

Regional Scalability Plan – Case study 13

Sorraia river restoration PT

Restoration of Mediterranean lowland River Landscapes (ReMiLes)

Imprint

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1 For the Reader

This RSP targets the Restoration of Mediterranean lowland River Landscapes, ReMiLes.

ReMiLes includes all lowland river landscapes with a considerable dimension of the valley, located in the basin of Sorraia, typically occupied by intensive agriculture and using irrigation. Given the characteristics of Mediterranean climates, with hot dry summers and the precipitation concentrated in short periods early in the year, the farmland is irrigated to ensure water availability during the drought periods but with high productivity. There are several sources of water for irrigation, by decreasing order of importance: reservoirs, surface and subterranean water sources. The water is stored in reservoirs upstream and supplied to the crops during growth season therefore the flow is generally regulated throughout the system and in multiyear cycles.

The document describes the main proposed measures to intervene in the rivers of such lowland plains in order to promote their rehabilitation and ecological functions. Water availability problems and the need to improve river corridors, extend to the whole basin, thus the target audience are farmers, foresters and municipalities, together with administrations - conservation, water and agriculture.

We wrote ReMiLes in cooperation with the High Authority for Irrigation. We had inputs from Farmers Associations, from companies involved in restoration actions, from two municipalities and from individual farmers. Hopefully, the recommendations of ReMiLes will help all readers understand the importance and the ecosystem services and benefits of managing and protecting riparian woods, and of river restoration. Climate impact is already having consequences in the water available for crops and the river system, and proposed Nature-based Solutions (NbS) may help to make these ecosystems more resilient, under intense human needs and water demands. ReMiLes will ensure environmental sustainability, thus the maintenance of provision services for crops and farmers.

ReMiLes is meant to be read by all farmers and water managers directly or indirectly linked to the irrigated Mediterranean flood plains of the Sorraia basin, as well as nature conservation and water administration entities related to floodplains, NGOs, municipalities, forest producer associations and the general public. Also, by policy makers related to such topics. However, the target audience for implementation of the restoration actions are the Water and Agricultural managers of Mediterranean irrigated floodplains of Sorraia. The irrigated valleys encompassed by the RSP include the area of Sorraia, and also areas such as Ciborro, Arraiolos/Divor and Longomel, along with other small scattered irrigated areas (Figure 2). Part of the larger areas have Farmer's Associations, and therefore some level of common water and river management.

The RSP should help them to perform a better management of rivers and to include riparian rehabilitation, river restoration and invasive plant control, besides biodiversity promotion within riparian areas. These are tasks in general demanded by the water authorities and WFD, the agricultural activities and PAC orientation. The management of these areas and agricultural fields are closely linked with the water prices and the PAC pillars.

2 Focus of the RSP

2.1 Regional Characteristics

In ReMiLes, we are dealing with the example of the Sorraia lowland valley, Tagus basin, and extending this experience to other irrigated areas of Sorraia basin. The spatial extent of the RSP is the irrigated areas and lowland river valleys of the Sorraia basin, whether under the management of Farmers Management Associations, or not, and the boundaries of such areas are defined using the LULC Corinne maps.

Mediterranean floodplains can be viewed as a mosaic of agricultural crops and natural infrastructures. Since these floodplains are irrigated, the riparian infrastructures have a fundamental role in regulating ecosystem functions and services, such as nutrient retention and sediment trapping (Cole et al., 2020; Riis et al., 2020). As this refers to a land sharing situation, it is essential to reconcile aquatic, riparian and terrestrial ecosystems within the floodplain, in a way that ecosystem services are both useful for agriculture without being compromised. In other words, ecosystem services should be made available to agriculture, but agriculture should not disturb, decrease nor degrade the provision of ecosystem services and their sustainability. This balance is being established in a context of climate change and water scarcity. At a global level, as the demand for food production increases, crop intensification also increases, competing with environmental constraints, especially natural flows.

The objective is to define what best Nature-based Solutions and rehabilitation tools we can use in this situation, and scale up techniques of riparian rehabilitation, river restoration, river functioning, and monitoring indicators to enable adaptive management across the basin.

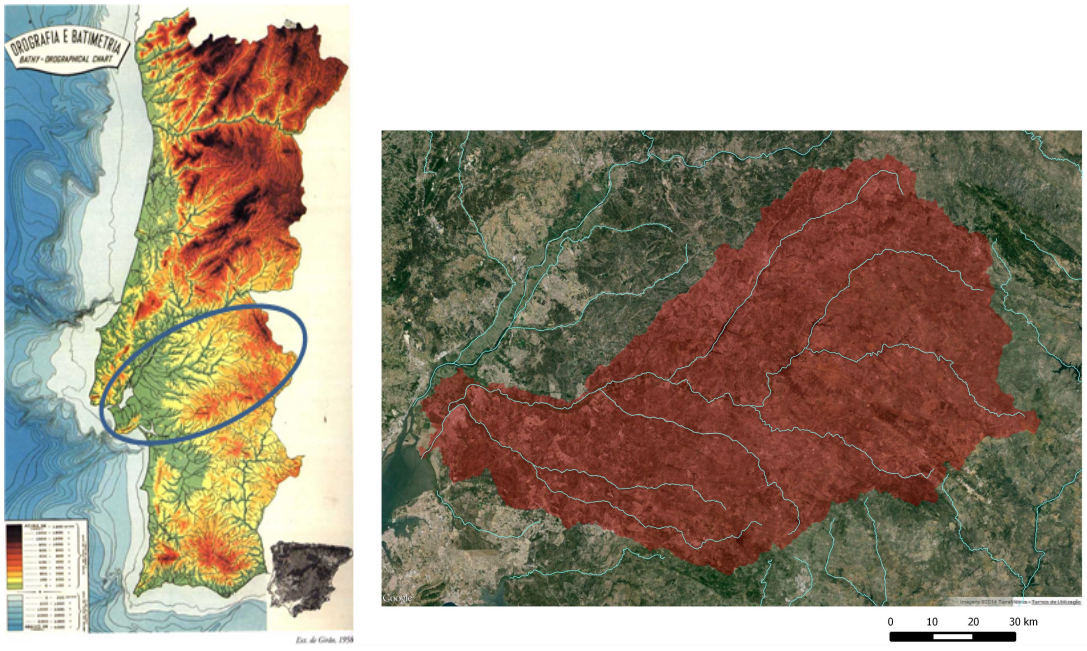


Figure 1. Location of the Sorraia basin on the left and display of the river network

The floodplain is crossed by rivers and channels. The agricultural matrix features long and narrow remnant ecological infrastructures. Riparian corridors and the river bed have outgrown of invasive exotic species. There is a decrease in sinuosity and changes in the river length and profiles. The flow is regulated. River Sorraia is the main tributary of the river Tagus left bank. It has a catchment area of 7611 km^2.

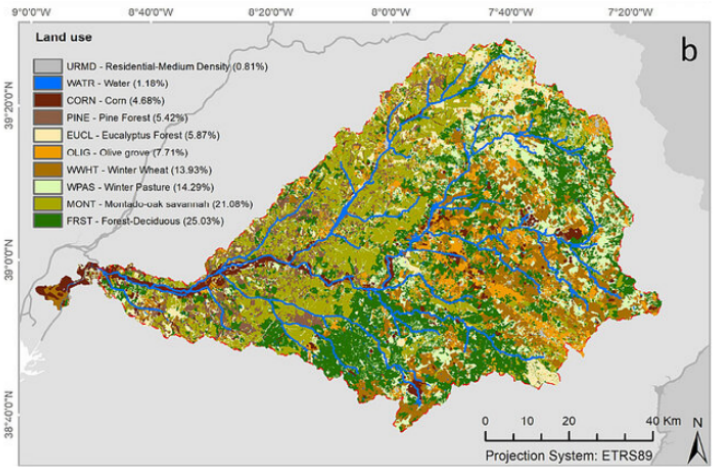


Figure 2. Land use and irrigated valleys in the basin of Sorraia expressed by "CORN" areas

There are two sorts of actors to consider as they have different priorities, therefore different decision-making processes. The main actor in terms of provision of services are farmers and forest producers. Both produce crop and wood material products and their interest is to produce more, and in the larger areas possible. The second set of actors are the administration agents of water and agriculture, and nature conservancy managers. Their interests are related to regulation of ecosystem and resource uses and environmental conservation, notably of water and soil, in order to guarantee that all land owners will continue to have water available while ensuring the sustainability of agricultural practices. In the Sorraia catchment, the land tenure is private, whereas the water element is public and in need of licensing and fees to be used. Secondary consequences of the intensification such as invasive plant spreading in river bed and banks, nutrient runoff and water pollutants. The obligations of these two sets of actors difficult the dialogue and favour conflict of interests.

2.2 Justification for the Region

The Sorraia valley and the irrigation floodplain is an ex-libris of the irrigated agriculture in Portugal, and extremely looked upon. If they start implementing restoration measures, they will be an example for others. The Sorraia valley has been studied by the ISA team since 1996, we have long term data from various PhD theses, and monitoring along the years. It is the object of a river basin management plan. It belongs to our more important river system - the Tagus. Consultation for the 3rd cycle of River Basin Management Plans with all documents in https://participa.pt/pt/consulta/3-ciclo-2022-2027-projeto-do-pgrh-do-tejo-e-ribeiras-do-oeste-rh5a

The restoration that we are developing only applies to irrigated lowland valleys, hence the spatial scope. Governance by farmers, water managers, the irrigation authority and the water management authority are typical of such areas and can be extrapolated in terms of pressures, problems and solutions.

Nature-based Solution plans and restoration strategies developed in Sorraia and that we expect to foster implementation, in other river systems from irrigated areas of Sorraia are:

1) Rehabilitation of the riparian infrastructures including: lateral expansion, indigenous tree planting, erosion control using natural engineering materials, control of giant reeds, control of water hyacinth, construction of temporary ponds, placement of shelters for bats, for birds and for pollinators, creation of pollinator flowering campus (Figure 3).
2) Development of Nature-based Solutions for river crossing of farmer when transporting crop products, using submerged culverts with large sections.
3) River bed improvement by promoting lateral channels and areas of flooding close to the river.

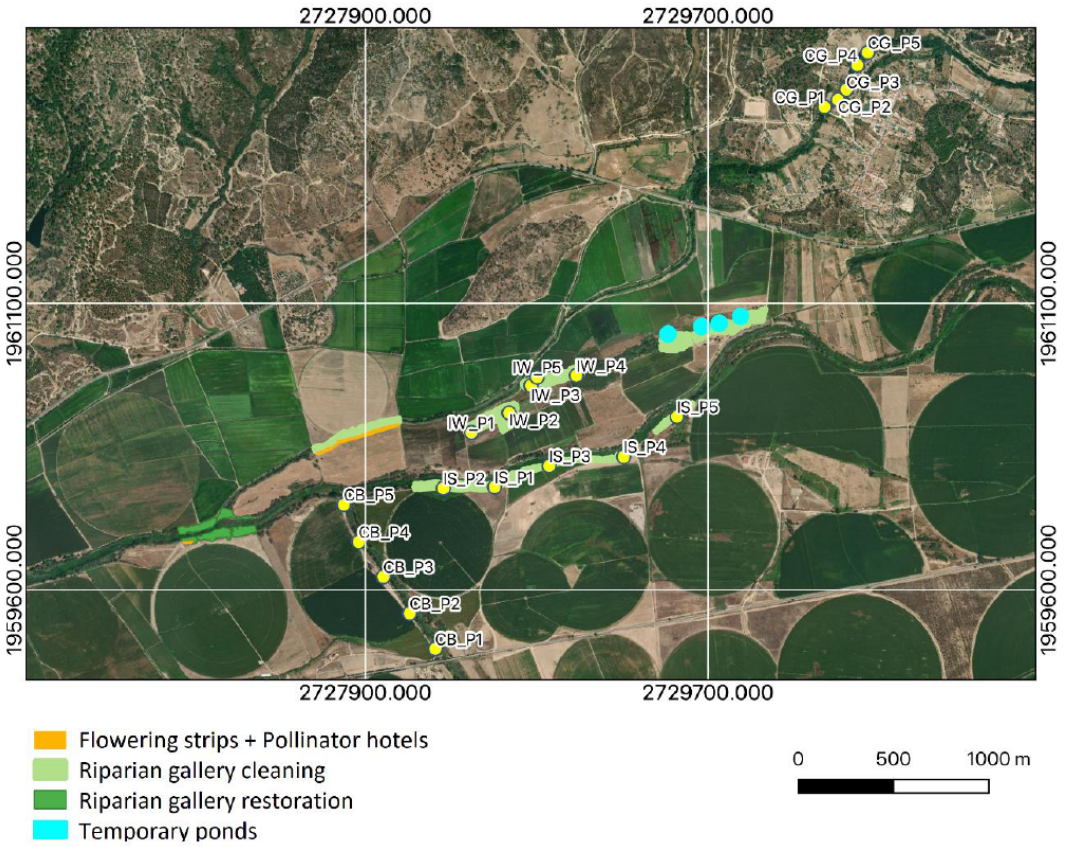


Figure 3. Restoration interventions in one of the sites

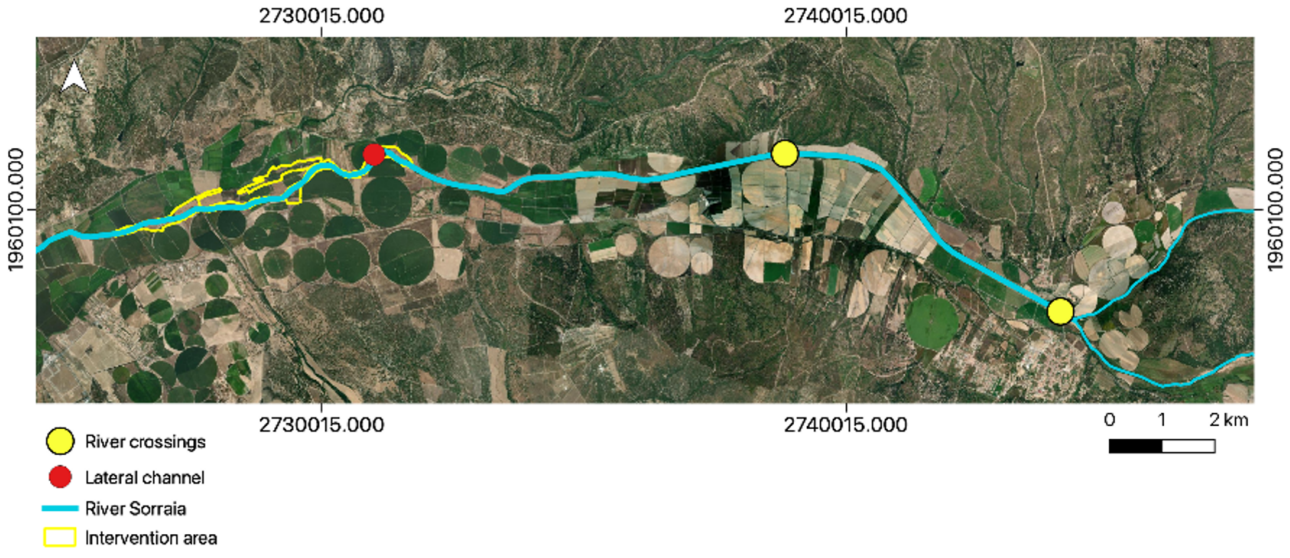


Figure 4. River crossings and lateral complexities implemented

2.3 Linkages and Synergies with Other Initiatives

Partnership between agricultural agents and water agents: the agriculture agents include stakeholders (farmers) and agriculture administration; water agents include regional and central water authorities.

The core actions will be built with the authorization of agricultural and forest authorities and water administration management. The agricultural authorities will link stakeholders and their benefit interests to the sustainable use of water and soil resources. In parallel, the water authorities will give support to the environmental management of the water. The added value is this linkage, seldom done, but needed. There are

no ongoing projects other than Merlin, for the moment, however, there is a project of river restoration funded by the National Foundation for Science and Technology, Optimus Prime (https://optimusprime.pt/). The project (PTDC/ASP-AGR/29771/2017) aimed to identify types and spatial configurations of Ecological Focal Areas that potentiate biodiversity and the provision of Ecosystem Services in Mediterranean irrigated agricultural systems, taking also into consideration the connectivity impairment in such fragmented landscapes. A webtool was created for farmers to calculate the value of nutrient filtering and sediment retention when riparian areas are rehabilitated and increased (http://optimusprime.agrotejo.pt/#resultados).

There are no citizen science initiatives. There are no projects opposing riparian restoration, simply put, it is an ignored topic in general. However, the water managers are well aware of river problems, especially flow decrease, water quality issues and invasion by aquatic and riparian alien plants, which they need to solve in order to maintain properly the river system. The General public, including municipalities and NGOs, should be aware of river pressures and need to restore, and be called to support. These would be:

- Farmer (crop and forest producers): managing the Blue-Green infrastructures of their properties
- Agriculture authorities: managing water, river channels and aquatic communities
- Water authorities: permits, legislative support, awareness
- Academia: provision of scientific support
- NGOs and public: awareness, influence, communication
- Municipalities: awareness and supportive initiatives
- Public: awareness, involvement in water planning and decision making, in order to strive for intergenerational inclusivity.

There are no projects opposing riparian rehabilitation, simply put, river rehabilitation is an ignored topic in general. Furthermore, the stakeholders and associations of farmers are willing to restore the river, provided there is financial support from the CAP or the RBMP. We are not aware of opposing groups, although the interventions should be seen for the conditions of each landowner in its propriety in particular.

3 Stakeholders of the RSP

3. 1 Sorraia Case Study Main Stakeholders

MERLIN's Sorraia case study has several key stakeholders, essential to the successful implementation of the project. Below and in Table 1, we present a brief overview of each stakeholder, including the level of involvement.

INSTITUTO SUPERIOR DE AGRONOMIA (collaborated)

The Instituto Superior de Agronomia (ISA), School of Agriculture, is the largest and most qualified school of graduate and post-graduate degrees in the Agricultural Sciences, in Portugal, and its know-how is recognized nationally and internationally. With over 100 years of experience, it has been adjusting its teaching to both the technological evolution and the reality of the country, focusing both on quality and modernization. ISA has been responsible for coordinating the restoration efforts in the Sorraia Case study.

More information at: https://www.isa.ulisboa.pt/

ASSOCIAÇÃO DE REGANTES E BENEFICIÁRIOS DO VALE DO SORRAIA (collaborated)

The Association of Irrigators and Beneficiaries of Sorraia Valley (ARBVS) aims to promote and defend the interests of its associates in the use and management of water resources, mainly for irrigation purposes, as well as in the social, economic, and environmental development of the region. The ARBVS are in charge of managing water canals, provide technical guidance for irrigation purposes and ensure that all associated farmers have the necessary water resources for agriculture. Additionally, the ARBVS is also in charge of clearing the damages caused by floods and stabilising the river margins, with the aim of protecting the surrounding crops.

More information at: https://www.arbvs.pt/

Mushmore (consulted)

Mushmore is a company specialised in biomass management interventions and environmental recovery/regeneration in sensitive ecosystems. The Ecolução Network brings together the best professionals with operational capacity at the national level, suitable for various scenarios and civil and environmental protection needs. Mushmore has been responsible for the demonstration actions namely the flowering strips, pollinator hotels, riparian gallery cleaning and restoration and temporary ponds.

More information at: https://www.mushmore.net/

ASSOCIAÇÃO DE AGRICULTORES DE CORUCHE E VALE DO SORRAIA (consulted)

The Farmers Association of Coruche and Sorraia Valley (AACS) is a farmers' cooperative in Coruche, responsible for providing technical help and advice to farmers when applying for state subsidies.

CENTRO DE COMPETÊNCIAS PARA O REGADIO NACIONAL (consulted)

The National Irrigation Technology Centre (COTR) is a non-profit association whose main activity is to promote agricultural development through scientific promotion and experimentation. They focus on developing new irrigation technologies to make an efficient and more sustainable use of the water resources in agriculture.

More information at: http://www.cotr.pt/

CÂMARA MUNICIPAL DE CORUCHE (consulted)

Municipality of Coruche is a local governmental body, in charge of the public affairs of Coruche. Recently they have been involved in implementing a phytoremediation system to clear the point-source pollution coming from discharge pipes into river Sorraia.

More information at: https://www.cm-coruche.pt/

ÁGUAS DO RIBATEJO (consulted)

Ribatejo Waters are a public company, with social and environmental responsibilities, in charge of planning, executing and projecting the future of the region in conjunction with community funding. They aim to provide the Ribatejo region with infrastructures for public water supply and for drainage and wastewater treatment. They optimize existing systems, build new ones and make investments in the areas of water supply and basic sanitation.

More information at: https://aguasdoribatejo.com/

DIREÇÃO-GERAL DE AGRICULTURA E DESENVOLVIMENTO RURAL (consulted)

General Directive of Agricultural and Rural Development (DGADR) is the Portuguese government agency responsible for agricultural and rural development policies and programs. It aims to promote sustainable and competitive agriculture and forestry sectors, while also preserving natural resources and promoting the social and economic development of rural areas. DGADR, as the implementation partner of MERLIN's Sorraia case study, can help to ensure that the restoration measures align with broader agricultural and rural development goals, through the coordination with other relevant government agencies and organisations.

More information at: https://www.dgadr.gov.pt/

ASSOCIAÇÃO DE PRODUTORES FLORESTAIS DO CONCELHO DE CORUCHE E LIMÍTROFES (APFC) (consulted)

The Association of Forest Producers of the Municipality of Coruche (APFC) is a local association, responsible for defending and promoting the interests of the forest landowners of the region. It aims to provide their associates with a greater knowledge about their products, for an adequate valorization; a greater knowledge about their stands, for a more effective management; and helps foresters to develop mid- and long-term plans for certified cork and timber production.

More information at: https://www.apfc.pt/

LOCAL FARMERS (affected)

Farmers are indirectly involved as the majority are integrated in the above mentioned associations. The farmers whose lands are being used for implementation restoration measures have been involved since the beginning of the project as their permission for restoration is required. Eventually all farmers should be involved as escalation is achieved, as they witness positive results from demonstration sites.

LOCALS (affected)

The inhabitants of the surrounding area should be positively affected by restoration and escalation. The foreseen effects are positive as restoration measures will improve water quality, decrease mosquito populations, increase fish population (allowing for fishing activities) and overall better environmental quality.

Table 1. Overview of stakeholders engaged in RSP.

Name of stakeholder	Acronym	Sector	Involvement status	Scale	Ownership	website
Farmers Association	ARBVS	Agriculture	Already involved	Regional	Private (Commercial, investor, etc)	https://www.arbvs.pt/
Instituto Superior de Agronomia	ISA	Other	Already involved	Regional	Public	https://www.isa.ulisboa.pt/
Mushmore COOP	MSH	Spatial Planning	Already involved	Local	Private (Commercial, investor, etc)	https://www.mushmore.net/
Direção Geral De Agricultura E Desenvolvimento Rural	DGADR	Cross Sector (governance, regulation, etc.)	Already involved	National	Public	https://www.dgadr.gov.pt/
Municipality Of Mora	CM Mora	Cross Sector (governance, regulation, etc.)	Already involved	Local	Public	https://www.cm-mora.pt/
Municipality Of Coruche	CM Coruche	Cross Sector (governance, regulation, etc.)	Already involved	Local	Public	https://www.cm-coruche.pt/
WATERS RIBATEJO (Águas Do Ribatejo)	Arib	Water resources	Already involved	Regional	Public	http://www.aguasdoribatejo.com/
Association Of Forest Producers Of The Municipality Of Coruche	APFC	Forestry	Already involved	Local	Private (Commercial, investor, etc)	https://www.apfc.pt/
Irrigation Technology Center	COTR	Agriculture	Already involved	National	Other	https://www.cotr.pt/
Coruche And Sorraia Valley Farmers Association	AACS	Agriculture	Already involved	Local	Public	
Portuguese Agency For The Environment	APA	Environment, Climate and Disaster	Already involved	National	Public	https://apambiente.pt/

Name of stakeholder	Acronym	Sector	Involvement status	Scale	Ownership	website
Sociedade Agrícola Casal de Santo Amaro, Lda	Farmers	Agriculture	To be invited	Local	Private (Commercial, investor, etc)	
SMP, Sociedade Agrícola, Lda	Farmers	Agriculture	To be invited	Local	Private (Commercial, investor, etc)	
Raízes Verticais - Exploração Agrícola, Lda	Farmers	Agriculture	To be invited	Local	Private (Commercial, investor, etc)	
Agro-Maneta, Sociedade Agricola Unipessoal, Lda	Farmers	Agriculture	To be invited	Local	Private (Commercial, investor, etc)	
António Francisco Malta da Veiga Teixeira	Farmers	Agriculture	To be invited	Local	Private (Commercial, investor, etc)	
Sociedade Agrícola Monte da Sé, Lda	Farmers	Agriculture	To be invited	Local	Private (Commercial, investor, etc)	
Casa Agrícola 3 Ribeiras, Lda	Farmers	Agriculture	To be invited	Local	Private (Commercial, investor, etc)	
José Carlos Freire Dias Correira	Farmers	Agriculture	To be invited	Local	Private (Commercial, investor, etc)	
Sociedade Agricola AB Ferreira, Lda	Farmers	Agriculture	To be invited	Local	Private (Commercial, investor, etc)	
Tecnorisi Sementes, Lda	Farmers	Agriculture	To be invited	Local	Private (Commercial, investor, etc)	

4 Green Deal Goals

4.1 SMART Green Deal Goals Relevant for the Region: Primary Goals

ReMiLes focuses on primary goals that align with the EU Green Deal objectives, emphasizing climate action, biodiversity conservation, and inclusivity. These goals are detailed to meet the specific, measurable, actionable, relevant, and time-bound (SMART) criteria necessary for successful implementation.

Biodiversity net-gain and Sustainable Food Systems (F2F): To enhance biodiversity, the plan proposes to restore and reconnect riparian habitats across the floodplains with irrigated areas. By 2030, to support ecological processes and species diversity, the objective is to exceed 30% of present riparian cover (which is about 10% of the original), to reduce the area of invasive giant reed and water hyacinth, and to promote areas for lateral connectivity and solve longitudinal disconnectivity of small cross-river infrastructures. Restoration efforts will focus on reinstalling and promoting native riparian species and removing invasive species to restore natural floodplain dynamics.

Importantly, restoration includes explaining to farmers and owners the importance of riparian yearly maintenance and tending of the riparian areas, where the role of riverine metastability is decreased due to flood control and water use for irrigation. Finally, increasing the width and reconnecting blue-green patches at the landscape level will have a direct effect on species metapopulations.

Overall, riparian network restoration will result in a boost to the ecological functioning of the river ecosystems.

Zero pollution goals: The maintenance and restoration of the Blue-Green landscape infrastructure will ensure higher nutrient retention services, and thus improve water quality and diminish greenhouse gas emissions. Increasing the width of the riparian belts will also promote sediment and soil retention.

These ecosystem services, considering local crop type, soil and topography) can be calculated using a previously implemented SWAT modelling specifically developed for Sorraia conditions, and are accessible to farmers at their local structures, e.g. http://optimusprime.agrotejo.pt/#resultados. ReMiLes seeks to reduce nutrient runoff and enhance water quality through improved riparian management and upscaling it to landscape level. The target is to achieve a 20% reduction in nitrate levels in water bodies across the floodplain by 2030, and 60% on the long run. This will be accomplished by implementing natural water retention measures and improving soil health to decrease runoff and enhance groundwater quality.

The increase of nutrient retention in riparian structures (nutrient retention modelled at http://optimusprime.agrotejo.pt/#resultados will be added to the current policies and practices, thus contributing to the zero pollution goals. The more upscaled these practices, the more contribution to the zero-pollution goals.

Climate-Related Goals: In the face of climate change, by lowering greenhouse gas emissions in irrigated floodplains, and promoting the green infrastructures, a higher attenuation of the Mediterranean climatic dryness and summer droughts is to be expected. Microclimates of wetness and cooler environments are extremely important during summer for ecosystem resilience. A greener surface cover by riparian woods through systematic ecosystem restoration efforts will enhance carbon storage and reduce CO2 emissions. By 2030, the goal is to increase carbon stocks and to maximize carbon sequestration, by improving vegetative cover over an estimated area of 500 hectares of floodplains, by increasing the width and patchiness of the riparian network.

Health and Wellbeing: Improving the riparian network and promoting a larger presence of cooler and wetter environments for plants, animals and people will increase public health and community wellbeing, enhancing environmental quality and access to natural areas. Local governance structures can also increase public access to green spaces, for leisure activities and angling, thus improving recreational opportunities and community health outcomes.

Beyond improvements in recreational facilities, ReMILes focuses on enhancing the overall wellbeing of the community by providing more accessible and higher-quality green spaces. These are qualitative direct and indirect goals. These areas restored will serve not just as places for leisure but also as venues for

environmental education and community engagement, fostering a deeper connection between residents and their natural surroundings.

Inclusivity Goals: Engaging local communities in conservation efforts is key to improving environmental awareness and participation. ReMILes sets a target to reach 15 local schools and 10 community groups by 2027, incorporating environmental education and citizen science projects. These efforts aim to increase appreciation of local natural values and the social legitimacy of nature-based solutions through targeted community outreach and participatory events. The actions will be conducted by the local municipalities involved. On the long run, the investment in schools will tend to mitigate and reduce future environmental conflicts.

Another important aspect is the setting of example practices. When owners and stakeholders can observe that environmental practices for riparian corridors done by their neighbours are worthwhile for environmental promotion, and to obtain benefices from CAP regulations, the implementation of the restoration actions will be much facilitated.

Additional Benefits: Establishing clear, common guidelines for the management of irrigated floodplains applicable across Mediterranean regions is an overarching objective. ReMILes involves collaborating with regional stakeholders to develop and implement scalable management practices that can be adopted universally in similar ecological contexts.

These goals are designed to ensure that ReMILes contributes effectively to the EU Green Deal while addressing local environmental and community needs in a structured and measurable way.

The primary goals of ReMILes will develop in the following temporal order:

1) Blue-Green infrastructures are locally enhanced in the Sorraia lowland valley (focusing on riparian structure naturalness and connectivity enhancement, invasive control), followed by monitoring of riparian structure evolution, and target species groups (vegetation cover and structure, fish, pollinators, amphibia, bats).
2) Local riparian and connectivity enhancement become frequent in the Sorraia valley, and acts as seed for dissemination and knowledge promotion for the managers in the other irrigated river valleys of the basin.
3) As time passes, riparian and connectivity management becomes a current practice for farmers and is also performed in the other irrigated river valleys of the basin. Management authorities are attentive to the management being performed.

Long term benefits can be calculated (flood damage, sediment retention, nutrient values, animal groups' evidence of good state, invasive species close to residual), but more importantly the agricultural yearly practices include the maintenance of river dynamics and keeping the riparian structures healthy. Such agricultural practices are positively incorporated in regulations.

4.2 SMART Green Deal Goals Relevant for the Region: Secondary Goals

For the **secondary goals of the ReMILes**, a series of measures have been identified that contribute to the broader objectives of the EU Green Deal. These goals, while secondary, support the primary objectives and enhance the overall impact of the plan across a 10-25 year timeline, from 2024 to 2050. In all goals there is an element od scale. The more widespread riparian rehabilitation practices, the faster and more intense the goals are achieved.

Flood and drought resilience goals: as most Mediterranean rivers, the Sorraia basin is characterized by intensive episodes of rainfall and floods, followed by long periods with low flows. The natural disruption of such a system and its ability to restore are large. Flood retention in reservoirs to keep the water for irrigation has decreased the higher floods and changed the flow patterns, altering also the sediment deposits locations and river dynamics. Nonetheless, when large floods occur, the retention capacity is still overpassed. With climate change, floods tend to have a larger magnitude and shorter period, and droughts tend to combine with heat waves, both having economic and environmental consequences. The increase of the riparian networks across the irrigated landscapes mitigates the flood peaks by slowing down its progression and increases drought

resilience by retaining humidity and increasing green water storage, and harvesting of water during drought periods.

Mitigation of flood and drought risks through the rehabilitation of riparian structures, the natural greening of the landscape, and the control of aquatic invasive species. Enhancement of the metastability and resilience of local ecosystems. Less soil losses and nutrient for agricultural fields (sediment retention modelled at http://optimusprime.agrotejo.pt/#resultados). The educational components to improve community understanding of flood risks.

Economic Development and green growth goals: Promoting sustainable economic development through nature-based solutions and conservation is also a priority. ReMILes will promote jobs and economic activities directed to companies that manage and replant vegetation, vivaria and greenhouses that supply plants, companies working in hydraulic structures and local temporary man-power hired for riparian maintenance and vegetation cleaning. New activities in the fields of nature conservation notably dissemination, will be also promoted, as well as nature-based tourism and leisure activities. Importantly, we foresee an enhancement of local income through environmentally friendly practices that are subsidized by CAP regulation.

ReMILes initiative is expected to stimulate local economies by creating new opportunities in restoration businesses and promoting circular economy activities. This includes the stimulation of work actions and products needed, but also the development of green jobs and business that contribute to the economic viability of the region. Enhancement of local income through environmentally friendly practices will improve opportunities for subsidies according to CAP regulation. Sustainable environmental practices will result also from education campaigns.

Knowledge Goals: The evidence-base for decision-making of agriculture and water administrations, notably for regulation and law enforcement, will be significantly enhanced with ReMILes. This results from the monitoring of environmental changes resulting from the green riparian and river connectivity enhancement and is regularly performed within the frames of the WFD by water authorities and the water quality and quantity by agriculture authorities. For some time now the area of Sorraia is used for academic thesis, Portuguese or from other countries notably Netherlands. The ReMILes will leverage local academic and research institutions to continually assess and adapt strategies based on empirical data.

Sustainable Transport Goals: ReMILes will promote sustainable transport options that complement the regional focus on green growth and reduced carbon footprints. It results from local river crossing infrastructures shortening the distance between crop production and delivery to markets and industries and creating better conditions for environmentally-friendly vehicles. It is also lined with the dissemination of environmentally-friendly practices in agricultural areas.

Sustainable Energy and Food Goals: Opportunities for integrating sustainable energy solutions into the floodplain management strategy will be assessed. This might include the use of solar power for water pumps and other infrastructure, reducing the carbon footprint of agricultural and conservation activities. Crop products will be made under a better environment with less pollutants and nutrients.

These secondary goals complement primary objectives, and contribute significantly to the holistic approach of ReMILes, ensuring comprehensive benefits to the environment, economy, and community of the Sorraia valleys.

5 From General Goals to Actions

5.1 Actions to be Developed

In ReMILes, translating the goals and their temporal sequence into specific actions ensures that the objectives aligned with the EU Green Deal are realized effectively. This section outlines concrete actions for primary and secondary goals set forth, covering various types of actions including restoration, partnerships, public participation, monitoring, funding, and research.

Climate Goal

Action 1: Enhance reforestation projects of riparian areas and connected natural vegetation patches to increase carbon sequestration across identified areas of the floodplain.

Action 2: Develop and implement green infrastructure solutions notably increase riparian width, to reduce CO2 emissions and enhance carbon stocks in agricultural areas.

Action 3: Increase vegetated buffer areas between crops and river to improve carbon retention, provide food sources and habitat, reduce erosion.

Biodiversity Goal

Action 1: Restore native habitats and ecological corridors to increase biodiversity, namely of target animal groups, and ecological connectivity.

Action 2: Manage and increase riparian areas to keep juvenile patches mimicking the reduced flow dynamics, to increase sediment retention and nutrient filtering effect.

Action 3: Remove invasive species both in banks and in the river bed, and facilitate the dominance of native flora and fauna to restore natural ecological balance.

Action 4: Create spare wetland areas in specific locations, with less crop use or longer set-aside, or creating small wetlands in the floodplain where former oxbow wetlands existed, to conserve critical habitats and species.

Inclusivity Goal

Action 1: Develop educational programs and workshops for local schools and community groups to enhance understanding of environmental stewardship.

Action 2: Implement citizen science projects to engage the community in monitoring and protecting local biodiversity.

Action 3: Establish community advisory boards to ensure local participation in decision-making processes related to land use and conservation.

Zero Pollution Goal

Action 1: Implement natural filtration systems using riparian structures, within agricultural landscapes, to reduce runoff and improve water quality. The increase in ecotones is also efficient for sediment retention, flood and drought mitigation.

Action 2: Continue to promote the adoption of sustainable farming practices that minimize soil loss, agricultural pollution and pesticide use.

Action 3: Enhance monitoring programs and enforcement of environmental regulations to ensure compliance and reduce pollution.

Action 4: adaptation of agriculture regulations to clearly include river restoration and management.

Health and Wellbeing Goal

Action 1: Expand public access to green spaces through the development of trails and recreational areas especially in the vicinity of urban areas.

Action 2: Launch public health campaigns focusing on the benefits of natural environments to physical and mental **health.**

Action 3: Develop programs that integrate physical activity and nature exposure to improve community health outcomes.

5.2 Design and Implementation

Restoration Actions:

- Implementing technical-physical conservation measures: maintaining riparian areas, reforesting and area increase, habitat restoration. Mapping of the blue-green infrastructure already exists, and target areas for restoration. Implementation is conducted by the Farmer's Association and local farmers.
- Substitute all river crossing with nature base solutions, and enhance lateral wetting cycles and areas, while creating connectivity with lateral temporary ponds. Implementation by the Farmer's Association.

Institutional Partnerships:

- Building a praxis of dialogue and cooperation between water and agriculture authorities including harmonization of legislation, of practices and of goals. Both authorities involved in the action implementation.
- Building collaborations between local agents, administrations and universities for co-creative research, identification of nature-based solutions and monitoring schemes. All management and governance entities involved.
- Establishing "blue-ribbon" commissions to guide and support ReMILes initiatives. All management and governance entities involved plus stakeholders.

Public Participation:

- Developing a comprehensive communication plan organized by municipalities that includes outreach to schools and the local community through various media.
- Organizing field trips and public seminars to increase awareness and support for the ReMILes.

Monitoring:

- Setting up a special WFD monitoring framework to track improvements (water authorities), an agriculture monitoring plan to track benefices to farmers of river restoration (DGADR) and the community engagement (municipal survey).
- Regularly updating stakeholders on progress and adapting strategies based on monitoring outcomes (Farmer's Association).

Funding Actions:

- Identifying and securing sustainable funding sources, via PAC (PT_PEPAC). Farmers' Association.
- Analyzing potential funding gaps and developing strategies to address them (via RMBP). Water Management Authorities.

Research and Knowledge Building:

- Writing guidelines for environmentally-friendly river crossings, after follow-up and validation using migratory fish species. University, commissioned by the Environmental Protection Agency.
- Identify and study new NbS for riparian areas and rivers, notably pre-technological solutions. University, commissioned by the Environmental Protection Agency.

These actions are designed to ensure the effective implementation of the ReMILes goals, with a clear focus on measurable and actionable steps that contribute to broader environmental, social, and economic benefits. Table 2 depicts potential roles for stakeholders.

Table 2. Roles of stakeholder in terms of RSP implementation

Action	Implementer	Funder	Monitorer	Coordinator
1. Climate	Instituto Superior de Agronomia (ISA) can guide reforestation and green infrastructure projects	Águas do Ribatejo may provide financial support for soil management practices aimed at carbon retention.	Mushmore Company can oversee the implementation of soil management practices and report on their effectiveness in carbon sequestration.	Centro de Competências para o Regadio Nacional (COTR) can coordinate between different stakeholders involved in the climate goal actions.
2. Biodiversity	Associação de Regantes e Beneficiários do Vale do Sorraia (ARBVS) will take charge of invasive species removal and riparian and and habitat restoration.	The Farmer's Association will provide support for the riparian maintenance and connectivity enhancement, together with stakeholders	Instituto Superior de Agronomia (ISA) may monitor the results of biodiversity and habitat connectivity improvements.	The Farmers' Association will coordinate actions. Câmara Municipal de Coruche will ensure that biodiversity goals align with local land use policies and community interests.
3. Inclusivity	Associação de Agricultores de Coruche e Vale do Sorraia (AACS) lead stakeholders participatory actions. The municipalities will organize educational programs and citizen science projects.	Municipalities can support the establishment of community advisory boards and funding local participatory events.	Companies such as Mushmore will track community engagement levels and the effectiveness of educational programs.	Direção-Geral de Agricultura e Desenvolvimento Rural (DGADR) will coordinate inclusivity actions to ensure alignment with national agricultural and rural development strategies.
4. Zero Pollution	Mushmore will implement natural filtration systems and sustainable farming practices.	Águas do Ribatejo and Associação de Regantes e Beneficiários do Vale do Sorraia (ARBVS) will provide financial backing for pollution reduction technologies and practices.	Environmental Protection Agency will monitor water quality improvements and compliance with environmental regulations.	Centro de Competências para o Regadio Nacional (COTR) will coordinate efforts across stakeholders to ensure holistic agropollution management.
5. Health and Wellbeing	Municipalities will insure implementation of trails and recreational areas.	Associação de Agricultores de Coruche e Vale do Sorraia (AACS) will fund health campaigns and programs integrating physical activity and nature exposure.	Instituto Superior de Agronomia (ISA) and local schools (citizen science) will monitor public health outcomes and environmental quality improvements.	Direção-Geral de Agricultura e Desenvolvimento Rural (DGADR) will ensure that health and wellbeing goals are integrated into broader rural development initiatives.

6 Timeline

	period (2-yr interval)					period (5-yr interval)		
	2025-2026	2027-2028	2029-2030	2031-2032	2033-2034	2035-2039	2040-2044	2045-2049
Activity 1: Climate								
subactivity 1.1: Enhance reforestation projects	x	x	x					
subactivity 1.2: Develop and implement green infrastructure solutions	x	x	x	x				
subactivity 1.3: Increase vegetated buffer areas		x	x	x	x			
Activity 2: Biodiversity								
subactivity 2.1: Restore native habitats and ecological corridors	x	x	x	x	x	x		
subactivity 2.2: Manage riparian áreas and increase riparian cover	x	x	x	x	x	x	x	x
subactivity 2.3: Remove invasive species	x	x	x	x	x	x	x	x
subactivity 2.4: Create spare areas		x	x	x	x	x	x	x
Activity 3: Inclusivity								
subactivity 3.1: Develop educational programs	x	x	x	x				
subactivity 3.2: Implement citizen science projects		x	x	x	x	x		
subactivity 3.3: Establish community advisory boards			x	x	x	x	x	x
Activity 4: Zero Pollution								
subactivity 4.1: Implement natural filtration systems	x	x						
subactivity 4.2: Promote and subsidize the adoption of sustainable farming practices		x	x	x	x	x	x	
subactivity 4.3: Enhance monitoring and enforcement			x	x	x	x	x	x
Activity 5: Health and Wellbeing								
subactivity 5.1: Expand public access to green spaces	x	x	x					
subactivity 5.2: Launch public health campaigns		x	x	x	x			
subactivity 5.3: Develop programs that integrate physical activity and nature exposure			x	x	x	x	x	x

7 Budget

The budget planning for the ReMILes is a critical component to ensure the sustainable financing of all activities outlined until the year 2050. This section provides an overview of the anticipated income sources and expenses, with a focus on the first 1-5 years, and explores how restoration costs can be viewed as investments in nature-based solutions.

Budget Categories	2024-2025 (€)	2025-2026 (€)	2026-2027 (€)	2027-2028 (€)	2028-2029 (€)
Activity 1: Climate					
Enhance reforestation projects	500,000	500,000	500,000		
Green infrastructure solutions	300,000	300,000	300,000	300,000	
Vegetated buffers		250,000	250,000	250,000	250,000
Activity 2: Biodiversity					
Restore habitats and corridors	400,000	400,000	400,000	400,000	400,000
Manage & increase riparian areas	200,000	200,000	200,000	200,000	200,000
Remove invasive species	200,000	200,000	200,000	200,000	200,000
Create spare areas		300,000	300,000	300,000	300,000
Activity 3: Inclusivity					
Develop educational programs	150,000	150,000	150,000	150,000	
Implement citizen science projects		100,000	100,000	100,000	100,000
Community advisory boards			75,000	75,000	75,000
Activity 4: Zero Pollution					
Natural filtration systems	250,000	250,000			
Sustainable farming practices		200,000	200,000	200,000	200,000
Monitoring and enforcement			150,000	150,000	150,000
Activity 5: Health and Wellbeing					
Expand public access to green spaces	100,000	100,000	100,000		
Public health campaigns		50,000	50,000	50,000	50,000
Physical activity and nature programs			50,000	50,000	50,000
Total	2,150,000	2,700,000	2,725,000	2,525,000	1,825,000

The budget for each category includes both direct costs (e.g., materials, labour) and indirect costs (e.g., administrative expenses, monitoring). The figures escalate in the initial years as programs ramp up and are projected to stabilize as some activities reach their planned completion or reduce in scope.

Costs are anticipated to decrease towards the end of this period as the initial high-intensity restoration and infrastructure projects complete their major phases. This budget does not include potential additional funding from governmental or private sources which could alter the financial planning significantly.

This budget framework will help guide the RSP's financial strategy, ensuring that resources are allocated efficiently to achieve the plan's objectives over the next five years.

8 Uncertainties and Assumptions/ Boundary Conditions

The last section of the ReMILes addresses the uncertainties, assumptions, and boundary conditions that underpin the strategic planning and implementation process. Understanding these elements is crucial for adapting and revising the plan to better align with realistic expectations and achievable outcomes.

8.1 Main Uncertainties

Climate Variability and Change: The impact of climate change on weather patterns, especially in terms of increased frequency and severity of droughts and floods, remains a significant uncertainty. This variability can affect the effectiveness of water management and conservation strategies planned under the RSP.

Policy and Regulatory Changes: Changes in environmental policies, both at the national and EU levels, can impact the planned activities. For instance, shifts in the Common Agricultural Policy (CAP) or local water management laws could influence funding priorities and regulatory compliance requirements.

Technological Advancements: The pace and applicability of technological advancements in areas like irrigation efficiency, pollution control, and habitat restoration are uncertain. These technologies are critical to achieving the RSP's goals but depend heavily on ongoing research and development.

Stakeholder Engagement: The degree of collaboration from all stakeholders, including local communities, farmers and governmental bodies, presents an uncertainty. Effective engagement is crucial for the successful implementation of nature-based solutions and other restoration actions.

Economic Fluctuations: The availability of funding from various sources (governmental, private, and non-profit) can be influenced by broader economic conditions. Economic downturns or shifts in funding priorities could affect the RSP's financial sustainability.

8.2 Main Assumptions

Continued Support for Environmental Initiatives: The plan assumes ongoing support and prioritization of environmental restoration and climate action at both local and EU levels. This includes the assumption that current levels of funding and regulatory support will at least be maintained, if not increased.

Effectiveness of Nature-Based Solutions: There is an underlying assumption that the nature-based solutions proposed will perform as expected in terms of enhancing biodiversity, reducing pollution, and improving water management.

Stakeholder Cooperation: It is assumed that all identified stakeholders will actively cooperate and that their interests will remain aligned with the RSP's goals throughout its implementation.

Accessibility of Technological Solutions: The plan assumes that necessary technological solutions will be available and affordable for local implementation, especially in terms of monitoring and managing water resources.

8.3 Boundary Conditions

Legislative Framework: The plan is constrained by current environmental legislation and water management policies. Any significant changes in these areas could necessitate a revision of the RSP strategies.

Geographic Scope: The plan's actions are confined to the designated river basins and floodplains, and any expansion beyond these areas would require additional assessments and possibly new stakeholder agreements.

8.4 Overcoming Policy Barriers

The RSP identifies certain policy barriers, particularly relating to CAP legislation, that are outside the immediate sphere of influence. While direct influence on CAP adjustments may not be feasible in the short term, the RSP can include strategies to engage more actively with policy-making processes through advocacy and partnership with larger organizations that have a voice in EU policy discussions.

8.5 Validating Assumptions and Mitigating Uncertainties

Regular stakeholder meetings and updates will be crucial for validating the assumptions made in the RSP. These gatherings will also serve to ensure that all parties share a common understanding and commitment to the goals. To mitigate uncertainties, the plan includes a robust monitoring framework to track the effectiveness of implemented actions and adaptively manage responses to changing conditions, such as technological advancements and economic shifts.

In conclusion, identifying these uncertainties and assumptions allows for the continuous refinement of the RSP, ensuring that it remains relevant and effective in achieving its long-term goals.

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