Good enough? Evidence on multiple benefits of NWRM from EU NRWM Pilot Project

· Gonzalo Delacámara | gonzalo.delacamara@imdea.org

Natural Water Retention Measures [NWRM]

Pilot Project

DG ENV project lead by OIEau (France)

Partners: ACTeon (France), IMDEA WATER (Spain), IACO (Cyprus/Greece), REC (Hungary/ Central & Eastern Europe), REKK inc. (Hungary), BEF (Baltic States), SLU (Sweden), ENVECO (Sweden) SRUC (UK) and AMEC (UK

Main deliverables

- **Knowledge base** on NWRM that can easily be accessed by all within the Water Information System for Europe (WISE);
- Contribute to the development of an active **European "community of NWRM practitioners"**,
- Website: http://nwrm.eu/
- Guidance document for policy makers

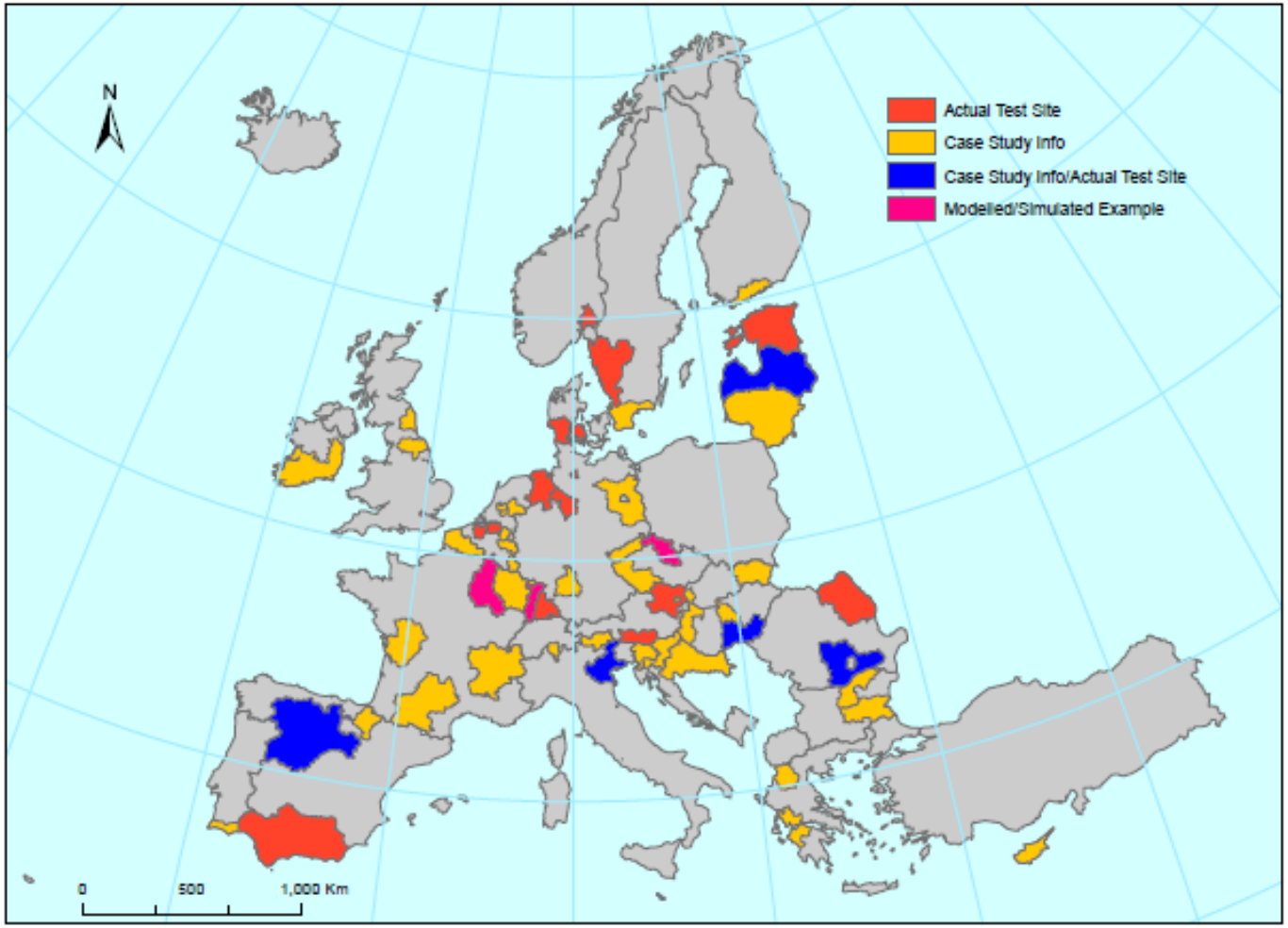
NWRM Pilot project

Main outputs

- **Catalogue of measures** – 53 measures clustered in 3 land-use groups (urban, agriculture, forestry) and 1 group of river restoration measures
- 40 in-depth **case studies** & 56 additional case studies throughout the 28 EU Member States
- NWRM individual **factsheets** (for each of the 53 measures)
- 12 **synthesis documents** on policy questions – biophysical and technical; socio-economic; governance, implementation, and financing.
- **Platform** for end-users integrating the different elements of the knowledge base – targeting practitioners, managers, policy-makers, etc.
- 8 regional **workshops** (2014) – Brussels, Budapest, Riga, Madrid, Gimo, Bucharest, Strasbourg, Turin

NWRM Pilot project

Wealth of case studies and illustrations



NWRM Pilot project

Regional networks

Baltic Sea Co-ordinator // Heidrun Fammler
heidrun.fammler@bef.lv
Danube Co-ordinator // Jovanka Ignjatovic
JIgnjatovic@rec.org
Western Co-ordinator // Nick Jarritt
nick.jarritt@amec.com
Mediterranean Co-ordinator // Gonzalo Delacámara
gonzalo.delacamara@imdea.org

NWRM Pilot project

Guidance document

- Guidance document to be drafted & approved by SCG & Water Directors in Nov-Dec 2014

- WG POM Drafting team - DG ENV, DE, FR, IT, NL, UK, EEB, WWF, WI, NWRM PP and WFD CIS support consultants

- Ensure coherence with tools and documents of the NWRM pilot project:
  - Knowledge base
  - Case studies and experiences
  - Technical background and practical guidance tools

NWRM Pilot project

Deliverable

- Short policy document (for policy and decision-makers, 15 -20 pages)

- Aim:
  - Explain policy relevance of NWRM, stimulate uptake

- Target Group:
  - Water Directors and decision-makers at the National Competent Authorities for WF/FD - persuade other policy makers for joined action
  - Local and regional catchment-scale decision-makers.

NWRM Pilot project

Deliverable

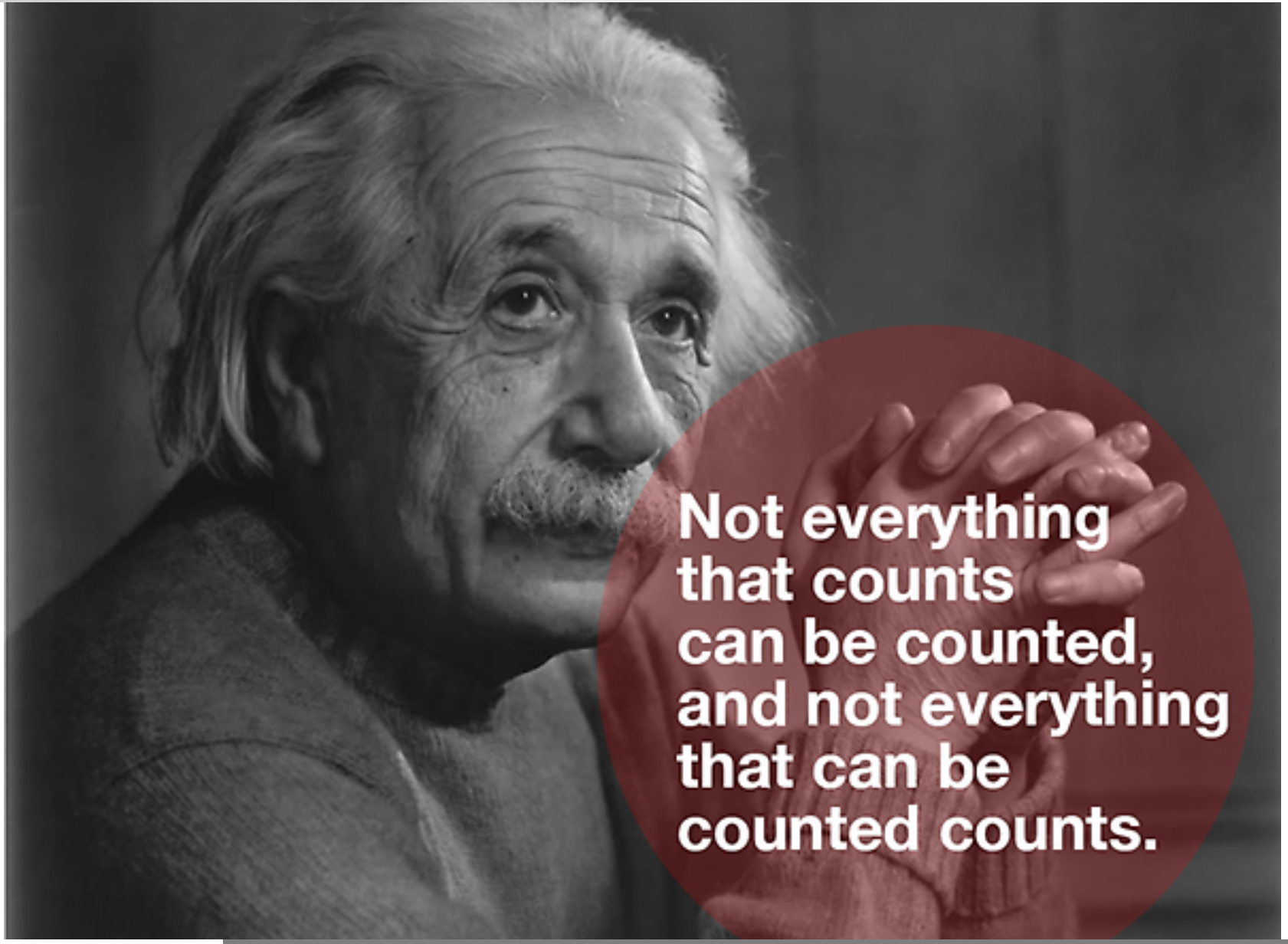
Natural Water Retention Measures are multi-functional measures that aim to protect water resources and address water-related challenges by restoring or maintaining ecosystems as well as natural features and characteristics of water bodies using natural means and processes.

The main focus of applying NWRM is to enhance the retention capacity of aquifers, soil, and aquatic and water dependent ecosystems with a view to improve their status. Appropriate application of NWRM supports green infrastructure, improves the quantitative status of water bodies as such, and reduces the vulnerability to floods and droughts. It positively affects the chemical and ecological status of water bodies by restoring natural functioning of ecosystems and the services they provide. The restored ecosystems contribute both to climate change adaptation and mitigation.

NWRM Pilot project

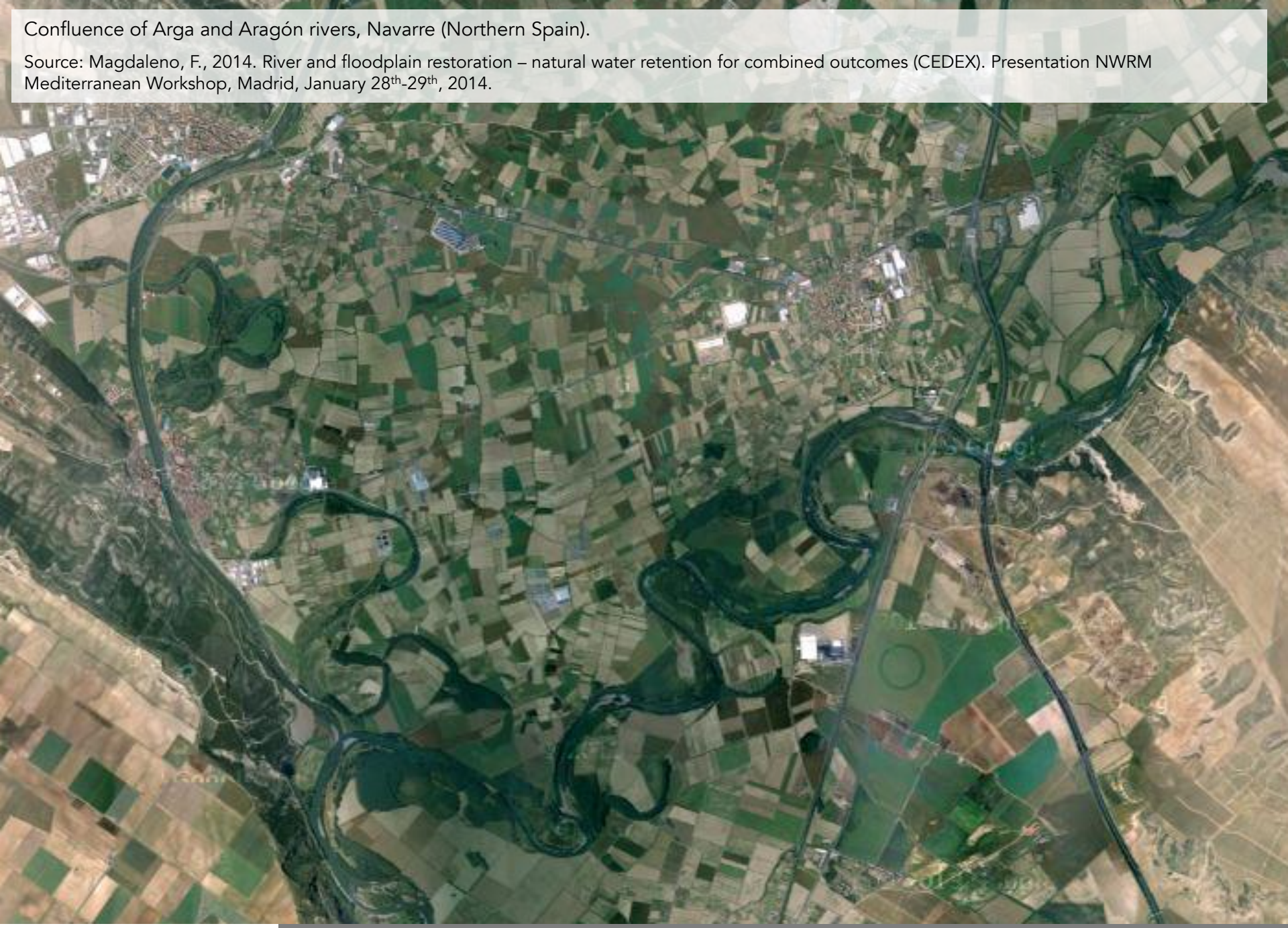
What they are

Type	Class	NWRM Measure
Direct modification in ecosystems	**Rivers and connected wetlands**	Creation of basins and ponds, wetland restoration and creation, floodplain reconnection and restoration, reconnection of hydraulic annexes, elimination of riverbank protection
	Lakes and connected wetlands	Restoration of lakes
	Aquifers	Artificial groundwater recharge (AGR)
Change & adaptation in land-use & water management practices	**Agriculture**	Restoring and maintaining meadows and pastures, buffer strips, soil conservation practices (crop rotation, intercropping...), conservation tillage, green cover, terracing, (re-)establishment of hedgerows, riparian trees in agriculture landscape
	Forestry and pastures	Afforestation of riparian areas/mountainous areas/reservoir catchments, Targeted planting in Mediterranean areas for "catching" precipitation, land-use conversion for water quality improvements, continuous cover forestry, maintenance of riparian buffers, appropriate design of roads and stream crossing, urban forests
	Urban development	Green Roofs, rainwater harvesting, permeable pavings, swales, filter strips & trenches, bioretention areas, soakaways, infiltration trenches and basisn, rain gardens, detention basins, retention ponds, wetlands, urban channel restoration, floodplain restoration, managed aquifer recharge


Not everything
that counts
can be counted,
and not everything
that can be
counted counts.

Confluence of Arga and Aragón rivers, Navarre (Northern Spain).

Source: Magdaleno, F., 2014. River and floodplain restoration – natural water retention for combined outcomes (CEDEX). Presentation NWRM Mediterranean Workshop, Madrid, January 28th-29th, 2014.



Overflow of the Arga river in the riverine towns of Villada and Burlada in January 2013 (Greater Pamplona, Navarre, Spain)

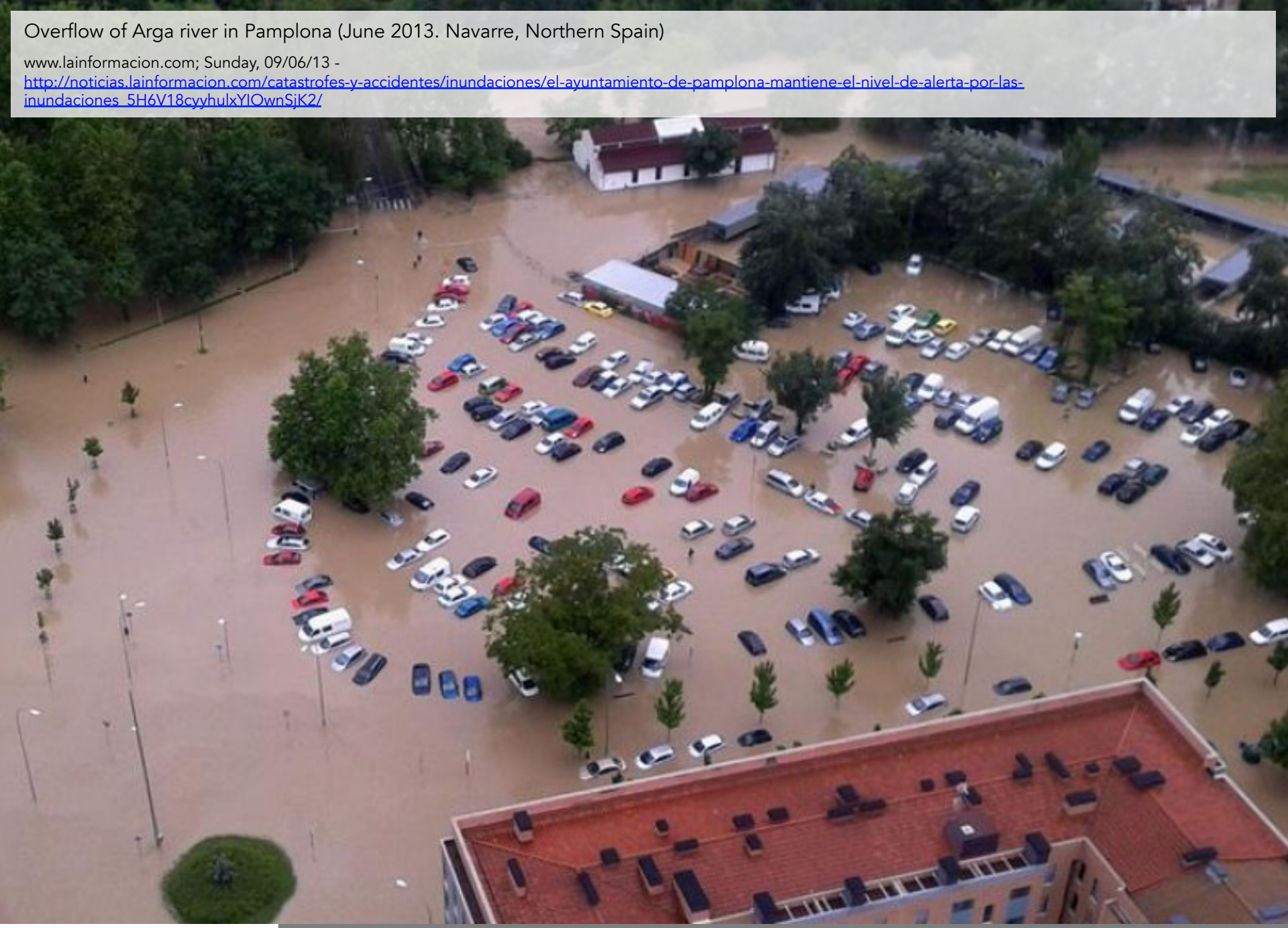
Source: www.diariodenavarra.es; 16/01/2013.
http://www.diariodenavarra.es/noticias/navarra/pamplona_comarca/2013/01/16/las_inundaciones_alteran_vida_normal_comarca_pamplona_104160_1002.html

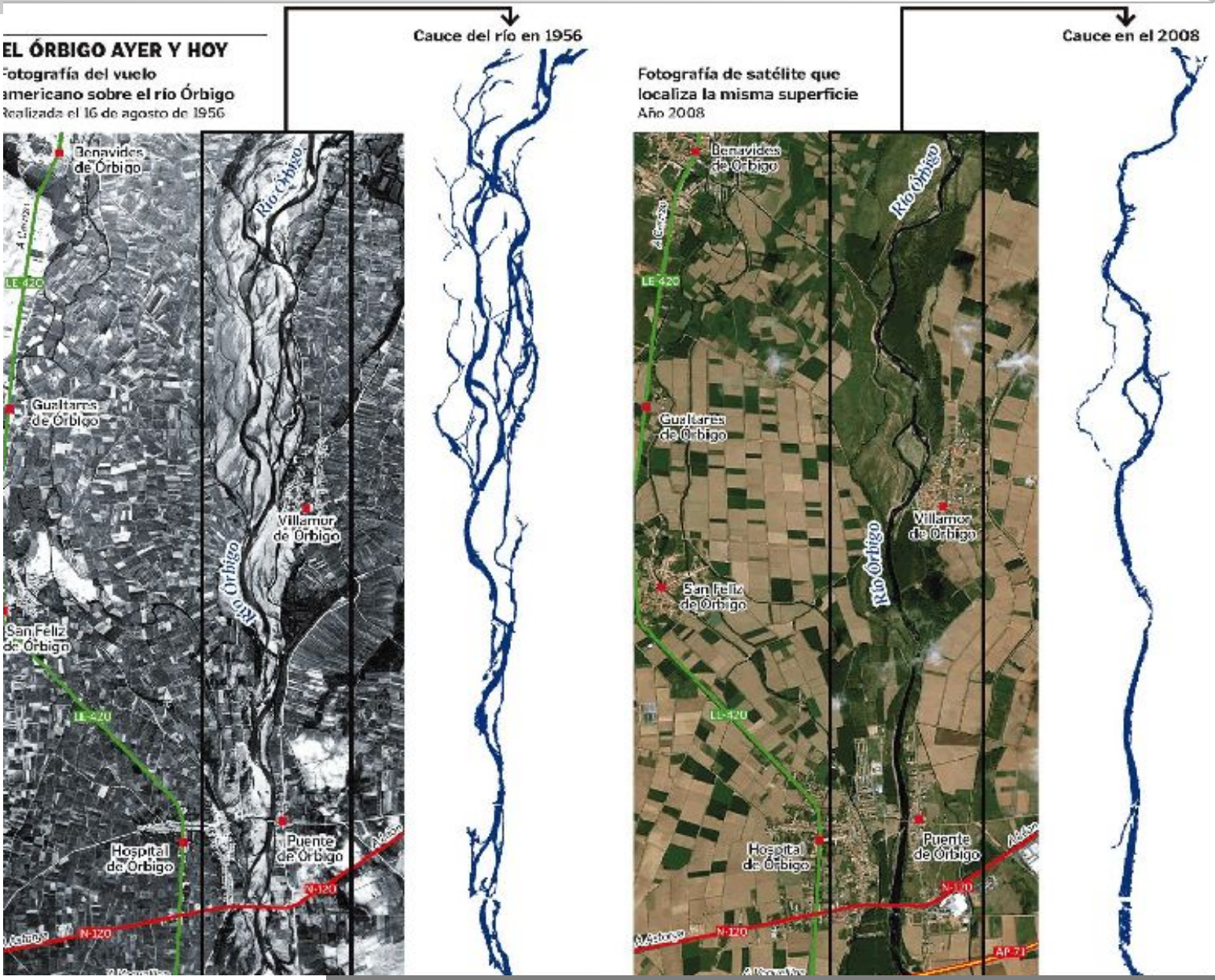
National motorway N-113 flooded due to the overflow of Arga river in June 2013. Navarre (Spain)

Source: www.lainformacion.com; Monday, 10/06/13 - http://noticias.lainformacion.com/medio-ambiente/rios/la-carretera-n-133-pamplona-madrid-cortada-en-castejon-por-las-inundaciones_hCU4EPd05G1eDVCqpqAGd4/

Overflow of Arga river in Pamplona (June 2013. Navarre, Northern Spain)

www.lainformacion.com; Sunday, 09/06/13 -
http://noticias.lainformacion.com/catastrofes-y-accidentes/inundaciones/el-ayuntamiento-de-pamplona-mantiene-el-nivel-de-alerta-por-las-inundaciones_5H6V18cyyhulxYlOwnSjK2/





Órbigo river channel in 1956 and 2008. Effects of channelization and alteration of the river hydromorphology.

Source: Duero River Basin Authority (Confederación Hidrográfica del Duero, CHD).

Poplar crops in the Órbigo River Basin (Castille and León, Spain)

Source: Rodríguez I., Santillán J.I., Huertas R., Ortega L., 2012. The Órbigo River Restoration Project and its implications in flood risk prevention. (WGF Thematic Workshop: Stakeholder Involvement in Flood Risk Management. 17, 18 April, 2012. Bucharest-Romania. Session 4: Working with institutional stakeholders and other sectors, in particular in land use)

Poplar crops are compatible with flooding episodes. Órbigo River Basin (Castille and León, Spain)

Source: Duero River Basin Authority (Confederación Hidrográfica del Duero, CHD), 2013. River Órbigo Restoration Project.

Biophysical impacts of measures

Qualitative Scale
High
Medium
Low
Negative

		Mechanisms of Water Retention							*Biophysical Impacts Resulting from Water Retention*									
		Slowing and Storing Runoff				Reducing Runoff			Reducing		Soil		Creating Habitat			Climate Alteration		
		BP1	BP2	BP3	BP4	BP5	BP6	BP7	BP8	BP9	BP10	BP11	BP12	BP13	BP14	BP15	BP16	BP17
		Store runoff	Slow runoff	Store river water	Slow river water	Increase evapotranspiration	Increase infiltration and/or recharge	Increase soil water retention	Reduce Pollutant Sources	Intercept Pollution Pathways	Reduce Erosion and/or Sediment Delivery	Improve Soils	Create Aquatic Habitat	Create Riparian Habitat	Create Terrestrial Habitat	Enhance Precipitation	Reduce Peak Temperature	Absorb and/or Retain CO_2
A1	Meadows and Pastures																	
A2	Buffer Strips and Shelter Belts																	
A3	Crop Rotation																	
A4	Strip Cropping																	
A5	Intercropping																	
A6	No Tillage																	
A7	Reduced or Conservation Tillage																	
A8	Green Cover																	
A9	Early Sowing																	
A10	Traditional Terracing																	
A11	Controlled Traffic Farming																	
A12	Reduced Stocking Density																	
A13	Mulching																	
N1	Basins and Ponds																	
N2	Wetlands																	
N3	Floodplain Reconnection																	
N4	Re-Meandering																	
N5	Revitalisation of Flowing Waters																	
N6	Temporary Tributaries																	
N7	Hydraulic Annexes																	
N8	Riverbed - Alluvial Mattress																	
N9	Levelling of Dams and Longitudinal Barriers																	
N10	Natural Bank Stabilisation																	
N11	Elimination of Riverbank Protection																	
N12	Lake Restoration																	
N13	Aquifer Restoration																	
N14	Floodplain Restoration																	

Biophysical impacts of measures - continued

Qualitative Scale
High
Medium
Low
Negative

		Mechanisms of Water Retention							*Biophysical Impacts Resulting from Water Retention*									
		Slowing and Storing Runoff				Reducing Runoff			Reducing		Soil		Creating Habitat			Climate Alteration		
		BP1	BP2	BP3	BP4	BP5	BP6	BP7	BP8	BP9	BP10	BP11	BP12	BP13	BP14	BP15	BP16	BP17
		Store runoff	Slow runoff	Store river water	Slow river water	Increase evapotranspiration	Increase infiltration and/or recharge	Increase soil water retention	Reduce Pollutant Sources	Intercept Pollution Pathways	Reduce Erosion and/or Sediment Delivery	Improve Soils	Create Aquatic Habitat	Create Riparian Habitat	Create Terrestrial Habitat	Enhance Precipitation	Reduce Peak Temperature	Absorb and/or Retain CO_2
U1	Green Roofs																	
U2	Rainwater Harvesting																	
U3	Permeable Paving and other permeable surfaces																	
U4	Swales																	
U5	Channels and Rills																	
U6	Filter Strips																	
U7	Soakaways																	
U8	Infiltration Trenches																	
U9	Rain Gardens																	
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U12	Infiltration Basins																	
U13	Managed Aquifer Recharge																	
F1	Riparian Buffers																	
F2	Headwater Areas																	
F3	Reservoir Catchments																	
F4	Targeted Planting for Catching Precipitation																	
F5	Land Use Conversion																	
F6	Continuous Cover Forestry																	
F7	Water Sensitive Driving																	
F8	Appropriate Design of Roads and Stream Crossings																	
F9	Sediment Capture Ponds																	
F10	Coarse Woody Debris																	
F11	Urban Forest Parks																	
F12	Trees in Urban Areas																	
F13	Overland Flow Areas																	
F14	Peak Flow Control Structures																	

Contribution of measures to Ecosystem Services Benefits

		ES1	ES2	ES3	ES4	ES5	ES6	ES7	ES8	ES9	ES10	ES11	ES12	ES13	ES14
		Provisioning			Regulatory & Maintenance						Cultural		Abiotic		
		Water Storage	Fish Stocks and Recruiting	Natural Biomass Production	Biodiversity Preservation	Climate Change Adaptation and Mitigation	Groundwater/Aquifer Recharge	Flood Risk Reduction	Erosion/Sediment Control	Filtration of Pollutants	Recreational Opportunities	Aesthetic/Cultural Value	Navigation	Geological Resources	Energy Production
A1	Meadows and Pastures					M	M	H	H	M					
A2	Buffer Strips and Shelter Belts			L	L	M	M	H	H	H					
A3	Crop Rotation						M	L	L	M					
A4	Strip Cropping						M	M	H	M					
A5	Intercropping						M	M	H	M					
A6	No Tillage						M	L	L	M					
A7	Reduced or Conservation Tillage						M	L	L	L					
A8	Green Cover			L	L	M	M	H	H	H					
A9	Early Sowing					M	H	H	H	M					
A10	Traditional Terracing							M	H	M					
A11	Controlled Traffic Farming						L	M	M	M					
A12	Reduced Stocking Density						L	M	M	M					
A13	Mulching						M	M							
N1	Basins and Ponds	M		L	L		H	H	M	M	M	M			
N2	Wetlands	M	L	M	H		H	H	M	H	M	M			
N3	Floodplain Reconnection	M	L	M	H	L	H	H	H	H	M	M			
N4	Re-Meandering	L	L	H	H	M	M	H	M	H	L	L			
N5	Revitalisation of Flowing Waters	L	L	H	H	L	L	H	M	H	L	L			
N6	Temporary Tributaries	M	M	L	H		L	H	H	H	M	M			
N7	Hydraulic Annexes	M	M	L	H		L	H	H	H	M	M			
N8	Riverbed - Alluvial Mattress	L	L	H	H			M	H	H	L	L			
N9	Levelling of Dams and Longitudinal Barriers	M	M	H	H			M	M	H	M	M			
N10	Natural Bank Stabilisation	M	M	H	H			H	H	H	M	M			
N11	Elimination of Riverbank Protection	M	M	H	H			H	H	H	M	M			
N12	Lake Restoration	H	M	M	H	L	M	H	H	H	H	H			
N13	Aquifer Restoration	H	M		M		H	H	H	H	H	H			
N14	Floodplain Restoration	H	M	M	H		H	H	H	H	H	H			

Qualitative Scale	
	High
	Medium
	Low
	Negative

Contribution of measures to Ecosystem Services Benefits - continued

		ES1	ES2	ES3	ES4	ES5	ES6	ES7	ES8	ES9	ES10	ES11	ES12	ES13	ES14
		Provisioning			Regulatory & Maintenance						Cultural		Abiotic		
		Water Storage	Fish Stocks and Recruiting	Natural Biomass Production	Biodiversity Preservation	Climate Change Adaptation and Mitigation	Groundwater/Aquifer Recharge	Flood Risk Reduction	Erosion/Sediment Control	Filtration of Pollutants	Recreational Opportunities	Aesthetic/Cultural Value	Navigation	Geological Resources	Energy Production
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F8	Appropriate Design of Roads and Stream														
F9	Sediment Capture Ponds														
F10	Coarse Woody Debris														
F11	Urban Forest Parks														
F12	Trees in Urban Areas														
F13	Overland Flow Areas														
F14	Peak Flow Control Structures														

Qualitative Scale
High
Medium
Low
Negative

Contribution of measures to policy objectives

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
		Water Framework Directive								FD	HD & BD	2020 Biodiversity Strategy			
		Improving Status of Biology Quality Elements	Improving Status of Physico-Chemical Quality Elements	Improving Status of Hydromorphology Quality Elements	Improving Chemical Status & Priority Substances	Improved Quantitative Status	Improved Chemical Status	Prevent Surface Water Status Deterioration	Prevent Groundwater Status Deterioration	Take Adequate and Co-ordinated measures to reduce flood risks	Protection of Important Habitats	Better protection for ecosystems and more use of Green Infrastructure	More sustainable agriculture and forestry	Better management of fish stocks	Prevention of biodiversity loss
A1	Meadows and Pastures														
A2	Buffer Strips and Shelter Belts														
A3	Crop Rotation														
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Qualitative Scale
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Medium
Low
Negative

Contribution of measures to policy objectives - continued

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14
		Water Framework Directive								FD	HD & BD	2020 Biodiversity Strategy			
		Improving Status of Biology Quality Elements	Improving Status of Physico-Chemical Quality Elements	Improving Status of Hydromorphology Quality Elements	Improving Chemical Status & Priority Substances	Improved Quantitative Status	Improved Chemical Status	Prevent Surface Water Status Deterioration	Prevent Groundwater Status Deterioration	Take Adequate and Co-ordinated measures to reduce flood risks	Protection of Important Habitats	Better protection for ecosystems and more use of Green Infrastructure	More sustainable agriculture and forestry	Better management of fish stocks	Prevention of biodiversity loss
U1	Green Roofs									Low		Low			
U2	Rainwater Harvesting									Low					
U3	Permeable Paving and other permeable surfaces		Low		Low	Medium			Low	High		High			
U4	Swales		Low	Low	Low			Medium	Medium	High		High	Medium		Medium
U5	Channels and Rills		Low		Low										
U6	Filter Strips		Medium	Medium	Medium		Medium	High	Medium	High	Medium	High	High	Medium	High
U7	Soakaways					Medium		Medium	Medium	High		High	Medium		Medium
U8	Infiltration Trenches					Medium		Medium	Medium	High		High	Medium		Medium
U9	Rain Gardens		Medium		Medium	Medium	Medium	High	High	High	Medium	High	High	Medium	High
U10	Detention Basins	Low						High		High		High	High		High
U11	Retention Ponds	Medium						High		High		High	High	Medium	High
U12	Infiltration Basins	Low			Low	Medium		High	Medium	High		High	High		High
U13	Managed Aquifer Recharge					Medium			Medium	High		High			
F1	Riparian Buffers	High	Medium	Medium	Medium	Low	Medium	High	Medium	Low	High	High	High	High	High
F2	Headwater Areas	Medium		High				High		High		High	High		High
F3	Reservoir Catchments	Medium		High				High		High		High	High		High
F4	Targeted Planting for Catching Precipitation			Medium				Medium		High		High			
F5	Land Use Conversion	Medium		High				High		High		High	High		High
F6	Continuous Cover Forestry	Low		Medium				High		High		High	Medium		Medium
F7	Water Sensitive Driving	Medium		Medium				High		High		High	High	Medium	High
F8	Appropriate Design of Roads and Stream	Medium		Medium				High		Medium	Medium	High		High	Medium
F9	Sediment Capture Ponds	Medium		Medium				High		Medium	Medium	Medium		High	Medium
F10	Coarse Woody Debris	Low						Medium							
F11	Urban Forest Parks	Medium		Medium				High		High		High	High		High
F12	Trees in Urban Areas		Low	Medium				High		Medium		High	Medium		Medium
F13	Overland Flow Areas					Low			Low	Medium		Low			
F14	Peak Flow Control Structures									High		Low			

Qualitative Scale
High
Medium
Low
Negative

Why do NWRM hardly ever seem to be cost-effective…

… even when they are? (Ashton Eaton vs. Usain Bolt, a parable by Carlos M. Gómez, IMDEA)

Bottom line // a fair comparison between a specialist and a multipurpose measure should be based on more than one criterion.

Does a NWRM help if your baby is crying? Are NWRM to blame when the soup cools down?

- Catchment scale is of paramount importance – individual measures may have little effect; it is rather the cumulative effect of (a set of) measures that is relevant when factoring in economic benefits.
- Challenges: when it comes to assess not only the performance & effectiveness of NWRM but also their contribution to welfare, benefits are often widespread – quite often interventions in one place (i.e. upstream) may generate benefits elsewhere (i.e. downstream). Cost-effectiveness is a matter of choosing the right system boundaries rather than merely a monetary question.
- This also has implications in terms of relevant (direct & indirect) benefits: NWRM provide multiple benefits way beyond water retention. Water retention indeed is an ancillary benefit of measures (also) serving other purposes. If some benefits are overlooked, NWRM would not seem cost-effective (i.e. lack of incentives for engagement).
- Valuing benefits is a challenging issue – currently evidence on effectiveness mostly refers to design conditions, not actual performance (this is a main drawback for economic valuation).

The need to go beyond (financial) project appraisal

- Avoiding self-indulgence – NWRMs are good in themselves because they serve to restore aquatic ecosystems and thus the biophysical flows of ecosystems services they deliver.

Yet

- Self-evidence of advantages tends to ignore the opportunity cost of the resources implied and the existence of alternatives that may serve the same purpose.

- Besides its rationale for restoration (and emulation of natural functions) NWRM need to be judged against its potential contribution to other objectives as stated in the WFD, FD, EU 2020 Biodiversity Strategy, Climate Change Adaptation Strategy, CAP reform…).

- Properly designed and implemented NWRM represent opportunities that need to be adapted for the purposes of water management.

It's (almost) all about incentives

- Prevailing incentives favour the maintenance of the *status quo* (in semi-arid water scarce areas in the Mediterranean, incentives to retain water are weaker than in relatively water abundant areas).

- A NWRM might be rational from an overall cost-benefit perspective but still non-appealing for those in charge of implementing it. Voluntary acceptance, in forestry and agriculture, requires properly designed economic incentives - The CAP reform (CAP pillar 1: greening but also RDP) can be one example (more: ESIF // partnership agreements; CCA & DRR; R&TD and innovation funds; LIFE; EIB).

- If NWRM's benefits are not public goods (non-rival and non-excludable) how could beneficiaries pay for them?

- The cost-recovery issue: if in addition to water management, NWRM serve many other purposes how should these measures be financed?

- Can payment for environmental services be based upon public information and *ex-post* evaluation?

Example A // Financial appraisals and any single purpose could be enough to justify the adoption of many NWRM

The Belford Burn catchment [I]

- History of flooding (since 1877)
  - high cost
  - constricted channel (thus the lack of space for floodwalls and embankments),
  - relative low number of properties at risk, which does not meet the criteria for Grant-in Aid funding.
  - ➢ This means that besides purely financial reasons, there are technical elements that may favour alternative approaches.

- Traditional flood defences are not too suitable for Belford.
- A low-cost NWRM which harnesses the natural landscape to combat flooding is based on runoff attenuation measures (RAFs):
  - less costly (€0.25 million as compared to the €3m cost of building a floodwater storage reservoir)
  - cumulative benefits to all downstream flood sites.
- Evidence on the cost-effectiveness and flood protection levels of these NWRM as compared to conventional engineering solutions: Wilkinson and Quinn (2010) or Nicholson et al. (2012)

The Belford Burn catchment [II]

- It is difficult to get a very large amount of flood storage volume, but it is possible to attenuate flows and therefore affect the shape of hydrographs and flood damages.
- A major advantage of RAFs - flexibility:
  - ✓ a network of RAFs can be introduced to defend a town or a village from a flood of a certain return period and, if flood frequency and severity increases, additional features can be added to the system to increase protection levels;
  - ✓ if the aim is to alleviate high return period events, the offline diversion ponds could always be activated at a high river stage to ensure that they have not filled prior to the arrival of the main flood wave.

Upland RAFs on peat soils and grassland with shallow soils

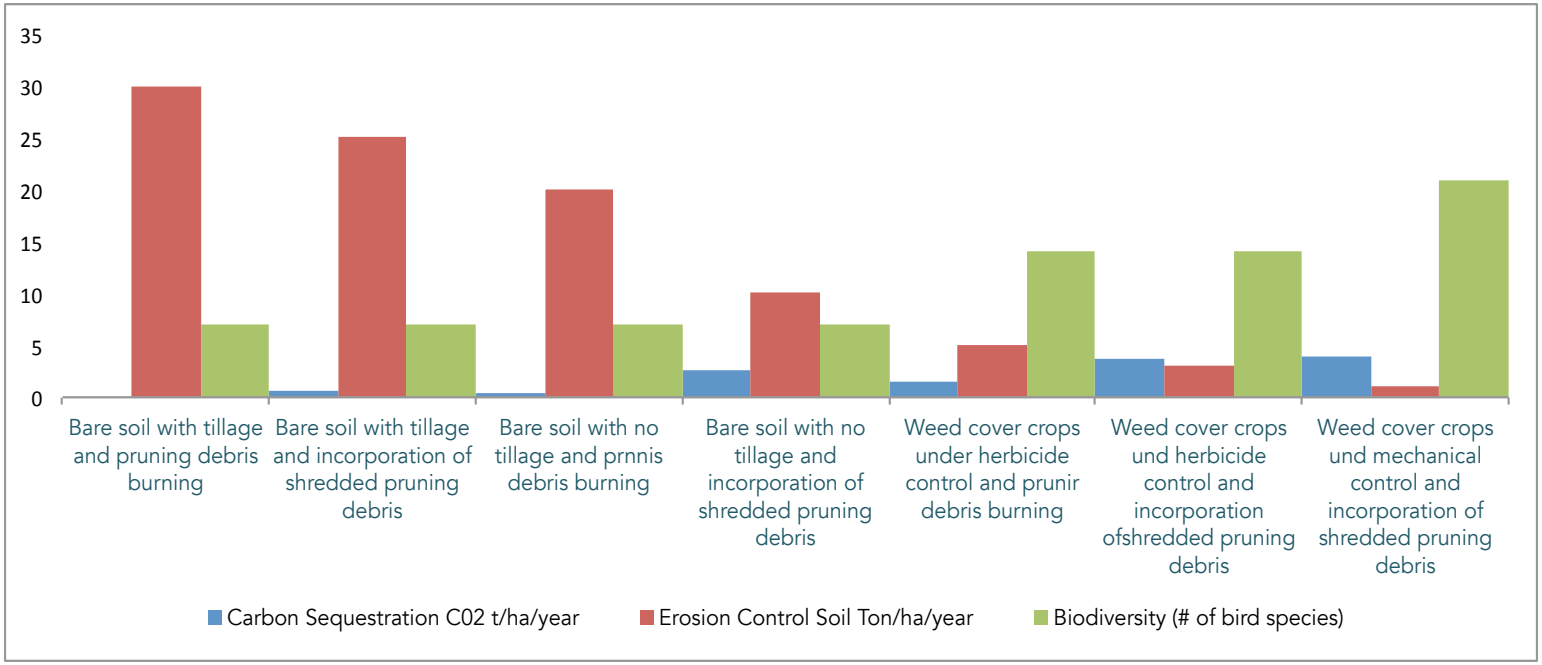

Belford proactive flood solutions


Belford proactive flood solutions


Belford proactive flood solutions

Example B // The multiple benefits of soil conservation practices in Europe (Panagiopoulos et al., 2011).

- When examining the impact of soil conservation practices on river loads one finds out an estimate of 20 tonnes or 8% annual decrease of TP (Total Phosphorus) against baseline.
- Filter strips in corn fields reduced annual sediments by 66 ktonnes or 5%, NO_3–N (nitrates–nitrogen) by 71 tonnes or 9.5% and TP by 27 tonnes or 10%, with an additional cost of 3.1 €/ton, 3.3 €/kg and 8.1 €/kg of each pollutant respectively.



Please, bear trade-offs in mind

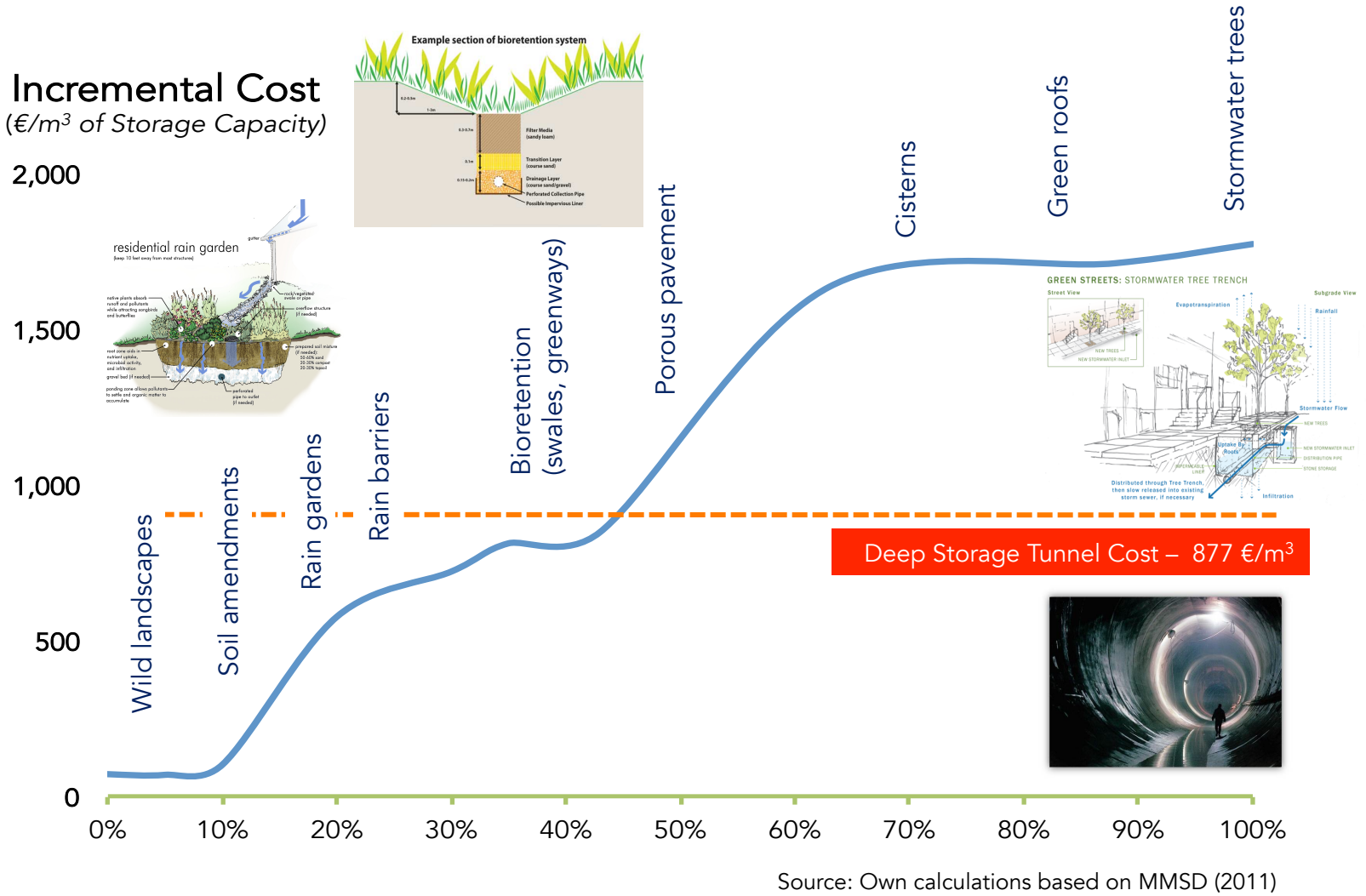
(critical from an economic viewpoint)

3.4 Crop practices Change in [%] from the baseline 2030 scenario For water stress change in [days per year] from				
	Fast flow [%]	Evapotrans. [%]	Groundw. recharge [%]	Water stress [d per year]
N. Scandinavia	0.0	0.0	0.0	-0.1
S. Scandinavia	-0.3	0.1	0.0	-0.5
Baltic	-1.1	0.4	-0.8	-1.4
Denmark/N.Germany	-2.5	1.0	-1.9	-3.0
Odra/Vistula	-1.1	0.6	-2.1	-2.0
Elbe to Ems	-1.2	0.7	-1.4	-2.0
Rhein to Schelde	-0.9	0.6	-0.5	-2.0
GB	-0.9	0.5	-0.7	-1.2
Irland/N.Ireland	-0.3	0.2	0.0	-0.9
France Atlantic	-2.2	1.0	-1.6	-2.6
Danube	-1.9	0.8	-2.4	-1.8
Iberia Atlantic	-1.1	0.7	-1.1	-0.9
Iberia Mediterranean	-1.4	0.6	-1.7	-0.7
France Mediterranean	-0.5	0.3	-0.3	-1.0
Po	-1.2	0.7	-0.8	-1.8
Corsica	-0.2	0.1	0.0	-0.5
Sardinia	-1.5	0.7	-0.6	-1.2
Sicily	-3.4	1.3	-2.5	-2.3
South Italy	-1.7	0.9	-0.7	-1.8
Adige/Balkan	-0.5	0.4	-0.1	-1.2
Greece/Evros	-1.8	0.8	-1.4	-0.9

1.2 Afforestation in mountainous areas Change in [%] from the baseline 2030 scenario For water stress change in [days per year] from				
Region	Fast flow [%]	Evapotrans. [%]	Groundw. recharge [%]	Water stress [d per year]
N. Scandinavia	-0.2	0.0	-0.1	1.0
S. Scandinavia	-0.5	0.2	-0.2	0.4
Baltic	-0.5	0.2	-0.6	0.6
Denmark/N.Germany	0.2	0.0	-1.3	0.4
Odra/Vistula	-0.1	0.1	-0.3	0.6
Elbe to Ems	-1.1	0.4	-0.9	0.4
Rhein to Schelde	0.0	0.0	-0.2	0.6
GB	0.4	-0.5	0.0	0.6
Irland/N.Ireland	1.5	-0.8	0.1	0.6
France Atlantic	-0.3	0.2	-0.4	0.3
Danube	-0.3	0.2	-0.4	1.2
Iberia Atlantic	-0.1	0.1	-0.3	0.4
Iberia Mediterranean	-0.4	0.2	-0.3	0.3
France Mediterranean	-1.0	1.3	-0.3	0.5
Po	0.0	0.1	-0.1	0.7
Corsica	0.9	-1.0	-0.1	2.2
Sardinia	1.2	-0.5	0.1	2.0
Sicily	0.3	-0.1	0.0	0.6
South Italy	-0.2	0.3	-0.3	0.8
Adige/Balkan	0.0	0.1	0.0	0.3
Greece/Evros	-0.2	0.1	-0.1	0.4

Source. JRC (2012) Evaluation of the effectiveness of Natural Water Retention Measures: Support to the EU Blueprint. to Safeguard Europe's Waters

Sometimes cost-effectiveness advantages of NWRM on financial grounds are clear…



Source: Own calculations based on MMSD (2011)

…but just enough to pick the low-hanging fruit?

Traditional cost-effectiveness analysis uses only one environmental benefit (7) and just one economic criterion (2).

Economic Benefits
1 Green Job Opportunities
2 Reduced infrastructure Cost
3 Reduced Pumping and Treatment Cost
4 Increased Property values

Social Benefits
5 Improved quality of life and aesthetics
6 Improved Green Space

Environmental Benefits
7 Captured stormwater runoff
8 Reduced pollutant loads
9 Increased Groundwater recharge
10 Reduced Carbon Emissions
11 Reduced Energy Use for Cooling
12 Improved Air Quality

And then it ignores 10 of the 12 benefits of any sustainable urban drainage system.

Thank you!