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## Natural Water Retention Measures

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Service contract n°07.0330/2013/659147/SER/ENV.C1

# *Case Study*

## *Floodbreaking hedgerows*

### *Southern France*



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## I. Basic Information

Application ID	France_01		
Application Name	Floodbreaking Hedgerows – Southern France		
Application Location	Country:	France	Country 2:
	NUTS2 Code	FR62-Midi-Pyrénées	
	River Basin District Code	FRF-L'Adour, la Garonne, la Dordogne, la Charente et les cours d'eau côtiers charentais et aquitains	
	WFD Water Body Code		
	Description	The Lèze is a river located in the South of France, near the Pyrenees, on the French départements Ariège and Haute-Garonne.	
Application Site Coordinates <i>(in ETRS89 or WGS84 the coordinate system)</i>	Latitude: 43,254	Longitude: 1,362	
Target Sector(s)	Primary:	Agriculture	
Implemented NWRM(s)	Measure #1:	A2 Buffer strips and shelter belts	
Application short description	This case study shows the implementation of floodbreaking hedges. Floodbreaks are located across the flooding plain of the Lèze and they are regularly spaced every 300 to 500 metres. Partially obstructing the flow, such hedges can slow down running water and dissipate its energy. Impacts of flooding are therefore reduced. Floodbreaking hedges delay and spread out the peak-flow of the river, reducing therefore the potential damages.		

## II. Policy context and design targets

Brief description of the problem to be tackled	<p>In the Lèze river basin, within 28 years (1980-2008), 300 km of hedgerows disappeared (that is to say about 10 km per year in average). The removal of “effective” (from a hydrological point of view) hedgerows, including floodbreaks, was even faster than the removal of other hedges.</p> <p>Land consolidation in the river basin is the main explanation of the removal of hedges. The change of agricultural machinery enabled/needed larger parcels of land.</p> <p>The loss of “effective” hedgerows have several direct consequences such as:</p> <ul style="list-style-type: none"> <li>- A decrease of the infiltration rate and an increase of the runoff rate;</li> <li>- A concentration of the runoff and an acceleration of the water flow;</li> <li>- An increased risk of soil erosion and a more frequent risk of mudslides;</li> <li>- Higher and faster peak flow of flood events causing damages on human populations and activities.</li> </ul>
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What were the primary & secondary targets when designing this application?	Primary target #1:	Flood control and flood risk mitigation	
	Secondary target #1:	Mass stabilisation and control of erosion rates	
	Remarks	The primary target of floodbreaking hedges is to delay and spread out the peak-flow of the river during flood events. Floodbreaks also aim at reducing the energy of the river and its potential of erosion.	
Which specific types of pressures did you aim at mitigating?	Pressure #1:	Floods Directive identified pressure	Other pressure contributing to flooding / flood risk
	Remarks	The primary pressure targeted by floodbreaking hedges is the peak-flow of the river during flood events.	
Which specific types of adverse impacts did you aim at mitigating?	Impact #1:	Floods Directive identified impact	<i>Economic activity</i>
			<i>Infrastructure</i>
			<i>Property</i>
	Remarks	Floods may damage economic activities, properties or infrastructures.	
Which EU requirements and EU Directives were aimed at being addressed?	Requirement #1:	Floods Directive-mitigating Flood Risk	The implementation of floodbreaks is included in an action programme for the river basin of the Lèze. This programme contains actions aiming at preventing flood risks.
	Requirement #2:	Floods Directive-establishing adequate PoM	The implementation of floodbreaks is included in an action programme for the river basin of the Lèze. This programme contains actions aiming at preventing flood risks.
	The action programme which includes the implementation of floodbreaks is called the PAPI of the Lèze. PAPI means “ <i>Programme d’actions de prevention des inondations</i> ” (Action Programme for Preventing Floods). At the scale of river basins, PAPIs promote integrated flood prevention.		
Which national and/or regional policy challenges and/or requirements aimed to be addressed?	Floodbreaks are part of the PAPI of the Lèze. PAPIs are action programme promoting an integrated management of flood risks at the scale of river basins. They are agreements between the state and local authorities on the implementation of actions. PAPIs are tools of the French policy for flood risks mitigation.		

### III. Site characteristics

Dominant Land Use type(s)	Dominant land use	211 Non-irrigated arable land
	Secondary land use	313 Mixed forest
	Other important land use	111 Continuous urban fabric
	Share of land use: - Agricultural areas: 83,39 % - Forest and semi-natural areas: 15,40 % - Artificial surfaces: 1,15 %	
Climate zone	cool temperate moist	
Soil type		
Average Slope	sloping (5-10%)	
Mean Annual Rainfall	600 - 900 mm	
Mean Annual Runoff		
Average Runoff coefficient (or % imperviousness on site)		
	Annual runoff is not known.	
Characterization of water quality status (prior to the implementation of the NWRMs)	The Total Suspended Solids (TSS) is the main problem of water quality. The second problem is the nitrogen content of the river due to agricultural activities.	
Comment on any specific site characteristic that influences the effectiveness of the applied NWRM(s) in a positive or negative way		

### IV. Design & implementation parameters


Project scale	Large (e.g. watershed, city, entire water system)	River basin of the Lèze (35 000 ha)
Time frame NWRM(s) Installation date and lifespan	Date of installation/construction	Start of the installation of floodbreaking hedges: 03.2009
	Expected average lifespan (life expectancy) of the application in years	Long term
Responsible authority and other stakeholders involved	<i>Name of responsible authority/ stakeholder</i>	<i>Role, responsibilities</i>
	1. SMIVAL	The SMIVAL (Syndicat Mixte Interdépartemental de la Vallée de la Lèze - an association of 24 communes localised in the Lèze's valley) has been created in 2003. It is responsible for leading, for defining and for implementing actions for a qualitative and quantitative use of the Lèze and its tributaries and for preventing its floods. As such, it is the initiator and the responsible for the implementation of floodbreaking hedges.
	2. Technical	The Technical Committee supervises the implementation

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	Committee	of the PAPI. It is presided by a sub-prefect and the president of the SMIVAL. Technical Committee includes the SMIVAL, local authorities, technical state departments, public agencies for water management (Onema, Agence de l'eau Adour-Garonne) and Chambers of agriculture.
	3. Chambers of agriculture	The two Chambers of agriculture (one for each Département) represent farmers. As such, they are involved in all steps linked to agriculture (consultation phase, definition of a land policy...).
The application was initiated and financed by	<p>The SMIVAL initiated the planting of 3500 metres of hedges. The 2500 metres left were initiated by the Haute-Garonne département with the support of the SMIVAL.</p> <p>Financing comes from the French State, the SMIVAL, local authorities, FEDER and the Water Agency. Up to now, about 75 000 € have been spent for floodbreaks. About 20 % of the financing comes from the SMIVAL and 80 % from other financing partners.</p> <p>Sources of financing for the period 2007-2011:</p> <ul style="list-style-type: none"> <li>- The French State: 4425,42 €</li> <li>- The SMIVAL: 8970,51 € (each municipality of the SMIVAL is involved in its budget)</li> <li>- Conseil Général (authorities at the level of each Département): 1008,36 €</li> <li>- Conseil Régional (authorities at the level of each Région): 2144,37 €</li> <li>- FEDER Programme: 456,95 €</li> <li>- Adour-Garonne Water Agency: 5306,35 €</li> </ul>	
What were specific principles that were followed in the design of this application?	<p>Principal principles followed in the design of this application have been:</p> <ul style="list-style-type: none"> <li>- Functionality</li> <li>- Acceptability</li> <li>- Information to the public</li> <li>- Consultation and participation of stakeholders</li> </ul>	
Area (ha)	Number of hectares treated by the NWRM(s).	35 000 ha
	Text to specify	The area of the river basin of the Lèze is about 35 000 ha big. Up to now, about 6000 metres of hedges have been planted. 5000 metres are waiting for an administrative approval (DIG: <i>Déclaration d'Intérêt Général</i> )
Design capacity	<p>Following a hydrological study, the localisation of 38 km of potential floodbreaking hedges has been identified.</p> <p>In 2006, 70 km of flood breaking hedges were initially planned to be planted from 2010 to 2016. This objective was reduced up to 35 km in 2008.</p> <p>Cost of planting floodbreaking hedges (hedges with 5 rows of plants): 11 €/m as previously planned in the PAPI. But for the two test hedgerows, costs reached 45 to 60 € per metre.</p> <p>The peak flow of flood events could be reduced by 25% in comparison with the same river basin with field crops.</p>	
Reference to existing engineering	<i>Reference</i>	
	1.	<p>Study on the localisation of hedges</p> <p><a href="http://www.smival.fr/smival/images/imgs_articles/etudeloc/rapporthaies.pdf">http://www.smival.fr/smival/images/imgs_articles/etudeloc/rapporthaies.pdf</a></p>
		<i>URL</i>

standards, guidelines and manuals that have been used during the design phase	2.	Technical sheet on floodbreaking hedges	<a href="http://www.smival.fr/smival/images/imgs_articles/haies/ft-haie.pdf">http://www.smival.fr/smival/images/imgs_articles/haies/ft-haie.pdf</a>
	3.	Newsletter on floodbreaking hedges	<a href="http://www.smival.fr/smival/images/imgs_articles/bulletins/bulletin18.pdf">http://www.smival.fr/smival/images/imgs_articles/bulletins/bulletin18.pdf</a>
	4.	Hydraulic study of the Lèze	<a href="http://www.smival.fr/smival/index.php?option=com_content&amp;view=article&amp;id=29&amp;Itemid=35">http://www.smival.fr/smival/index.php?option=com_content&amp;view=article&amp;id=29&amp;Itemid=35</a>
Main factors and/or constraints that influenced the selection and design of the NWRM(s) in this application?	<p>Cooperation issues with land owners and farmers: planting of hedges questions the current agricultural model.</p> <p>Finding voluntary farmers and land owners.</p> <p>Drainage or irrigation equipment constrains the design of floodbreaks.</p>		

## V. Biophysical impacts

Impact category (short name)	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)
Select from the <b>drop-down menu</b> below: 			
Runoff attenuation / control	<i>Describe the impact on runoff reduction and/or control</i>		
Peak flow rate reduction	<p>No in-depth hydrological analysis has been carried out in order to assess the impact of floodbreaking hedges on the dynamic of flood events (flood flows, velocity, spread of peak flows, etc.). Moreover, such an analysis his difficult to carry out.</p> <p>According to a hydrological model: In the case where the flood plain of the Lèze would be covered by regularly spaced floodbreaking hedgerows, the peak flow of flood events could be reduced by 25% in comparison with the same river basin with field crops. In the reality, the river basin already has hedges (about 900 km) and one will not achieve a landscape with a very dense network of hedges. The model only shows a trend.</p>		
Impact on groundwater			
Impact on soil moisture and soil			



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storage capacity			
Restoring hydraulic connection			
Water quality Improvements			
WFD Ecological Status and objectives			
Reducing flood risks (Floods Directive)			
Mitigation of other biophysical impacts in relation to other EU Directives (e.g. Habitats, UWWT, etc.)			
Soil Quality Improvements			
Other			

### VI. Socio-Economic Information

What are the benefits and co-benefits of NWRMs in this application?	<p>Direct benefits of the implementation of the measure are:</p> <ul style="list-style-type: none"> <li>- Reduction of flood damages in urban areas (houses, school, roads...)</li> </ul> <p>Indirect benefits of the implementation of the measure are:</p> <ul style="list-style-type: none"> <li>- Landscape conservation</li> <li>- Provision of ecosystem services to farmers</li> </ul>		
Financial costs	<b>Total:</b>	75 000 € (April 2014)	<p>Between 2009 and 2012, 3020 linear metres of hedgerows have been planted (including 520 linear metres for the two test hedgerows) for a total cost of 47 870 € (costs for hedgerows which have planted later are not taken into account).</p> <p>Costs are distributed as follow:</p> <ul style="list-style-type: none"> <li>- Technical study: 9 240 € in 2007</li> <li>- First test hedge (in Montaud): 4 221,40 € in 2008 and 3 532,98 € in 2009</li> <li>- Second test hedge (in Artigat): 3 420 € in 2010</li> <li>- Hedge planting 2011-2012: 27 456 € in 2011 and 2012</li> </ul> <p>Cost of one linear metre of hedge: 11 € as planned the PAPI. But for the test hedgerows, costs reached 45 to 60 € per linear metre.</p>
	<i>Capital:</i>	<i>Value in €</i>	

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	<i>Land acquisition and value:</i>	Value: 5000 €/ha	Four types of agreements with the SMIVAL were proposed to farmers and land owners. For one option, the SMIVAL had to buy the land to the owner. The price of land depends on the crop (arable lands or permanent grasslands) and on the département. In Ariège, prices are 5000 €/ha for arable land and 2500 €/ha for permanent meadows. In Haute-Garonne they respectively reach 6000 €/ha and 3000 €/ha. This option was never chosen by land owners.
	<i>Operational:</i>		
	<i>Maintenance:</i>		
	<i>Other:</i>		
Were financial compensations required? What amount?	<p><i>Total amount of money paid (in €): 0€</i></p> <p><i>Compensation schema:</i></p> <p>Payment depends on the agreement between farmers/landowners and the SMIVAL. In some case, there is no payment. There may be a payment to landowners when arable land is bought or rent by the SMIVAL. There may also be a payment to farmer when new hedgerows disturb the organisation of the farmers.</p> <p>Farmers chose an agreement without any financial compensations (considered as simpler for farmers)</p>		
Economic costs			
<p>Which link can be made to the ecosystem services approach?</p> <p><i>Hint: The actual benefits of improving nature's water storage capacity are essentially linked to an improved provision of some of the following ecosystem goods and services:</i></p> <ul style="list-style-type: none"> <li>- <i>Freshwater for drinking.</i></li> <li>- <i>Water provision to deliver water services to the economy both for drinking and non-drinking purposes.</i></li> <li>- <i>Water security (reliability of supply and resilience to drought).</i></li> <li>- <i>Health security (control of waterborne diseases).</i></li> <li>- <i>Flood security and protection.</i></li> </ul>	<ul style="list-style-type: none"> <li>- Flood security and protection: reduction of flood damages in urban areas (houses, school, roads...)</li> <li>- Biomass production: production of biomass usable by farmers</li> <li>- Amenities: habitats for auxiliary wildlife</li> </ul>		

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<ul style="list-style-type: none"> <li>- <i>Storm surge protection.</i></li> <li>- <i>Biomass production.</i></li> <li>- <i>Amenities (associated to habitat protection): fish and plants, tourism, recreation, and others.</i></li> <li>- <i>Benefits of improved coastal water quality and ecological status for a sustainable commercial production of shellfish with human health and welfare values.</i></li> </ul>	
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### VII. Monitoring & maintenance requirements

Monitoring requirements	
Maintenance requirements	Maintenance scheme depends on the agreement between the farmers and the SMIVAL. Currently, only one option has been chosen. In this option, maintenance of hedges is under the responsibility of the SMIVAL during the three years following the planting. Then, farmers or land owners are responsible for the maintenance of hedges.
What are the administrative costs?	

### VIII. Performance metrics and assessment criteria

Which assessment methods and practices are used for assessing the biophysical impacts? <i>Please describe e.g.: comparison to, paired watershed, pre vs. post, etc.</i>	No assessment
Which methods are used to assess costs, benefits and cost-effectiveness of measures?	
How cost-effective are NWRM's compared to "traditional / structural" measures?	
How do (if applicable) specific basin characteristics influence the effectiveness of measures?	
What is the standard time delay for measuring the effects of the measures?	

### IX. Main risks, implications, enabling factors and preconditions

What were the main implementation barriers?	<p>Planting of hedges questions the current agricultural model (larger filed plots, drainage and irrigation equipments, etc.)</p> <p>The ownership of land and the attachment of owners to their land.</p> <p>The implementation of floodbreaking hedges requires voluntary farmers and land owners.</p> <p>Data about farmers having lands in the Lèze flood plain were difficult to access. It is therefore more difficult for the SMIVAL to target these farmers and to invite them to meetings, for example. This information is confidential and</p>
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	cannot be easily spread. The current localisation of drainage and irrigation equipment
What were the main enabling and success factors?	An enabling factor for involving local stakeholders is the meeting of global issues by local events. For example, the involvement of farmers is higher when they see mudslides in their fields than when they hear about slowing down peak flow.
Financing	Financing comes from the French State, the SMIVAL, local authorities, FEDER and the Water Agency. Up to now, about 75 000 € have been spent for floodbreaks. About 20 % of the financing comes from the SMIVAL and 80 % from other financing partners. Sources of financing for the period 2007-2011: <ul style="list-style-type: none"> <li>- The French State: 4425,42 €</li> <li>- The SMIVAL: 8970,51 € (each municipality of the SMIVAL is involved in its budget)</li> <li>- Conseil Général (authorities at the level of each Département): 1008,36 €</li> <li>- Conseil Régional (authorities at the level of each Région): 2144,37 €</li> <li>- FEDER Programme: 456,95 €</li> <li>- Adour-Garonne Water Agency: 5306,35 €</li> </ul>
Flexibility & Adaptability	Floodbreaking hedges can potentially be adapted to all river basins where flood events occur.
Transferability	

### X. Lessons learned

Key lessons	<p>This case study shows the implementation of floodbreaking hedges. Floodbreaks are located across the flooding plain of the Lèze and they are regularly spaced every 300 to 500 metres. Partially obstructing the flow, such hedges can slow down running water and dissipate its energy. Impacts of flooding are therefore reduced. Floodbreaking hedges delay and spread out the peak-flow of the river, reducing therefore the potential damages.</p> <p>It is particularly important to involve farmers and land owners as well as the local population in order to make sure than enough voluntaries can be found.</p>
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### XI. References

Source Type <i>Select from the drop-down menu</i>	<i>Project Report</i>	<i>Project Report</i>	<i>Project Report</i>	<i>Project Report</i>	<i>Project Report</i>
Source Author(s) <i>Provide the Name of the author(s)</i>	SMIVAL	SMIVAL	SMIVAL	SMIVAL	SMIVAL
Source Title <i>Provide the Tile of the reference</i>	Activity report 2009	Activity report 2010	Activity report 2011	Activity report 2012	Activity report 2013
Year of publication <i>Provide the year in the format (YYYY)</i>	2010	2011	2012	2013	2014

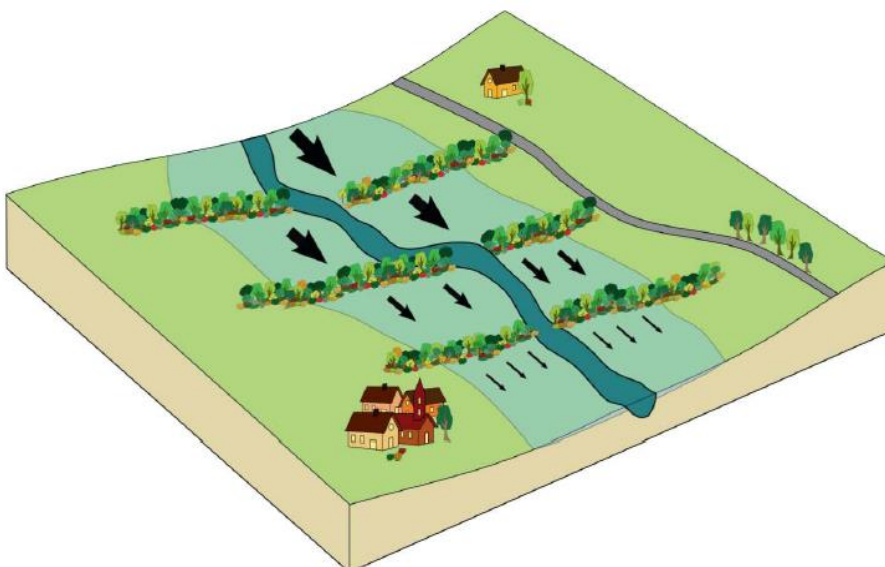
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Editor/Publisher <i>e.g. Journal/ Volume/ Issue</i>	SMIVAL	SMIVAL	SMIVAL	SMIVAL	SMIVAL
Source Weblink <i>Direct weblink(s) of the reference</i>	<a href="http://www.smival.fr/smival/images/imgs_articles_rapports_activite/RA2013.pdf">http://www.smival.fr/smival/images/imgs_articles_rapports_activite/RA2013.pdf</a>	<a href="http://www.smival.fr/smival/images/imgs_articles_rapports_activite/RA2012.pdf">http://www.smival.fr/smival/images/imgs_articles_rapports_activite/RA2012.pdf</a>	<a href="http://www.smival.fr/smival/images/imgs_articles_rapports_activite/RA2011.pdf">http://www.smival.fr/smival/images/imgs_articles_rapports_activite/RA2011.pdf</a>	<a href="http://www.smival.fr/smival/images/imgs_articles_rapports_activite/RA2010.pdf">http://www.smival.fr/smival/images/imgs_articles_rapports_activite/RA2010.pdf</a>	<a href="http://www.smival.fr/smival/images/imgs_articles_rapports_activite/RA2009.pdf">http://www.smival.fr/smival/images/imgs_articles_rapports_activite/RA2009.pdf</a>
Key People <i>List names, affiliation and contact details of key people who have communicated important information presented in this factsheet</i>	<i>Name / affiliation</i>			<i>Contact details</i>	
	1.	<b>Thomas BREINIG</b>		Director of the SMIVAL	

## XII. Photos Gallery



**Test floodbreaking hedge with info panels in Montaut (source: SMIVAL)**



**Diagram of floodbreaking hedges (source: SMIVAL)**