Editorial

Promoting Natural Water Retention - An Ecosystem Approach

By a combination of human activities, the European environment has been progressively dehydrated through overexploitation of its water resources. Climate change is likely to place even greater pressures on these resources, which provide essential ecosystem services to communities throughout Europe, and also lead to an increased risk of extreme events, such as droughts and flooding.

This special issue explores potential management measures aimed at enhancing the water storage potential of Europe's ecosystems and aquifers and safeguarding them against the effects of climate change and other such human-induced pressures.

Of particular concern to policymakers is the protection against flooding that natural ecosystems afford. However, the ability of natural features to retain water also delivers other vital ecosystem services including water provision and purification, improvement of soil quality, provision of habitat, cultural services, air quality, climate regulation and, especially in peat bogs, storage of carbon and climate change mitigation. Recognition of the wide range of societal benefits from natural ecosystems is part of an ongoing paradigm shift in the way we attach value to the natural world, i.e. a shift towards thinking about what it does, rather than simply what it is.

Land management measures to promote natural water storage draw on nature to regulate the flow and transport of water, so as to smooth peaks and moderate extreme events. Such measures include the restoration of floodplains and wetlands, river restoration, sustainable drainage systems, forest measures, soil management and sustainable agricultural practices.

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The articles covered by this special issue illustrate the importance of establishing the evidence base to underpin policy innovation and associated management actions. For example, it is vital to understand potential trade-offs of imposed measures (i.e. benefits from increased natural water retention versus losses in other services), to which the UK National Ecosystem Assessment has so far made a major contribution. In essence, policymakers need to think about water not in isolation but as part of the land-water-living resources system underlying a sustainable economy and the socio-cultural fabric of the EU.

The ‘ecosystem approach’ provides a useful methodological framework for achieving holistic and integrated approaches to promoting natural water retention. Reducing the vulnerability of water resources and related ecosystems to climate change and other anthropogenic pressure is the focus of the forthcoming EU ‘Blueprint to Safeguard Europe’s Waters’, which will address cost-efficient multifunctional natural water retention measures and their integration into River Basin Management Plans and sectoral policies.

Most natural water retention measures can also be regarded as components of the EU’s Green Infrastructure strategy, a holistic policy initiative integrating nature and biodiversity conservation, sustainable development, employment opportunities and recreation. The multi-functionality of natural water retention measures contributes to their cost-efficiency, making them good candidates for sustainable climate adaptation measures under the EU climate change adaptation strategy and Common Agricultural Policy (CAP).

The article ‘Wetland management needs a ‘human-centric’ approach’ describes the pathfinder role that wetland research has played in the paradigm shift, by strengthening the linkages with society. The authors discuss how a new, unifying Wetland Policy would go a long way to achieving greater coherence among different water and land management policies. Better integration of objectives for wetland creation/restoration at different landscape scales and the management of potential conflicts between objectives is discussed in ‘Four step strategy for wetland restoration and creation in agricultural landscapes’.

Peat bogs are a special type of wetland, which provide multiple ecosystem services, including storing significant amounts of carbon. ‘Blocking drainage ditches aids peatbog restoration’ describes how blocking ditches cut previously under agricultural practices which favoured improvement of upland grazing, effectively restores ecosystem integrity to degraded peat bogs, but highlights the need to monitor the hydrological impacts over long periods of time and at the landscape scale, rather than the local scale.

The importance of spatial scale is further highlighted in an agricultural context in ‘What factors affect runoff from agricultural land?’ As the article discusses, reducing agricultural runoff can potentially reduce erosion, productivity loss, downstream pollution and poor water quality. However, the greatest research gap lies in the limited understanding of the significance of the spatial and temporal aspects of patchiness and connectivity in the agricultural landscape.

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Spatial scale is also relevant to the influence of forests on the hydrological cycle. The article ‘Forests: A positive force for water availability’ tackles the apparently contradictory views on the relationship between forest cover/afforestation and water yield. On balance, the researchers conclude that as water providers rather than consumers, forests should be thought of as global public goods and be factored into drought mitigation strategies and the ecological footprint of forestry products and services.

Forest type is important in runoff and flood generation but soil conditions, often the result of prior land uses, are also significant. As discussed in ‘Soil properties are key factor in flood prevention’, soil characteristics should be taken into account in a multidisciplinary policy approach to flood prevention, involving a wide range of stakeholders from the forestry, agriculture, water management and spatial planning sectors.

Alongside efforts to restore valuable ecological environments to protect ecosystem services related to water retention, certain technical measures can contribute to effective, natural flood protection. The article ‘Decentralised Flood Protection: A key player in natural flood management’ demonstrates that supporting the entire drainage basin with a network of small flood prevention measures (i.e. retarding basins, river renaturation and afforestation of floodplains) can be used alongside larger technical interventions, such as dams and dykes.

In urban areas, grey infrastructure (i.e. buildings and concrete) reduces percolation of rainwater into groundwater reservoirs, increasing the risk of surface flooding and contamination of water through storm sewer overflow. The final article, ‘Overcoming the challenges of SUDS design’ highlights how the urban environment should be an important focus of attention through new planning and design of Sustainable Urban Drainage Systems (SUDS). Although the potential benefits of green roofs, bioswales and open gutters for stormwater management are high, significant technical, collaborative and practical challenges exist, calling for better engagement of landscape architects.

Professor Edward Maltby
Professor Emeritus of Wetland Science, Water & Ecosystem Management
University of Liverpool
Laborde Endowed Chair in Research Innovation, LSU, Baton Rouge

1. UK National Ecosystem Assessment. See: http://uknea.unep-wcmc.org/
Wetland management needs a human-centric approach

Wetland management needs to consider the role wetlands play in supporting livelihoods and wellbeing as well as more traditional conservation goals, according to UK researchers. Such a ‘human-centric’ approach, would link hydrological conservation to societal benefits, including clean water, food production, flood protection and improved human health.

Wetlands, such as swamps, marshes, bog and fens, cover 6% of the world’s land surface and have been important throughout human history. However, many wetlands in Europe and around the world have been drained, mainly for economic reasons.

Since the 1970s, international agreements, such as the Ramsar Convention1, have acknowledged the multifunctional importance of wetlands. The Rio Earth Summit in 1992, the Millennium Ecosystem Assessment2 and the UK National Ecosystem Assessment (UK NEA)3 have all improved our understanding of the generally understated, often non-market economic values of intact wetlands. In Europe, these include reducing or delaying floods, improving water quality and recharging aquifers (see Maltby, 20094).

The review examined the scientific evidence for wetland functions. For instance, wetlands can reduce or delay flooding, but only if their soils are not already saturated. However, surface run-off is slowed by wetland vegetation, which can reduce downstream flooding. Similarly, although some wetlands can resupply aquifers, others are fed by groundwater moving upwards. Wetlands can also enhance water quality, removing pollutants and absorbing sewage. However this depends on the wetland’s size, location and the vegetation it contains.

It is vital that wetlands are managed to support ecosystem services, particularly where they directly support sustainable production in developing countries. For example, the fishing and agricultural services provided by the Nigerian Hadeja-Nguru wetlands are economically more valuable than crops grown with water diverted upstream (US$32 compared to US$0.15 per 1000m²).

The researchers highlight several innovative international and European wetland restoration projects, such as the Australian Murray-Darling Basin Plan5, the Oostervaarders Plassen in the Netherlands and the UK Great Fen Project. However, they also identified gaps in wetland related policy and/or implementation. In Europe, the WFD requires the provision of protected areas but there is no specific Wetlands Directive. The value of ecosystem services wetlands provide is analysed in recent initiatives (TEEB6, UK NEA), which reinforce the importance of the role of natural capital. However, these ecosystem services cut across many different policy areas, making coordination difficult.

The researchers conclude that policymakers need a new approach to unifying existing land use and water management policies to better account for the diverse but poorly evaluated roles of wetlands in human health and wellbeing, as well as biodiversity. This approach should take advantage of innovative conservation tools, such as payments for ecosystem services, to ensure the buy-in of those with a stake in wetland management, such as local farmers.

1 Ramsar Convention on wetlands. See: http://www.ramsar.org/cda/en/ramsar-home/main/ramsar/1_4000_0__
3 UK National Ecosystem Assessment. See: http://uknea.unep-wcmc.org/
6 The Economics of Ecosystems and Biodiversity (TEEB). See: http://ec.europa.eu/environment/nature/biodiversity/economics/

“Wetlands cover 6% of the world’s land surface and have been important throughout human history.”

Four-step strategy for wetland restoration/creation in agricultural landscapes

New research has outlined a four-step approach to multipurpose wetland creation or restoration: clarifying the objectives, defining the scale and analysing possible conflicts, before finally defining a strategy.

Increasing attention is being paid to the restoration or creation of wetlands, driven by their ability to perform multiple ecosystem functions, such as improving water quality, supporting biodiversity and carbon sequestration. Based on a literature analysis, the new study provides a general strategy for wetland creation or restoration.

The researchers considered all available studies on wetland creation and restoration conducted in the last 30 years, reported under the Science Citation Index. Studies were categorised under three major objectives: improving water quality, improving soil quality and strengthening biodiversity. As most studies were site specific, i.e. restricted to the area suffering degradation, the review also considered a fourth category of studies conducted at a larger landscape scale with a multi-objective perspective.

Most studies investigated water quality improvement, with the majority examining nutrient retention (nitrogen and phosphorus). Wetlands have been shown to retain widely variable amounts of nitrogen (30-99%) and phosphorus (0-99%), both of which are harmful to the aquatic environment when present in excessive amounts.

The second most studied objective was strengthening biodiversity, particularly how wetlands support rare species. Fewer studies looked at soil improvement, but the number is increasing. Such studies have mainly assessed the variability in soil properties, such as levels of organic matter or phosphorus, which influence the distribution, composition, abundance and size of resident organisms.

Since the 1990s, more studies have been conducted at a landscape scale with the recognition that larger, connected areas promote the establishment of stable wildlife populations. However, site-scale restoration is commonly used when a specific area of wetland has been critically degraded.

More recently, studies on wetland creation and restoration have set multiple objectives, an approach that promotes several benefits, e.g. removing nitrogen and phosphorus from agricultural runoff, improving habitat for wildlife and providing recreational areas for local residents. However, research indicates that it can be difficult to maximise all functions. For example, irregular patch shapes promote bird communities, but this may not be ideal for improving water quality.

The researchers recommended a four-step process. Firstly, there should be clarification of the local requirements and limitations of the wetland and secondly, a definition of the spatial scale of the project. Thirdly, if more than one objective is pursued then conflicts and compatibilities should be identified and investigated before finally defining a strategy.

More generally, the review suggested that planning multipurpose wetlands at a landscape scale would promote more varied landscapes that support greater biodiversity and water quality improvement, and provide a range of services that fulfil ecological and social needs.

Blocking drainage ditches aids peatland restoration

A recent study suggests that blocking ditches originally dug in peatlands to drain water is an effective restoration method, but is influenced by local conditions. Restoration efforts should therefore be monitored over long periods of time at the landscape level to fully evaluate their impacts.

As well as providing clean water and storing significant amounts of carbon, peatlands are important habitats for birds, animals and plant life. However, many peatlands have now been drained using a network of ditches to allow animals to graze.

Allowing water tables to rise again by blocking drainage ditches is one method used to help restore drained peatlands. Partly funded by the EU’s LIFE programme¹, this study assessed at the landscape level and over the longer term, how effective this restoration measure has been in rehydrating a degraded blanket bog (a type of peatland) at Lake Vyrnwy in mid-Wales, UK. There, peat and heather bales were used to block about 100,000 m of ditches between 2007 and 2010.

The researchers measured the depth of water tables together with the presence or absence of surface waters at various points in the catchment area. Using geographical and climate data, they then used computer modelling to determine water table responses to drain blocking. Overall, more water was stored in the peat following restoration, indicating a return to the healthy functioning of the peatland.

Following blocking, water tables were found to rise after rainfall, which did not occur in non-restored sites. In particular, water tables down-slope of ditches rose by an average of 2cm, with the response being influenced by local factors, such as the slope of the ground and the depth of the peat.

In connection with rising water table depths, the occurrence of surface waters increased after blocking by up to 40% in some places. This was especially noticeable within 2m of the drains, where previously, unblocked drains significantly decreased surface water.

Previous studies have indicated that raised water tables result in increased discharge rates into drains and streams. However, this study resulted in both higher water tables and reduced frequency and severity of peak flows, as blocking lowered the rate at which water was discharged into drains and streams, keeping water tables higher for longer between rainfall events. This implies that restoration could potentially reduce the flood risk further downstream in the catchment area. Two separate papers further discuss the impacts of peatland restoration on flood risk reduction² and carbon flux balance³.

Variations in the recovery rates of the water table and surface waters in different catchment areas suggest local conditions significantly affect the extent and speed of recovery. This suggests that the water-table restoration potential of peatlands is underestimated and further studies over longer periods and at the landscape scale to effectively monitor their recovery.

¹ EU LIFE Programme. See: http://ec.europa.eu/environment/life/
What factors affect runoff from agricultural land?

A review of research into surface water runoff from agricultural land has found that less intensive management leads to more predictable runoff generation over the course of a year. The review also identified several gaps in our understanding, which need to be better represented in hydrological models if the environmental impact of runoff is to be reduced.

Surface runoff from agricultural fields can lead to erosion, loss of productivity, and can affect water bodies by silting up reservoirs and increasing the flood risk. Agricultural runoff can also cause pollution and poor water quality.

The researchers examined the effects of a variety of agricultural land management techniques on surface water runoff at two different scales. First, how practices changed the conditions in a single field over time and how this affected runoff, including changes to soil bulk density, soil ‘crusts’, and roughness. At the catchment scale, the researchers looked at the effects of the size and layout of different fields or ‘patches’ and the influence of linear features, such as ditches, on the passage of water from one part of the landscape to another and on overall runoff.

Within a single field, no-till systems, where the soil is not disturbed between growing seasons, produced less annual variation in soil bulk density than conventional ploughing. Soil cover (such as a layer of organic material) changed more under conventional ploughing regimes than others. The seasonality of soil cover is one of the important factors affecting the formation of a soil crust, caused by rainfall, which influences runoff as it prevents rainwater infiltrating the soil.

At the catchment scale, the review found that there were no studies of the effects of field size on runoff, although studies of natural landscapes have shown that fewer patches (i.e. larger field size) reduced the amount of water that was retained and made available for plants by 25%. Finally, the review found that some linear structures, such as ditches, increased runoff by up to 30%. However, linear features that increase the distance runoff has to travel, or reduced flow rate can reduce run-off rates. Despite their strong influence on runoff rates, linear structures are often not incorporated into models of surface runoff rates in small catchments.

This research highlights that a better understanding of the range of land use factors that affect agricultural runoff is critical to underpin mitigation strategies. Until these large knowledge gaps begin to close, particularly in terms of the interactions between patches over time, the spatial organisation of patches and the interactions with linear features, such as ditches, the ability of hydrological modelling tools to predict agricultural runoff and contribute to reducing the environmental impact is limited, say the researchers.

Forests: A positive force for global water availability

A recent study suggests that, since forests play a significant role in the regional and global supply of water vapour in the atmosphere, they should be thought of as global public goods and not viewed negatively in terms of water consumption.

Although it is generally accepted that forests increase carbon sequestration and promote biodiversity, their role in water availability is still hotly contested. From a demand perspective, forest cover is said to diminish the amount of water available at the local level for other uses, including agriculture, energy, industry and domestic consumption. A counter-argument from the supply perspective is that forest cover raises the amount of water available at the regional and global scales, by increasing the rate at which precipitation (rainfall and snow) is recycled.

Since the two schools of thought address very different geographical scales, the new study reviews both sides of the argument at both relevant scales: the small-scale catchment level (less than 1 km$^2$ to about 10 km$^2$) and larger regional and continental scales.

Although the water demand of trees can be estimated for small-scale catchments (less than 2 km$^2$), basins of this size can collect precipitation from other areas. Thus, the effects of changes, such as deforestation, might only be apparent further away, making it difficult to link cause and effect.

At larger scales, evapotranspiration (‘ET’, evaporation through transpiration of water by vegetation) increases the availability of water vapour for transport in the atmosphere, in particular in continental interiors that are distant from oceans. In hot summer months, ET is a significant source of rainfall over land, contributing up to 48% of rainfall at the regional and continental scales and 16% at the local level. A number of studies have found a link between deforestation and lower regional precipitation. For example, deforestation in the Amazon and Cerrado regions of Brazil increases the average length of the dry season by one month.

With anticipated climate change, diminished recycling of water vapour in the atmosphere as a result of deforestation, particularly in dry areas, could increase the likelihood and extent of drought. Planting more forested areas in Europe, on the other hand, should increase precipitation at the regional level through greater recycling of water via ET. The type of vegetation significantly affects the rate of ET. Compared with other forms of land cover, forests and wetlands are almost twice as efficient at returning water to the atmosphere.

Overall, the researchers conclude that policymakers should consider forests as ‘global public goods’, in terms of their strong positive impact on regional and global precipitation, in addition to their water demand. This approach would affect the valuation of ecosystem services for water-pricing strategies, determining water footprints of products, drought mitigation strategies and afforestation policies.

Soil properties are key factor in flood prevention

Soil conditions play a crucial role in determining water runoff and retention in forested sites, according to new research. Soil characteristics, such as compaction, play a greater role than forest type in determining water dynamics.

Forests help retain water and mitigate flooding by slowing peak water flows during storm events. However, forest management practices, such as clear cutting and heavy equipment use, can reduce their effectiveness. Climate change is predicted to increase the number and severity of extreme weather events, raising the question of how to prevent future flooding at the catchment level.

Research funded through the EU WaReLa\(^1\) and ForeStClim\(^2\) projects, investigated the influence of soil conditions on rainwater runoff. The study, carried out in the low mountain ranges of southwest Germany, conducted sprinkling experiments on 11 test sites within two forested catchments to simulate rainfall. Sprinkling occurred on three consecutive days and simulated 10 mm of rainfall over a 50 m\(^2\) area, reflecting natural levels that cause flooding in this area. The scientists measured the bulk density and water content of soil samples together with hydraulic conductivity (a measure of how water moves through the soil) and infiltration capacity.

The sites covered a range of different conditions, including established forest stands with deciduous and coniferous species, arable land and afforestation sites following agricultural land-use. Soil types also varied, but in all cases subsoil layers were compacted due to Ice Age periglacial dynamics, limiting deep percolation of water into the sites.

In the first catchment, runoff was highest in a relatively young (1 year old) afforestation site (20% of total simulated rainfall). Runoff was generally less in forested areas but higher run off in deciduous than coniferous forests (17% compared to 5%) was attributed to differences in the depth of the compacted soil layer, rather than tree type. Runoff was considerably lower in the second catchment (less than 4%) due to water being able to flow vertically through the compacted soil layer.

The compacted layer of soil was found near the surface within an afforestation site created 30 years ago, leading to similarly high runoff levels to an arable plot. This shows that the effects of cultivation are long lasting and that forest managers could use machinery to break up the compacted soil layer before afforestation to improve root penetration and water infiltration.

Approaches to flood protection should reflect the fact that runoff characteristics are site-specific and involve a range of stakeholders, including forestry, agriculture, water management and spatial planning representatives. An ecohydrological approach could be adopted to reverse ecosystem degradation while enhancing forests' ability to accommodate human impacts.

The researchers recommend a number of forest management practices, including sustainable soil management, using low-impact harvesting methods and avoiding clear cuts, drainage systems and extensions to forest roads. Further insight into the influence of soil properties on water retention is important for forest planning and large scale flood prevention.

\(^1\) WaReLa, Water Retention by Land Use, was funded by the European Commission through the INTERREG IIIB NWE programme. See: http://3b.nweurope.eu/page/projet.php?p=31&id=524

\(^2\) ForeStClim was funded by the European Commission through the INTERREG IVB NWE programme. See: http://forestclim.eu/

Decentralised Flood Protection: A key player in natural flood management

Scientists have modelled the potential benefits of decentralised flood protection (DFP) in Central Europe and conclude that it could be a significant step towards natural flood management in the EU.

DFP describes a network of individual flood protection measures using small technical interventions distributed throughout an entire drainage area, rather than applying large technical measures, such as dams, at sites of peak flood risk.

The new study concentrated on measures that tackle flood discharge after excess water (i.e. stormwater runoff) has concentrated in river channels. These include construction of retention basins (small dams or artificial lakes lined with vegetation), renaturation of river channels by restoring meanders and vegetation, and afforestation of floodplains.

The researchers investigated all three approaches in the mountain catchment of the upper Flöha river on the Germany-Czech Republic border. The mountain regions of southeastern Germany experienced more than €1.2 billion worth of damage following a storm in 2002.

Using real storm data from the period 2002-2008, the researchers simulated a flood event with a recurrence interval of 100 years, then again following the introduction of 32 small (10-65,000 m$^3$ capacity) retention basins positioned either upstream of villages prone to flooding or in low gradient valleys with high water storage potential.

Locally, the retention basins solved the problem of storm runoff for some villages by reducing peak flows by up to 48% and delaying the flood peak by 6-10 hours. The exact efficiency was related to the available storage capacity in the valleys upstream of the settlements, resulting in a reduction in runoff of 10% over the whole catchment. The basins generally drained within 36 hours, minimising the ecological impact, i.e. the adverse effect of standing water on the surrounding vegetation.

Renaturation only had a low impact, which the researchers attributed to a limited number of suitable river sections and high slope gradients. However, renaturation (especially restoration of former meanders) should not be excluded as it could help offset the ecological impact of constructing retention basins.

Afforestation of floodplains reduced peak flows by up to 4% when applied to all unwooded floodplains rather than restricted to 5m riparian zones along river banks. Over the whole catchment, afforestation in combination with retention basins reduced flood peak by 12.8% and delayed it by 3 hours, providing earlier warning times for nearby settlements.

DFP could make an important contribution to flood protection strategies by shifting from flood defence to management of flood risk, as targeted under the integrated Flood¹ and Water Framework² Directives. This approach also extends flood protection to the watershed, not just to the receiving water. The researchers highlight that DFP should be used alongside, not necessarily instead of, traditional large-scale technical solutions, such as building dykes and dams.


Overcoming the challenges of SUDS design

New research into how landscape architects approach the retrofitting of urban areas with sustainable urban drainage systems to manage stormwater has identified 11 main challenges. Importantly, the study also discusses solutions for how to overcome them.

Sustainable Urban Drainage Systems (SUDS) mimic natural systems, such as raingardens, in urban environments to drain surface water and release it slowly back into the environment. They are a valuable tool to address city flooding and sewage overflow, whilst also promoting urban greening and recreational areas. However, SUDS are a rather recent development so there is little planning experience and knowledge transfer behind them.

The study set six teams of professional landscape architects the task of designing a SUDS retrofit on a primary school. Through observations and interviews, as well as analysis of final designs, the researchers identified 11 major challenges and possible solutions, falling into three main categories:

**Better technical knowledge.** There is a need for more research and knowledge sharing on suitable plant species for SUDS, their maintenance, habitats that can be supported and emerging technologies to address water quality management, such as Dual Porosity Filtration. This would also help ensure the continuity of natural connections with the surrounding landscape.

Simple calculation schemes provided by university hydrologists could allow architects to more accurately estimate the amount of water flow and the capacity of the SUDS required. This would help overcome the tendency of architects to overestimate flow, resulting in SUDS remaining dry. Providing calculation tools and empirical figures in SUDS design guidelines could help lessen knowledge gaps in costs, both in terms of implementation and maintenance.

**Better collaboration.** Designing SUDS requires holistic working at several spatial scales, from sewersheds down to neighbourhood streets and single open gutters. More collaboration among different stakeholders, such as park departments, water utilities and traffic administrations, would ensure all requirements and local knowledge were considered.

**Greater practical experience.** Several challenges exist due to a lack of practical experience that will lessen as SUDS become more widely used. For example, more experience will promote better understanding of how to strike a balance between aesthetics, function and minimising terrain changes. Experience will inform how social context influences the design and the optimum choice of different SUDS elements, such as green roofs, bioswales and open gutters.

An interesting finding was the shift in some architects’ viewpoints from considering runoff water as a problem to considering it as a resource. A vital learning point was that interconnected systems within the natural catchment are both effective and environmentally sound as they enable designers to implement small systems on single sites, requiring less terrain works whilst supporting ecological connections. In general, meeting the observed design challenges requires improved standards and guidance on best practice in SUDS, based on more research, more knowledge sharing, and more hands-on design practice.

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A selection of articles on natural water retention measures from the Science for Environment Policy News Alert.

Farmers evaluate measures to reduce soil erosion and water pollution (Apr 2012)
Farmers have collaborated with scientists in France to evaluate agri-environmental measures that reduce soil erosion and surface water pollution at a catchment level. The exercise helped the farmers understand the benefits of the measures and provides an example of how policymakers could engage with stakeholders under the Water Framework Directive (WFD).

Urban forests: could they be doing us a disservice? (Feb 2012)
There is a growing body of scientific research into the health benefits of urban forests, such as improving air quality and providing recreational space. However, new research challenges the assumption that their overall impact on quality of life is always positive and land planners need to take into account ecosystem disservices as well as services, say the researchers.

Sloping smooth roofs prove best for rainwater harvesting (Sep 2011)
Collecting, or ‘harvesting’ rainwater may help society cope with a number of problems, such as water shortages, flooding and the degradation of urban streams. Urban roofs make up about half of the total sealed surface (‘unnatural’ surfaces, which cover over natural surfaces, such as soil) in cities and contribute the most to stormwater run-off, which could be harvested for other purposes. To maximise this potential, it is useful to know which type of roof can harvest the greatest amount of good quality water.

The impacts of global crop production on water and land use (Sep 2011)
A new study has estimated the water consumption and land use for the production of 160 crops that constitute most of the world’s cropland. The results suggest that, collectively, wheat, rice, cotton, maize and sugar cane account for 49% of water scarcity and 42% of land resource stress caused by worldwide crop production.

Will any wetlands survive future sea level rise? (Jun 2011)
Only wetland environments with high sediment input from rivers can keep pace with rising sea levels, according to a new study. However, human activity is destroying wetlands’ natural defences, making their survival increasingly unlikely. The researchers call for sustainable management approaches to protect wetlands under future climate change projections.

To view any of these articles in full, please visit: http://ec.europa.eu/environment/integration/research/newsalert/index_en.htm, and search according to article publication date.

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