Case Study

NBS for diffuse pollution control in Venice lagoon

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Table of content

I. Basic Information

Application ID				
Application Name	**Nature-based solutions for climate change adaptation and water pollution in agricultural regions.** **Lot 5: LDP in a continental environment**			
Application Location	Country:	Italy	Country 2:	
	NUTS2 Code			
	River Basin District Code			
	WFD Water Body Code			
	Description		The project is located in the two sub-basins of Marzenego and Dese-Zero, included in the plain of Venice Lagoon (Veneto Region)	
Application Site Coordinates *(in ETRS89 or WGS84 the coordinate system)*	Latitude:		Longitude:	
Target Sector(s)	Primary:	Agriculture		
	Secondary:			
Implemented NWRM(s)	Measure #1:	in-line wetland		
	Measure #2:	off - line wetland		
	Measure #3:	buffer strip		
	Measure #4:	woody buffer area		
Application short description	The area of the Venice Lagoon plain is easily subject to eutrophication because of the agricultural activities located in the area. This case study aims to investigate how Nature-based solutions (NBS) may contribute to reduce water pollution (main benefits) at sub-basin scale by retaining and processing diffuse pollutants generated by farming practices (Nitrogen, Phosphorus, sediments and pesticides) while delivering, at the same time, other benefits (Side Benefits) beyond water pollution control, such as shelters for biodiversity, amenity and recreational opportunities. 4 NBS have been investigated in this study: two wetlands (the Scolo Rusteghin site and the Salzano site), one buffer strip (Scandolara site), one woody buffer (NICOLAS site). The aim is to obtain the information necessary to upscale and estimate their environmental, social and economic benefits and costs on a sub-basin scale. The outcomes of the study showed that: NBS are effective in removing the nutrients and contaminants from diffuse pollution, displaying efficiencies in line with the scientific literature; NBS provide a high added value for the community every year; NBS need reasonable construction and O&M costs while providing several important benefits.			

II. Policy context and design targets

<table>
<tr><td>Brief description of the problem to be tackled</td><td colspan="3"></td></tr>
<tr><td rowspan="4">What were the primary & secondary targets when designing this application?</td><td>Primary target #1:</td><td colspan="2">Reducing water pollution from agricultural runoff</td></tr>
<tr><td>Secondary target #1:</td><td colspan="2">Flood control and flood risk mitigation</td></tr>
<tr><td>Secondary target #2:</td><td colspan="2">Water body ecological restoration</td></tr>
<tr><td>Remarks</td><td colspan="2">All the 4 implemented NBS are designed to achieve water purification with the broader perspective of water bodies ecological restoration, also in aesthetic terms through extensive interventions</td></tr>
<tr><td rowspan="3">Which specific types of pressures did you aim at mitigating?</td><td>Pressure #1:</td><td>Water pollution from agricultural runoff</td><td>Nitrogen/Phosphorous</td></tr>
<tr><td>Pressure #2:</td><td></td><td></td></tr>
<tr><td>Remarks</td><td colspan="2"></td></tr>
<tr><td rowspan="5">Which specific types of adverse impacts did you aim at mitigating?</td><td>Impact #1:</td><td>Water pollution from agricultural runoff</td><td>Nitrogen/Phosphorous</td></tr>
<tr><td>Impact #2:</td><td></td><td></td></tr>
<tr><td>Impact #3:</td><td></td><td></td></tr>
<tr><td>Impact #4:</td><td></td><td></td></tr>
<tr><td>Remarks</td><td colspan="2"></td></tr>
<tr><td rowspan="4">Which EU requirements and EU Directives were aimed at being addressed?</td><td>Requirement #1:</td><td></td><td></td></tr>
<tr><td>Requirement #2:</td><td></td><td></td></tr>
<tr><td>Requirement #3:</td><td></td><td></td></tr>
<tr><td>Remarks</td><td colspan="2"></td></tr>
</table>

Which national and/or regional policy challenges and/or requirements aimed to be addressed?	The project targets are in line with the Regional Director Plan approved by the Veneto Regional Council (Resolution n. 24/2000 of 1st March 2000)

III. Site characteristics

Dominant Land Use type(s)	Dominant land use	Agricultural use
	Secondary land use	
	Other important land use	
	Remarks	
Climate zone	temperate sub-continental	
Soil type		
Average Slope		
Mean Annual Rainfall	600 - 1100 mm	
Mean Annual Runoff		
Average Runoff coefficient (or % imperviousness on site)		
	Remarks	
Characterization of water quality status (prior to the implementation of the NWRMs)	There is no detailed information available about the water quality status prior to the implementation of the NWRM.	
Comment on any specific site characteristic that influences the effectiveness of the applied NWRM(s) in a positive or negative way	*Positive way:*	
	Negative way:	

IV. Design & implementation parameters

Project scale	Medium (eg. public park, new development district)	*Medium scale project involving two sub-basins (Marzenego and Dese-Zero), for a total surface of 37.785 hectares.*
Time frame	Date of installation/construction	Rusteghin wetland: 2014 Salzano wetland: 2004 Scandolara buffer strip: 2007 NICOLAS: 1997-2000
	Expected average lifespan (life expectancy) of the application in years	The lifespan of the NBS is expected to be in the range of decades (around 50 years)
Responsible authority and other stakeholders involved	*Name of responsible authority/ stakeholder*	*Role, responsibilities*
	1. Acque Risorgive drainage authority	Management Authority in charge of the NBS development and recipient of public funds for its realization
	2. Famers associations (Coldiretti, Confagricoltura, etc.)	Landowners. The drainage authority coordinates with farmers to plan the expropriations of the land where NBS are constructed.

<table>
<tr><td>The application was initiated and financed by</td><td colspan="3">The NBS were financed by the Veneto Region. The funds were used by Acque Risorgive drainage authority to implements the NBS.
The construction of the 4 NBS occurred in: 2014 (Rusteghin wetland); 2004 (Salzano wetland); 2007 (Scandolara buffer strip); 1997-2000 (NICOLAS)</td></tr>
<tr><td>What were specific principles that were followed in the design of this application?</td><td colspan="3">Achieving water purification with the broader perspective of water bodies ecological restoration, also in aesthetic terms through extensive interventions</td></tr>
<tr><td rowspan="2">Area (ha)</td><td colspan="2">Number of hectares treated by the NWRM(s).</td><td>29.46 ha (Effective area of the 4 NBS)</td></tr>
<tr><td colspan="2">The area of the project is approximately 40ha. The biodiversity is affected by the project in the area itself. Concerning the flood risk, it is reduced downstream, about 2km away from the area.</td><td>While the effective area is of the 4 NWRMs is mentioned above, the effective area of all the NWRMs in the sub-basins of study area is 185.95 ha</td></tr>
<tr><td>Design capacity</td><td colspan="3">Rusteghin wetland: 4,320 m^3d^{-1}
Salzano wetland: 2,909 m^3d^{-1}</td></tr>
<tr><td rowspan="6">Reference to existing engineering standards, guidelines and manuals that have been used during the design phase</td><td colspan="2">Reference</td><td>URL</td></tr>
<tr><td>1.</td><td></td><td></td></tr>
<tr><td>2.</td><td></td><td></td></tr>
<tr><td>3.</td><td></td><td></td></tr>
<tr><td>4.</td><td></td><td></td></tr>
<tr><td>5.</td><td></td><td></td></tr>
<tr><td>Main factors and/or constraints that influenced the selection and design of the NWRM(s) in this application?</td><td colspan="3">The sites and designs of the NWRMs were chosen in order to meet the necessities of decreasing the load of nitrogen and phosphorous arriving in the Venice lagoon and reducing the risk of flooding.</td></tr>
</table>

V. Biophysical impacts

Impact category (short name) Select from the **drop-down menu** below: ⇩	**Impact description** (Text, approx. 200 words)	**Impact quantification** (specifying units)	
		Parameter value; units	% change in parameter value as compared to the state prior to the implementation of the NWRM(s)
Water quality Improvements	Wetlands and buffer strips (BS) remove nutrients and contaminants thanks to physical (adsorption and sedimentation) and several biological processes. The different design of these NWRMs determine strong variations in the removal capacities of the two NWRMs. The data provided refers to the effects of wetlands and buffer strips at sub-basins scale	TN (g m^{-2} y^{-1}) TP (g m^{-2} y^{-1}) TSS (g m^{-2} y^{-1}) Glyphosate (g m^{-2} y^{-1})	CW 113.63 BS 32.664 CW 8.88 BS 4.2 CW 841.97 BS 6775.6 CW 0.774 BS 0.051
Reducing flood risks (Floods Directive)	To estimate the effects of NBS in term of flood risk reduction a "proxy" indicator has been used: the additional storage volume available thanks to the NWRMs. Since detailed information on the storage volume for each of the analysed NWRMs is not available, a simplified approach has been used.	Peak flow reduction (retention volume: m^3)	1,758,487

VI. Socio-Economic Information

What are the benefits and co-benefits of NWRMs in this application?	The environmental benefits of NWRMs are: the improved water quality (removal of pollutants from agricultural source); the reduced flood risk; biodiversity (increased number of aquatic fauna and the appearance of species of naturalistic interest). The social benefits are represented by: recreation and health opportunities for the local population; educations (natural areas are appreciated by schools).		
	Total:		
	Capital:	€ 45,968,183	
	Land acquisition and value:	€ 1,104,033	

Financial costs	*Operational:*	€/year 147,281	
	Maintenance:		
	Other:		
Were financial	*Yes*		

compensations required? What amount?	*Total amount of money paid (in €):*
	Compensation schema:[2]
	Comments / Remarks: Data provided refer to estimations made on the two sub-basins scale and related to a time period of 20 years.
Economic costs	*Actual income loss:* 378,489.00 €/year
	Additional costs:
	Other opportunity costs:
	Comments / Remarks: Data provided refer to estimations made on sub-basins scale of the farmland income loss during a time period of 20 years.
Which link can be made to the ecosystem services approach?	An estimation of the monetization of the ecosystem services have been made with value transfer method for the NWRMs within the two investigated basins obtaining a value ranging from 1,572,485 €/y to 2,741,362 €/y.

VII. Monitoring & maintenance requirements

Monitoring requirements	Several monitoring campaigns have been carried out to study the 4 NWMRs. The monitoring has been done both by the personnel of the drainage authority and both by the University of Padova.
Maintenance requirements	N/A
What are the administrative costs?	N/A

VIII. Performance metrics and assessment criteria

Which assessment methods and practices are used for assessing the biophysical impacts?	The assessment of TN,TP and TSS in wetlands has been described in the study "*MONITORAGGIO DELLE CAVE DI SALZANO 2009 – 2010*" carried out by Università degli Studi di Padova. The TN in buffer strips has been analysed by Gumiero et al. (2015) and Gumiero & Boz. (2017). Where data of TP, TSS and Glyphosate were not present, the parameters have through an experience-based analysis founded on the literature data.
Which methods are used to assess costs, benefits and cost-effectiveness of measures?	Costs: Reverse engineering Benefits and Cost-effectiveness: Value transfer method
How cost-effective are NWRM's compared to "traditional / structural" measures?	N/A
How do (if applicable) specific basin characteristics influence the effectiveness of measures?	N/A
What is the standard time delay for measuring the effects of the measures?	N/A

IX. Main risks, implications, enabling factors and preconditions

What were the main implementation barriers?	N/A
What were the main enabling and success factors?	The implementation of the NWRMs was strongly enhanced by the business model applied by the drainage authority "Consorzio di Bonifica Acque Risorgive"
Financing	NWRMs were financed by the Veneto region
Flexibility & Adaptability	N/A
Transferability	The positive approach of a "centralized business model" proposed in this study case can be transferred and applied in other geographical contexts by reproducing and adapting it to the local economical and political situation

X. Lessons learned

Key lessons	The the positive experience of the Consorzio Acque Risorgive demonstrates that a systematic implementation of NWRMs can be a successful approach to reduce the water pollution at sub-basin scale. Moreover, this approach was carried out with reasonable construction and O&M costs while providing several benefits. If monetized through a "value transfer" exercise, the approach shows a high value provided by the NWRMs every year for the community.

XI. References

Source Type	*Project Report*		
Source Author(s)	*IRIDRA srl*		
Source Title	Nature-based solutions for climate change adaptation and water pollution in agricultural regions. Lot 5: LDP in a continental environment - Feasibility Study		
Year of publication	2020		
Editor/Publisher	Joint Research Centre - JRC		
Source Weblink			
Key People		*Name / affiliation*	*Contact details*
	1.	*Fabio Masi*	*masi@iridra.com*

Source Type	*Project report*
Source Author(s)	Università degli Studi di Padova Facoltà di Ingegneria Dipartimento di Processi Chimici dell'Ingegneria Laboratorio Analisi dei Sistemi Ambientali
Source Title	*MONITORAGGIO DELLE CAVE DI SALZANO 2009 – 2010*
Year of publication	2011

Editor/Publisher	Università degli Studi di Padova		
Source Weblink			
Key People		*Name / affiliation*	*Contact details*
	1.		*lasa@unipd.it*

Source Type	*Journal article*		
Source Author(s)	Bologna University, Italy		
Source Title	Effectiveness of the cross-compliance Standard 5.2'buffer strips' on protecting freshwater against diffuse nitrogen pollution		
Year of publication	2015		
Editor/Publisher	Italian Journal of Agronomy		
Source Weblink	*https://doi.org/10.4081/ija.2015.772*		
Key People		*Name / affiliation*	*Contact details*
	1.	*Bruna Gumiero*	*bruna.gumiero@unibo.it*

Source Type	*Journal article*		
Source Author(s)	Bologna University, Italy		
Source Title	How to stop nitrogen leaking from a Cross compliant buffer strip?		
Year of publication	2017		
Editor/Publisher	Ecological Engineering		
Source Weblink	https://doi.org/10.1016/j.ecoleng.2016.05.031		
Key People		*Name / affiliation*	*Contact details*
	1.	*Bruna Gumiero*	*bruna.gumiero@unibo.it*