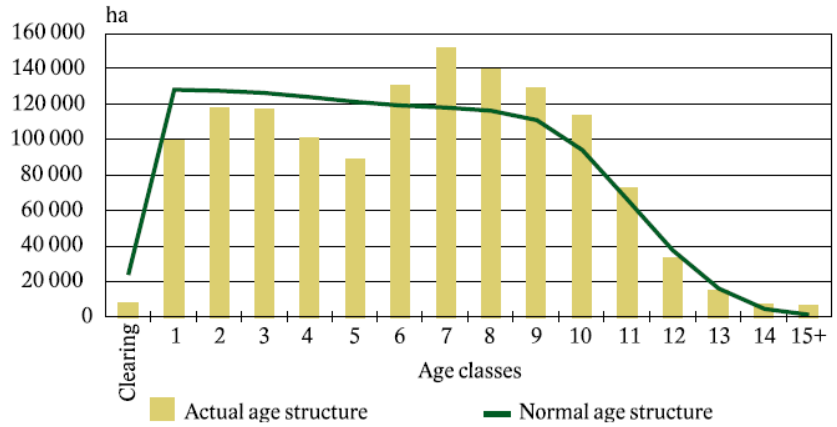
Source	1920	1950	2000	2006	2009
National Cadastre	1 637 837 ha	1 771 166 ha	1 997 961 ha	2 007 006 ha	2 008 257 ha
	33.4 %	36.1 %	40.7 %	40.9 %	41.0 %
National Forest Inventory (statistical survey)	-	-	-	2 172 341 ha (±19 615)	-
	-	-	-	44.3 ±0.4%	-

Source: National Forest Centre

Main trends in forest cover development

Slovak forests represent *genuine* forests with a relatively high average age, growing stock and stocking density. The average age of particular tree species varies between 49 and 78 years. The average stocking density gradually decreases with age from 0.9 in 10-20-year-old stands to around 0.7 in most mature stands. The age structure of Slovak forests is not entirely optimal since the area of clearings, majority of which are of calamity origin, represents only a tiny proportion of forest land.

Figure 6 Age structure of commercial forests (actual and normal).



Source: National Forest Centre

As the Figure clearly indicates, felling is presently being concentrated in *strong age classes* with high growing stock. Large felling volumes have a profound impact on many ecological aspects of forest including water quality. Public often considers clear-cuts for major culprits of flooding regardless of the fact that both their use and maximum area are severely limited. On top of that, many shelterwood cuts are often misinterpreted for clear-cuts. In few years time and *strong age classes* gone we will start to experience timber shortages. Lack of available timber might increase pressure on forest management practices and fuel intensive introduction of forest plantations.

Declining forest health and ever increasing incidence of windthrow represent two of *most* challenging issues facing the current generation of forestry professionals. They result in felling volumes regularly exceeding annual allowable cut and compromised tending of young stands (insufficient capacities for concurrent incidental felling and tending). The situation is further worsened by frequent bark beetle outbreaks thanks to which the volume of incidental felling is doubled compared to other years. Nonetheless, current total volumes of felling do not exceed annual increment – the fact which can soon be changed unless insect outbreaks are brought under control.

Table 6 Comparison of planned and actual felling with increment 2008

Total current increment		Annual allowable cut		Actual felling				
						Of which incidental felling		
						Removed	Pending	
11.786 mil m^3	80.3%	**7.522 mil m^3**	100.0 %	**9.467 mil m^3**	64.6 %	2.498 mil m^3	0.333 mil m^3	Abiotic
						2.827 mil m^3	0.817 mil m^3	Bark beetle
						0.374 mil m^3	0.048 mil m^3	Others
						6.115 mil m^3		**Total**
			25.9 %		35.4 %			
	19.7 %							

Source: National Forest Centre

Forest cover in Slovakia is sufficiently stable and projected to rise; the area of cuts and annual felling are reasonable given current forest production potential. Despite opinions of some NGOs there is no reason to consider forestry a *main culprit* of flooding events occasionally occurring in mountain regions, especially on heavier soils with poor infiltration capacity.

Forest management and water quality

Over the years, a number of practical measures have been introduced to protect soils against erosion. These measures, the most important of which is the designation of **forest areas for protective purposes** (protective forests), also indirectly improved water quality. These forests, which are typical for low intensity management, are designated on the basis of site survey results independently of forest owners' interests. Their primary function is to protect soils against erosion. Decreased levels of sediment load in our watercourses are only an indirect result of sensitive management of these forests since particular forest stands are designated protective independently of the sediment control objective at a landscape level. Owing to this fact, Slovak forestry practice does not recognise the concept of riparian buffer zones around watercourses.

The 2008 statistics put the area of these forests at 330 349 ha, equivalent to 17.1 % of total forest land in Slovakia. The extent of these forests has been moderately increasing as a result of improved soil survey. The growing incidence and volumes of incidental felling, however, often require the implementation of more invasive and complex management methods (calamity removal) originally unconsidered and for which majority of forest owners are not technologically equipped.

On top of that, there is a possibility to designate a special type of *water-protective forests* mostly concentrated around reservoirs of drinking water. The area of these forests greatly varies - from a narrow belt surrounding reservoir's shores to more substantial areas of entire watersheds. These forests are designated for a 10-year period and thus their area around particular reservoirs often changes. Generally, the total area of these forests (23 621 ha; 1.21 % of total forest land) remains largely unchanged.

As for pesticide use, their application in Slovakia is rather limited compared to other EU Member States (below EU average) with no single major water pollution incident reported in

2008. In forestry sector, their use is only marginal compared to agricultural production, although in recent years we have recorded an increase in the application of pesticides associated with control of bark beetle outbreaks (products containing alpha-cypermethrin).

Technical amelioration and torrent control

Technical amelioration and torrent control in forests are the legal responsibility of respective forestry bodies. Their obligations are defined by the Act No 364/2004 Coll on waters and the Act No 666/2004 Coll on flood prevention. Recent funding constraints have almost frozen investments into this area. As a result, new projects are quite rare and some of old structures are gradually falling into disrepair.
The state subjects under the MA SR (predominantly the Forests of the Slovak Republic, s.e. and State Forests of the Tatra National Park) in 2008 managed 17 855 km of minor watercourses. Forestry subjects under the SR Ministry of Defence and forestry colleges managed additional 651 km.

Table 7 Investments of Forests SR into managed watercourses

Investments 2008 (€)				
Category	**Internal resources**	**External funding**	**Total**	**Note**
Debris basins and flood control	240 119	33 177	273 296	Rural Development Programme for 2007–2013, Operational Programme - Environment
Fire control reservoirs	0	656 053	656 053	Rural Development Programme for 2007–2013
Dam improvement	0	111 579	111 579	Rural Development Programme for 2007–2013
Total	**269 873**	**689 231**	**959 103**	
Investments 2009 (€)				
Category	**Internal resources**	**External funding**	**Total**	**Note**
Fire control reservoirs		517 113	517 113	Rural Development Programme for 2007–2013
Debris basins and flood control		352 872	352 872	Operational Programme - Environment
Total	**0**	**613 452**	**613 452**	

Source: Forests of the Slovak Republic, s.e. Banská Bystrica

Table 8 Other expenses of Forests of SR, s.e. related to managed watercourses

2008	
Maintenance and repairs of watercourses	733 917
Repairs of flood damaged water channels and related constructions	315 873
Total	**1 049 790**
2009	
Maintenance of watercourses	42 759
Repairs of flood damaged water channels and related constructions	96 653
Total	**139 412**

Source: Forests of the Slovak Republic, s.e. Banská Bystrica

Investments of the State Forests of the Tatra National Park into the area were 103 070 € (in 2008), which included maintenance of minor watercourses, removal of woody debris from watercourses

(originating from avalanche and windthrow events), flood control measures and repairs of flood damaged water channels and related constructions.

Lack of coordination between forestry and water management sectors

One of the major challenges associated with the management of mountain watersheds is the improvement of existing cooperation with the Slovak Water Company, which administers major as well as many minor watercourses, and forest land administrators. The gap between both sectors is such wide that research focused on water quality issues is conducted separately and often without the presentation of achieved results to the counterpart (see *Chapter Water Plan* for more details). The previously mentioned direct responsibility of particular state forestry agencies for the management of minor watercourses is, in case of forests, combined with the fact that they cover the majority of mountain watersheds and significantly contribute to water quality in watercourses and their water balance. The Act No 364/2004 on waters compels forest owners to only very few broadly defined responsibilities: "*Forest land owners are obliged to manage their forests in a way to ensure appropriate conditions for water accumulation and water regime improvement; they are in particular obliged to eliminate detrimental changes to runoff regime and soil flushing processes maintain soil water content and enhance retention capacity of particular landscapes."* None of the abovementioned obligations has, however, been incorporated into regulatory guidelines or, indeed, documents of strategic importance.

At a theoretical level, **water management authorities** can direct forest owners to implement measures to meet the abovementioned obligations. Despite this fact, such approach is rarely used and, if used, is often associated with the management of particular watercourses. No cases of forest owners being directly ordered to impose erosion control measures have been reported so far. Crucially, the Act does not pay any attention to funding of imposed obligations.

The Act recognises 12 protected water management areas, majority of which are situated in mountain regions of Slovakia. Their primary objective is to protect strategic national sources of drinking water. Designation of these areas has practically no impact on forest management in a particular area. The Act explicitly prohibits only *drainage of forest land at a scale significantly disturbing water regime in the affected area,* the measure almost unknown to Slovak forestry practice.

Forestry practice is slightly more impacted by the designation of buffer zones around sources of drinking water (see also above). Some of buffer zone forests are included in the category of special purpose forests as *water protective forests*. A specific management regime applies in these forests owners of which are exempt from tax levy. Budget constraints make the competent water authorities largely hesitant to designate these forests since forest owners are entitled to compensations for management restrictions imposed on their land. Thus the whole process of sustainable stewardship of water sources largely stagnates.

National Water Plan

A recent approval of the National Water Plan (Government Decree No 109 from 10 February 2010) should improve the situation in the management of water resources. The plan directly implements the Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (the EU Water Framework Directive - WFD). The regulation's main objective is to counter deterioration of surface waters and achieve their acceptable quality by 22 December 2015.

The document itself provides a comprehensive analysis of surface and groundwater resources and includes both the proposal for their effective monitoring and identification of key challenges. Forests and forestry are nevertheless in the document mentioned only marginally. The only reference made to forestry is the one identifying it together with agriculture and industries as one of 3 major *contributors to water pollution*. There is neither reference to the role of forestry in

the maintenance of forest itself nor its contribution to rural development. The Directive represents a reference base for the *Complex Programmes of Erosion Control and Measures on Enhancement of Retention Capacity of Slovak Territory* compiled for particular catchments. On contrary to the previously mentioned, these programmes contain a direct, and fairly authoritative, reference to forestry and agriculture since they impose restrictions and/or bans on timber felling, forest road construction, crop selection, etc. Rather unilateral in their essence of focusing on the achievement of WFD objectives (enhancement of water quality and water habitats) they substantially lack consideration for challenges facing other sectors including forestry and agriculture. At the same time, they ignore a need for effective incentive schemes to promote defined objectives among landowners and other stakeholders. From a fiscal point of view, only payments for water management services are directly addressed – no reference is spared on payments for forest related services.

The deadline for the elaboration of these programmes including a public consultation procedure was set for the end of 2009. Their submission to the European Commission should be completed by the end of March 2010. Despite the fact that the documentation on WFD implementation contains a list of comments from numerous public bodies, the comments from forestry and agriculture sectors are missing. We can only speculate about the obscure reasons behind a total absence of consultations with landowners and land use specialists in the development of programmes for particular catchments.

Despite the aforementioned shortfalls the implementation of WFD will significantly influence the management of mountain watersheds and thus we hope for substantial communication and cooperation improvements.

GREEN PAPER on Forest Protection and Information in the EU: Preparing forests for climate change (Brussels, 1 March 2010)

The cross-compliance mechanism can as well have an effect on forest management, especially after the Health Check modification that introduced water management in the Good Agricultural and Environmental Condition (GAEC) framework with **the new standard** "Establishment of buffer strips along water courses" **that will be made compulsory from 2012 the latest**.

The implementation of the mentioned standard can bring positive changes to Slovak forestry practice where the absence of wooded buffers along water courses is considered one of its future challenges.