"Water Ecosystem Services, and restoration techniques"

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3rd MEDITERRANEAN WATER FORUM
Mediterranean regional process for the 8th World Water Forum
January 23rd, 2018
Marriott Hotel, Cairo, EGYPT

WATER IS LIFE!

…and humans are both a PART of ecosystems and a TENANT on them.

So, WHY SHOULD ECOSYSTEMS BE A TOP PRIORITY IN WATER MANAGEMENT ALL OVER THE WORLD?


1.WATER ECOSYSTEM SERVICES
2.RESTORATION TECHNIQUES
3.CONCLUSIONS

1.WATER ECOSYSTEM SERVICES

2.RESTORATION TECHNIQUES

3.CONCLUSIONS

1.WATER ECOSYSTEM SERVICES

What is an **Ecosystem Service**?

*"Benefits that humans derive from ecosystem functions"**

Features of Ecosystem Services:

- They are **free**!
- **Dynamic**, easy to maintain
- Different time and spatial **scales**
- **Resilient**, yet **vulnerable** to impacts
- Part of **complex** ecosystem processes.

* The handbook for management and restoration of aquatic ecosystem in river and lake basins, INBO, 2015.

1.WATER ECOSYSTEM SERVICES

Types of **Ecosystem Services:**

Several alternative, similar classifications:

- The Economics of Ecosystems and Biodiversity (**TEEB**)
- Common International Classification of Ecosystem Services (**CICES**)
- Millennium Assessment

European Environment Agency

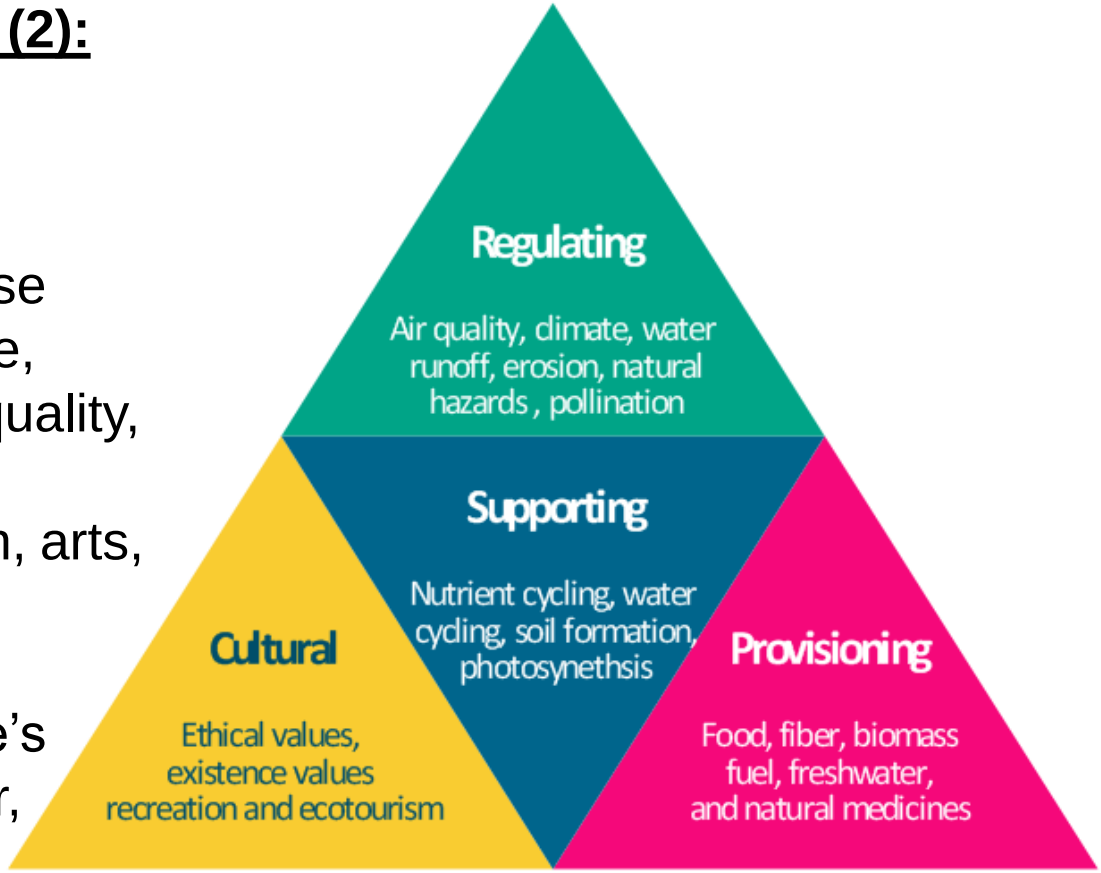
Evaluación de los ecosistemas del milenio de España - EME -
EVALUACIÓN DE ECOSISTEMAS DEL MILENIO DE ESPAÑA

1.WATER ECOSYSTEM SERVICES

Types of **Ecosystem Services (2):**

General categories:

- **Provisioning** services: they generate products we can use
- **Regulatory** services: climate, floods and droughts, water quality, erosion…
- **Cultural** services: recreation, arts, science&education, cultural heritage…
- **Supporting** services: nature's cycles (energy, matter, water, nutrients…)



* Picture: www.earthwiseaware.org

1.WATER ECOSYSTEM SERVICES

Ecosystem services provided by wetlands:

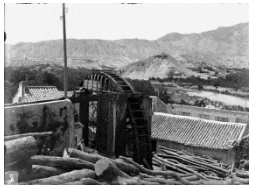
1. Shore protection
2. Soil retention
3. Flood protection
4. Water supply
5. Water quality
6. Carbon sequestration
7. Produces: fisheries, game, foraging
8. Tourism, recreation, research
9. Cultural , spiritual, heritage values











1.WATER ECOSYSTEM SERVICES

Types of **Ecosystem Services (3). CICES:**

Provisioning (Abiotic)	Water	Surface water used for nutrition, materials or energy	Surface water for drinking	4.2.1.1	By amount, type, source	Surface water for drinking	1.1.2.1
Provisioning (Abiotic)	Water	Surface water used for nutrition, materials or energy	Surface water used as a material (non-drinking purposes)	4.2.1.2	By amount & source	Surface water for non-drinking purposes	1.2.2.1
Provisioning (Abiotic)	Water	Surface water used for nutrition, materials or energy	Freshwater surface water used as an energy source	4.2.1.3	By amount, type, source	Not recognised in V4.3	N/A
Provisioning (Abiotic)	Water	Surface water used for nutrition, materials or energy	Coastal and marine water used as an energy source	4.2.1.4	By amount, type, source	Not recognised in V4.3	N/A
Provisioning (Abiotic)	Water	Ground water for used for nutrition, materials or energy	Ground (and subsurface) water for drinking	4.2.2.1	By amount, type, source	Ground water for drinking	1.1.2.2
Provisioning (Abiotic)	Water	Ground water for used for nutrition, materials or energy	Ground water (and subsurface) used as a material (non-drinking purposes)	4.2.2.2	By amount & source	Ground water as source of energy	1.2.2.2
Provisioning (Abiotic)	Water	Ground water for used for nutrition, materials or energy	Ground water (and subsurface) used as an energy source	4.2.2.3	By amount & source	Ground water for non-drinking purposes	N/A
Provisioning (Abiotic)	Water	Other aqueous ecosystem outputs	Other	4.2.X.X	Use nested codes to allocate other provisioning services from multiple systems to appropriate Groups and Classes	Not recognised in V4.3	N/A
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Water conditions	Regulation of the chemical condition of freshwaters by living processes	2.2.5.1	By type of living system	Chemical condition of freshwaters	2.3.1.1
Regulation & Maintenance (Biotic)	Regulation of physical, chemical, biological conditions	Water conditions	Regulation of the chemical condition of salt waters by living processes	2.2.5.2	By type of living system	Chemical condition of salt waters	2.3.1.2
Cultural (Biotic)	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Physical and experiential interactions with natural environment	Characteristics of living systems that that enable activities promoting health, recuperation or enjoyment through active or immersive interactions	3.1.1.1	By type of living system or environmental setting	Experiential use of plants, animals and land-/seascapes in different environmental settings	3.1.1.1
Cultural (Biotic)	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Physical and experiential interactions with natural environment	Characteristics of living systems that enable activities promoting health, recuperation or enjoyment through passive or observational interactions	3.1.1.2	By type of living system or environmental setting	Physical use of land-/seascapes in different environmental settings	3.1.1.2
Cultural (Biotic)	Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Intellectual and representative interactions with natural environment	Characteristics of living systems that enable scientific investigation or the creation of traditional ecological knowledge	3.1.2.1	By type of living system or environmental setting	Scientific	3.1.2.1

All of this services can be appraised and we can put a price tag on them. Their value is much higher than the cost of maintaining – restoring - enhancing them.

Bottom line: IF WE TAKE CARE OF ECOSYSTEMS WE GET BACK A LOT MORE THAN WHAT WE INVESTED!!!!!

1.WATER ECOSYSTEM SERVICES

2.RESTORATION TECHNIQUES

Picture: Can Cabanyes artificial wetland. Congost River, SPAIN

2. RESTORATION TECHNIQUES

Basic concepts & misconceptions

- **<u>Restoration</u>**: to restore the ecosystem to its natural status and functioning (!)

Other:
- Rehabilitation
- Remediation
- Enhancement
- Mitigation
- Amelioration
- Decontamination
- (…)


Órbigo river before the works


Works recently completed


After six months

2. RESTORATION TECHNIQUES

Basic premise:
IF POSSIBLE, REMOVE THE SOURCE(S) OF ALTERATION(S),
such as:

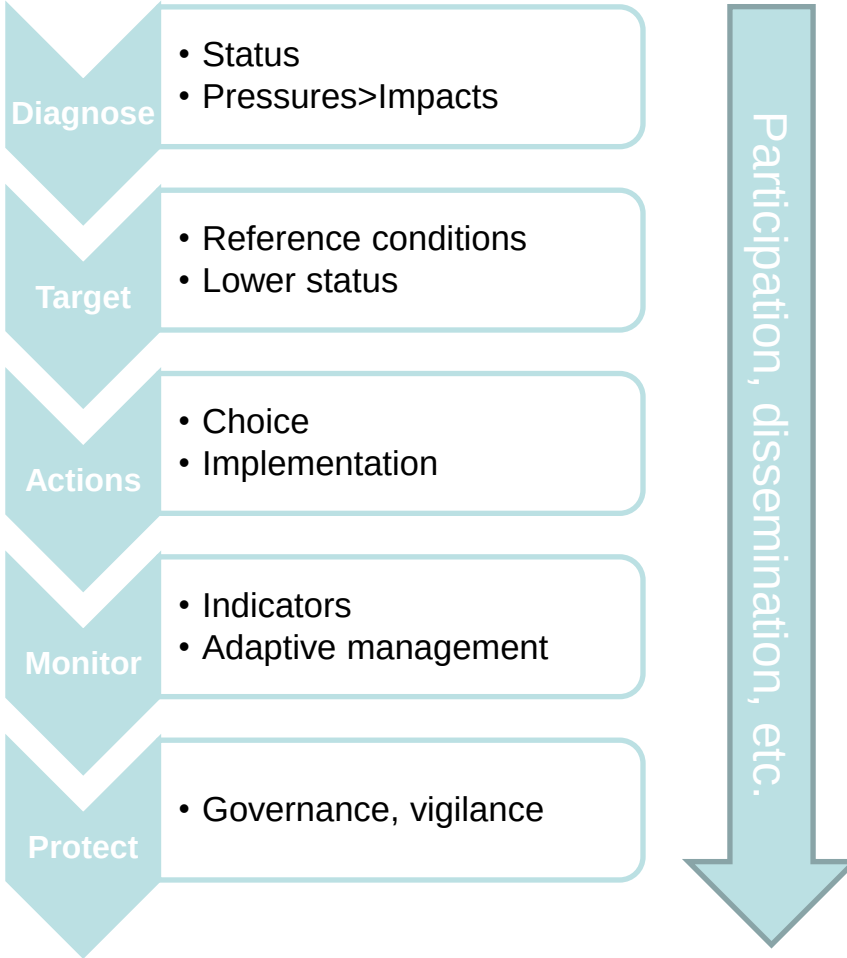
- **Biological** changes: INVASIVE ALIEN SPECIES
- **Hydromorphological** changes: structure and dynamism
- **Hydrological** changes: abstraction, water regime
- **Pollution**: nutrients, metals, POCs, temperature changes, noise…

2. RESTORATION TECHNIQUES

Basic stages:

- **Diagnose** the status of your system
- Stablish the **target** for your project:
  - Restoration: reference status
  - Enhancement: lower status
- Choose **actions** to be carried out accordingly. Implement
- Monitor via adequate **indicators**, to asses success
- **Protect,** in order to preserve new status

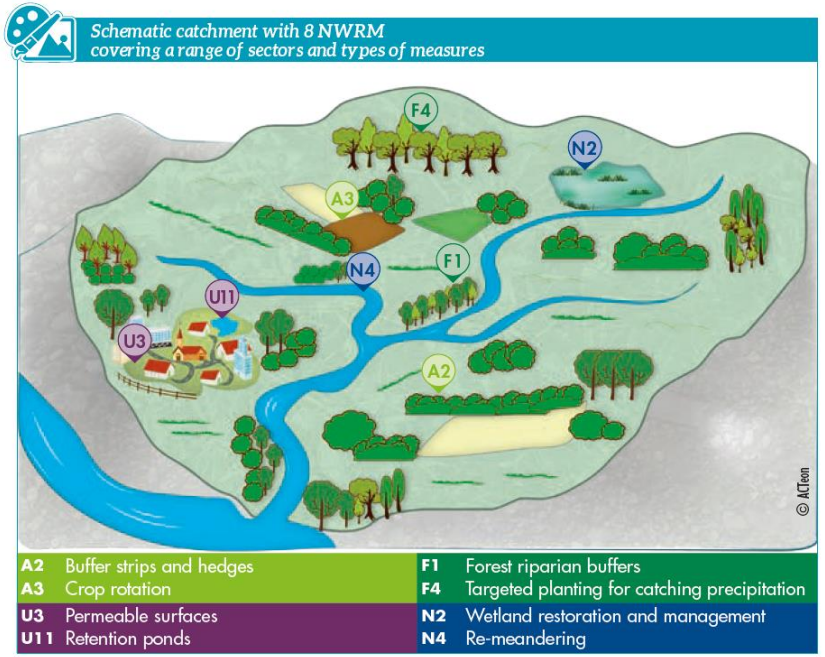
All throughout: dissemination, participation, networking, monitoring and adaptive management.



2. RESTORATION TECHNIQUES

- Examples (some are multi-purpose):
  - Dam removal. Water flow regime naturalization. Environmental flows. Artificial flash floods. Sediment flushing. Fish passages. Friendly infrastructures…
  - Remeandering, reconnecting riverbeds
  - Water quality: WWTP, bioremoval, artificial wetlands, Green filters, buffer strips, riparian forest plantations…

- Cross-cutting labels:
  - Green infrastructure
  - NWRM



Source: P.Strosser, G.Delacámara, A.Hanus, H.Williams and N.Jaritt. 2015. A guide to support the selection, design and implementation of Natural Water Retention Measures in Europe - Capturing the multiple benefits of nature-based solutions. Final version, April 2015.

2. RESTORATION TECHNIQUES

- Weir removal.

San Marcos Weir, Bernesga River, León, SPAIN

2. RESTORATION TECHNIQUES

- Dam removal.

Demolition of the Umbrías dam (Aravalle river, Duero Basin, Ávila-Spain)

2. RESTORATION TECHNIQUES

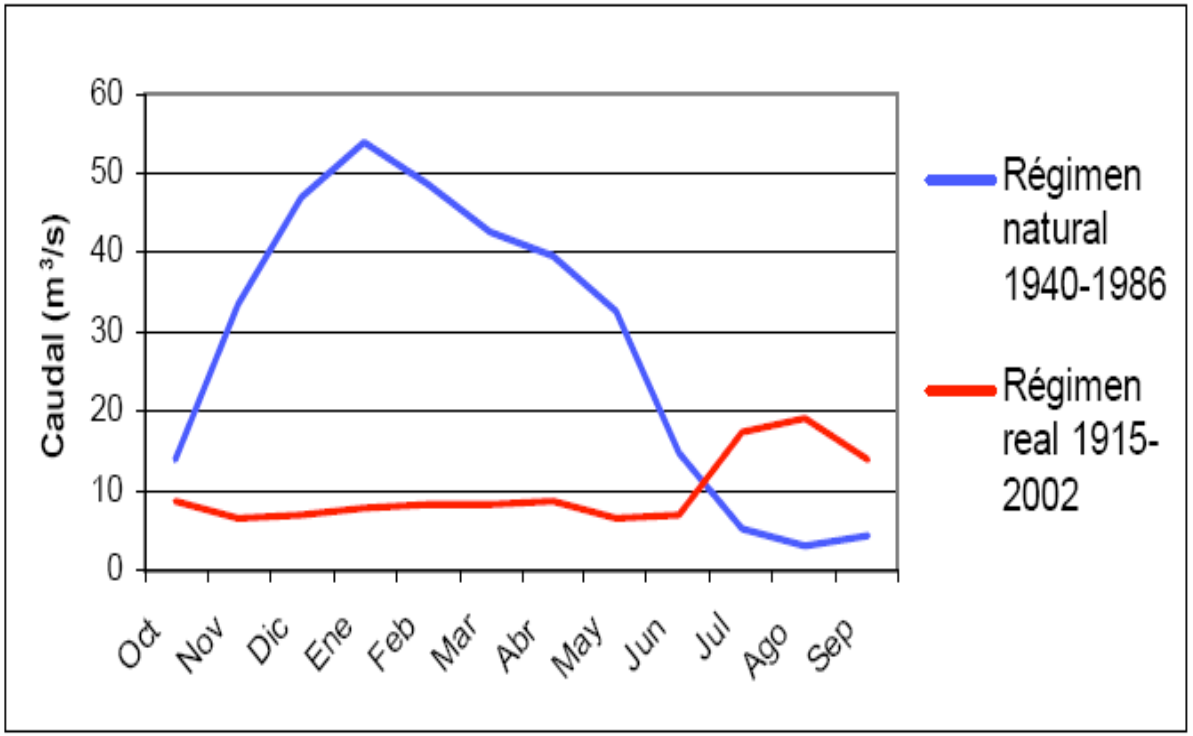
Fish passages, Several examples

Pictures: **LIFE+12/ENV/ES/1140 "SEGURA RIVERLINK"**
Project co-funded with the aid of EU's LIFE+ financial instrument

SEGURA RIVERLINK
FRANQUEO FLUVIAL

2. RESTORATION TECHNIQUES

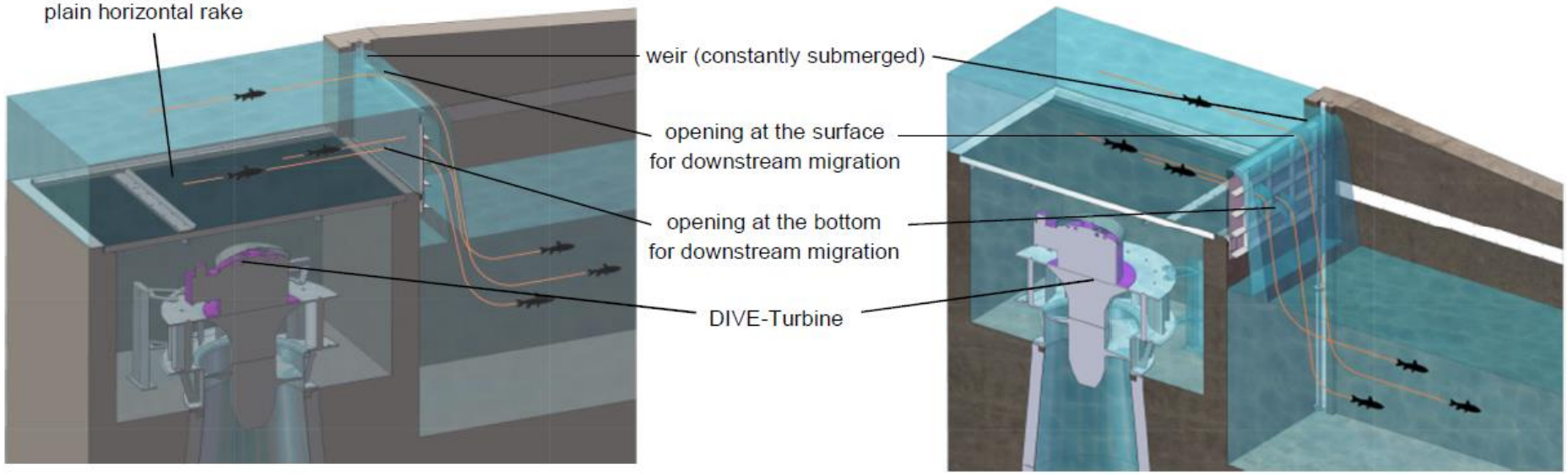
- Environmental Waterflow regime. Ebro River, comparison between natural and artificial yearly water flows.
- Environmental regime to encompass: Maximum flow; Minimum flow; Rate of variation; artificial flash floods or “generative flows”



2. RESTORATION TECHNIQUES

- Fish-friendly hydropower turbines.

Source: **DIVE Turbinen GmbH & Co. KG**



2. RESTORATION TECHNIQUES

- Remeandering/reconnecting riverbeds

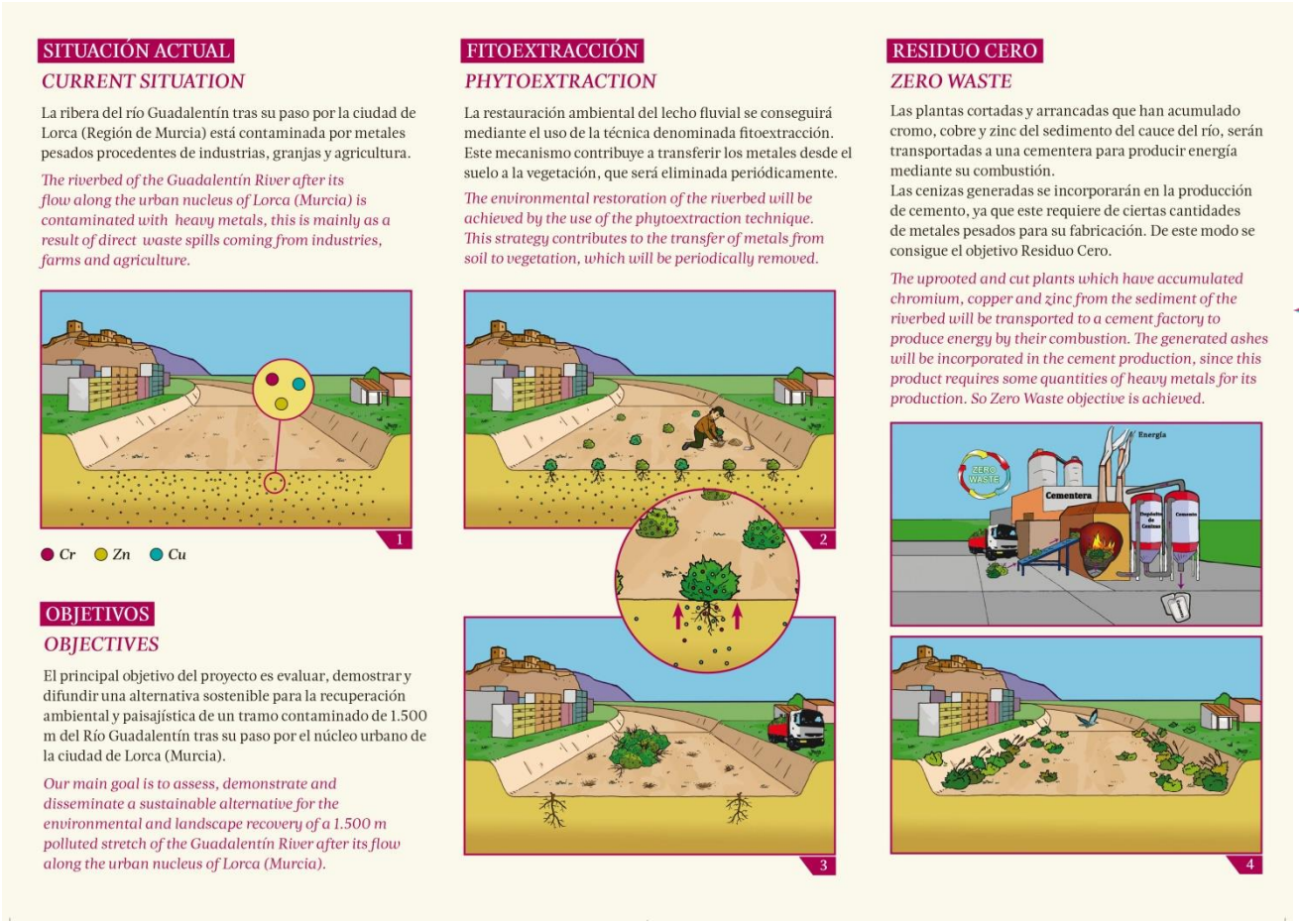
Abandoned riverbed restoration.
Riosequillo, Belver de los Montes,
Zamora, SPAIN

2. RESTORATION TECHNIQUES

- Wastewater Treatment Plants.

2. RESTORATION TECHNIQUES

- Bio removal.



Picture: **LIFE11 ENV/ES/000506 "RIVERPHY"**
Project co-funded with the aid of EU's LIFE+ financial instrument

RiverPhy LORCA | Life | NATURA 2000

2. RESTORATION TECHNIQUES

- Artificial wetlands: the “Tancat de la Pipa”, adjacent to “Albufera de Valencia”

2. RESTORATION TECHNIQUES

- Green Filters.



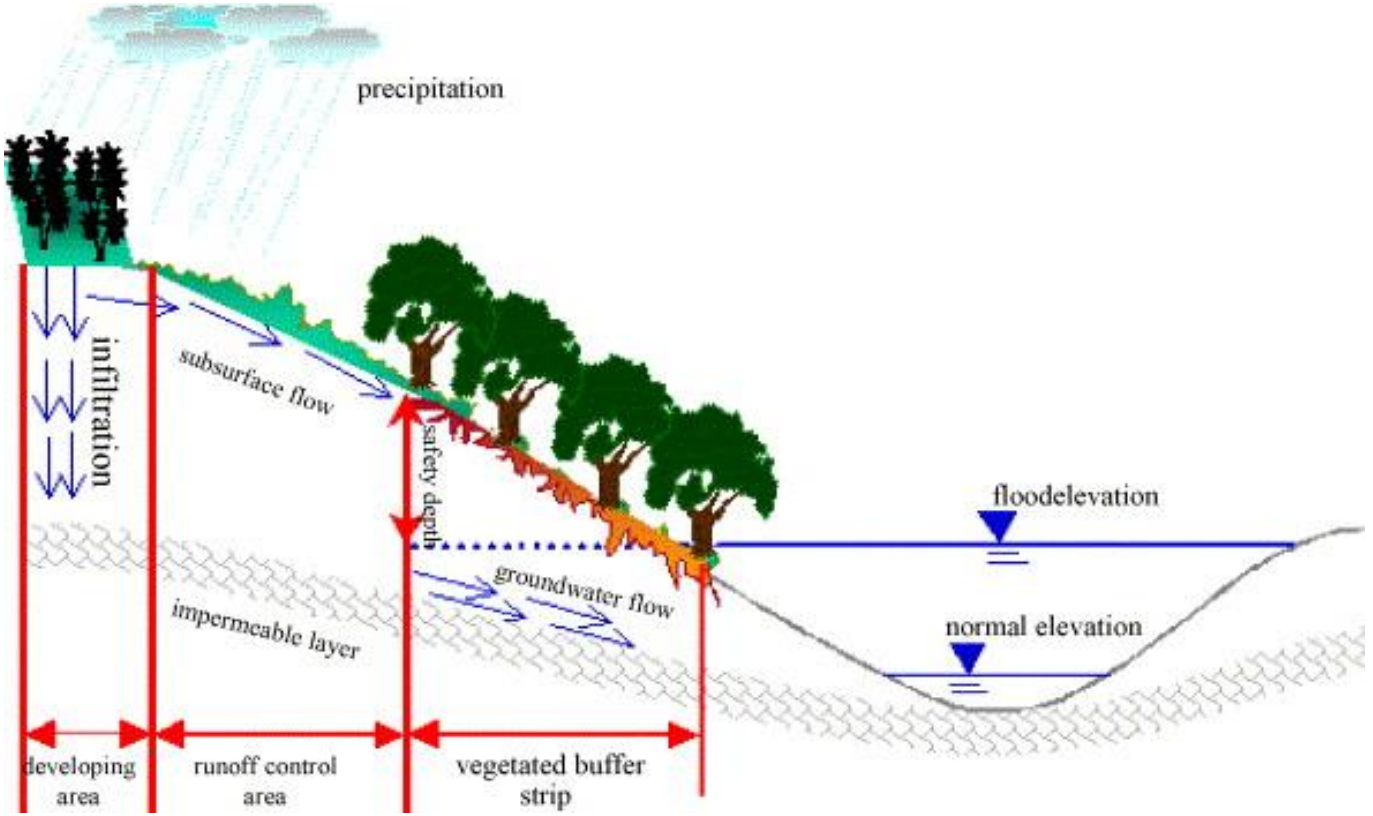






2. RESTORATION TECHNIQUES

- Buffer strips.



Picture: www.sciencedirect.com

2. RESTORATION TECHNIQUES

- Riparian forest plantation.

Picture: **LIFE+13/BIO/ES/1407 "RIPISILVANATURA"**
Project co-funded with the aid of EU's LIFE+ financial instrument

2. RESTORATION TECHNIQUES

- Green infrastructure.

The GI approach refers to the natural or semi-natural systems that provide services for water resources management with equivalent or similar benefits to conventional (built) "grey" water infrastructure.

Source:
UNEP. "Green Infrastructure Guide for Water Management: Ecosystem-based management approaches for water-related infrastructure projects"

Table 1 Green Infrastructure solutions for water resources management

Water management issue (Primary service to be provided)		Green Infrastructure solution	Location: Watershed	Location: Floodplain	Location: Urban	Location: Coastal	Corresponding Grey Infrastructure solution (at the primary service level)
Water supply regulation (incl. drought mitigation)		Re/afforestation and forest conservation	■				Dams and groundwater pumping Water distribution systems
		Reconnecting rivers to floodplains		■			
		Wetlands restoration/conservation	■	■	■		
		Constructing wetlands	■	■	■		
		Water harvesting*	■	■	■		
		Green spaces (bioretention and infiltration)			■		
		Permeable pavements*			■		
Water quality regulation	Water purification	Re/afforestation and forest conservation	■				Water treatment plant
		Riparian buffers		■			
		Reconnecting rivers to floodplains		■			
		Wetlands restoration/conservation	■	■	■		
		Constructing wetlands	■	■	■		
		Green spaces (bioretention and infiltration)			■		
		Permeable pavements*			■		
	Erosion control	Re/afforestation and forest conservation	■				Reinforcement of slopes
		Riparian buffers		■			
		Reconnecting rivers to floodplains		■			
	Biological control	Re/afforestation and forest conservation	■				Water treatment plant
		Riparian buffers		■			
		Reconnecting rivers to floodplains		■			
		Wetlands restoration/conservation	■	■	■		
		Constructing wetlands	■	■	■		
	Water temperature control	Re/afforestation and forest conservation	■				Dams
		Riparian buffers		■			
		Reconnecting rivers to floodplains		■			
		Wetlands restoration/conservation	■	■	■		
		Constructing wetlands	■	■	■		
		Green spaces (shading of water ways)			■		
Moderation of extreme events (floods)	Riverine flood control	Re/afforestation and forest conservation	■				Dams and levees
		Riparian buffers		■			
		Reconnecting rivers to floodplains		■			
		Wetlands restoration/conservation	■	■	■		
		Constructing wetlands	■	■	■		
		Establishing flood bypasses		■			
	Urban stormwater runoff	Green roofs			■		Urban stormwater infrastructure
		Green spaces (bioretention and infiltration)			■		
		Water harvesting*	■	■	■		
		Permeable pavements*			■		
	Coastal flood (storm) control	Protecting/restoring mangroves, coastal marshes and dunes				■	Sea walls
		Protecting/restoring reefs (coral/oyster)				■	

2. RESTORATION TECHNIQUES

- NWRM

"Natural Water Retention Measures or NWRM are measures with the primary function of enhancing and/or restoring the retention capacity of natural and manmade soil and aquatic ecosystems.

As a result, they deliver a range of services and multiple benefits to people while contributing to the achievement of the objectives of different environmental strategies and policies."

Box 12: Set of Natural Water Retention Measures

Agriculture area		Urban area		Aquatic environment		Forest area	
A1	Meadows and Pastures	U1	Green roofs	N1	Basins and ponds	E1	Forest riparian buffers
A2	Buffer strips and hedges	U2	Rainwater harvesting	N2	Wetland restoration and management	E2	Maintenance of forest cover in headwater areas
A3	Crop rotation	U3	Rainwater harvesting	N3	Floodplain restoration and management	E3	Afforestation of reservoir catchments
A4	Strip cropping along contours	U4	Swales	N4	Re-meandering	E4	Targeted planting for "catching" precipitation
A5	Intercropping	U5	Channels and rills	N5	Stream bed re-naturalization	E5	Land use conversion
A6	No till agriculture	U6	Filter strips	N6	Restoration and reconnection of seasonal streams	E6	Continuous cover forestry
A7	Low till agriculture	U7	Soakaways	N7	Reconnection of oxbow lakes and similar features	E7	"Water sensitive" driving
A8	Green cover	U8	Infiltration trenches	N8	Riverbed material renaturalization	E8	Appropriate design of roads and stream crossings
A9	Early sowing	U9	Rain gardens	N9	Removal of dams and other longitudinal barriers	E9	Sediment capture ponds
A10	Early sowing	U10	Detention basins	N10	Natural bank stabilisation	E10	Coarse woody debris
A11	Controlled traffic farming	U11	Retention ponds	N11	Elimination of riverbank protection	E11	Urban forest parks
A12	Reduced stocking density	U12	Infiltration basins	N12	Lake restoration	E12	Trees in urban areas
A13	Mulching			N13	Restoration of natural infiltration to groundwater	E13	Peak flow control structures
				N14	Re-naturalisation of polder areas	E14	Overland flow areas

Source: P.Strosser, G.Delacámara, A.Hanus, H.Williams and N.Jaritt. 2015. A guide to support the selection, design and implementation of Natural Water Retention Measures in Europe - Capturing the multiple benefits of nature-based solutions. Final version, April 2015.

3. CONCLUSIONS

- Wetlands provide numerous Ecosystem Services.
- Economic value of ecosystem services >> cost of restoration.
- Maintaining ecosystem services << costs of “grey infrastructure”.
- Several restoration techniques available.
- 1st step: good diagnosis.
- If possible, remove impacts/pressures.
- **ECOSYSTEMS: KEY IN PROVIDING QUALITY WATER FOR MANKIND**

RELEVANT MATERIALS AND BIBLIOGRAPHY

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https://www.ramsar.org/sites/default/files/documents/library/bn7e_0.pdf
- INBO: "The handbook for management and restoration of aquatic ecosystems in river and lake basins". March 2015.
http://www.inbo-news.org/riob/publications-et-documents/article/the-handbook-for-management-and-4201
- Protocols for improving the success of hydromophological restoration measures:
www.Reformrivers.eu
- Catalogue of river restoration case studies:
www.Restorerivers.eu
- EU Commission work on Natural Water Retention Measures:
www.Nwrm.eu
- UNEP. Green Infrastructure Guide for Water Management
http://www.unepdhi.org/-/media/microsite_unepdhi/publications/documents/unep/web-unep-dhigroup-green-infrastructure-guide-en-20140814.pdf

THANKS FOR YOUR ATTENTION!

CIREF
centro ibérico de restauración fluvial

http://www.cirefluvial.com/

Iberian Center for River Restoration

More:

www.chsegura.es

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