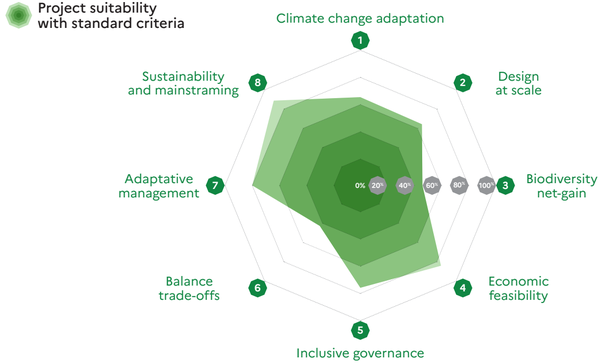
LEVERS FOR SUCCESS

- **Technical skills:** the scientific and technical expertise of specialists from several disciplines (Scientific Interest Group).
- **Funding:** the project has benefited from numerous complementary funding sources: INRAE, MTE, MAA, Électricité de France (EDF), Rhône, Mediterranean and Corsica Water Agency, PACA Region, EU (European Regional Development Fund).
- **Concertation:** involvement of stakeholders by means of a steering committee.

RECOMMENDATIONS

- Assess the benefits derived from vegetation engineering structures in terms of protecting populations and economic gains regarding flood risk.
- Take better into consideration trends in climate parameters and their consequences for the whole watershed.
- Set up training on vegetation engineering for contracting authorities.

ASSESMENT ACCORDING TO THE IUCN GLOBAL STANDARD FOR NATURE BASED SOLUTIONS



FOR FURTHER INFORMATION

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PROJECT LEADER

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RÉPUBLIQUE FRANÇAISE
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OFFICE FRANÇAIS DE LA BIODIVERSITÉ

FLOOD PREVENTION THROUGH VEGETATION ENGINEERING

1998 - 2013


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IDENTITY CARD

GEOGRAPHICAL SITUATION

Durance River Basin,
Provence Alpes Côte d'Azur

TARGET ADAPTATION ISSUE(S)

- **Erosion**
- **Flooding**

HABITAT(S) CONCERNED

Continental aquatic habitats

TYPE(S) OF NBAS

Restoration of ecosystems

PROJECT LEADER(S) AND ASSOCIATED PARTNER(S)

- **INRAE**
- Associated partners (see funders)

FUNDERS AND BUDGET

- Ministry of Agriculture (37%)
- EDF (8%)
- Rhône, Mediterranean and Corsica Water Agency (8%)
- Provence-Alpes- Côte d'Azur Region (8%)
- Ministry of Ecological Transition (3%)
- European Union (36%)

Total budget: **1 470 000 € TTC**

REGULATORY CONTEXT OF THE PROJECT

GEMAPI (Management of Aquatic Habitats and Flood Prevention)

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UICN Comité Français
artisan — Le climat change, adaptons-nous avec la nature

INRAE

PROJECT OBJECTIVES

- **For adapting to climate change** prevent the risk of flooding and respond to erosion and sedimentation issues in the Durance River Basin.
- **For biodiversity** encourage the return of biodiversity associated with this habitat through vegetation engineering, by means of ecological restoration actions on degraded land.

Start of works
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CONTEXT AND ISSUES

The Durance's watershed, in the southern Alpes, is characterised by considerable annual variability in water resources between upstream (abundant resources regulated by large dams) and downstream (low resources and high demand). This spatial contrast is accentuated by an issue of alternating excesses of water and droughts on eroded terrain, exacerbated by climate change. In addition, the excess of fine sediments in the rivers is responsible for the degradation of natural habitats and an increased risk of flooding.

The implementing of the local authority jurisdiction GEMAPI (Management of Aquatic Habitats and Flood Prevention) now calls for solutions that can combine flood prevention with the integrated management of aquatic habitats. Innovative uses of this type of solution have particularly been developed in the Durance River Basin in order to increase safety levels regarding the risk of flooding, the resilience of ecosystems and the conservation of aquatic ecological communities.

ACTIONS IMPLEMENTED

In order to reduce inputs of fine sediments while at the same time initiating a process of ecological restoration of these degraded habitats, an innovative use of vegetation engineering was carried out, by means of its role in controlling erosion and sedimentation, within the Durance's watershed. It involves allowing the erosion to take place on the slopes and stopping the eroded matter before it reaches the River Durance and its tributaries, with as little intervention as possible. Vegetation engineering structures were placed in the beds of the eroded ravines, forming effective plant obstacles to trap and retain the eroded marly sediments.

To better define the ecological engineering rules to be applied to these habitats, tests and full-scale pilot operations have been carried out since 1998, with the construction (spread over 10 years) of 1578 vegetation engineering structures, developing plant cover on bare terrain, corresponding to a linear stretch of riverbed more than 1000 km long. The vegetation engineering structures used are based essentially on cuttings (Purple Willow, Bitter Willow, Black Poplar). They are arranged in a cascade in the beds of ravines to reduce the energy of high waters by means of the sills created, to increase the total capacity of the structure for trapping sediments.

The research results were used to develop recommendations intended to enable the replication of the project over the whole Durance's watershed, and an interactive tool for operators, managers and decision-makers to determine the most economically viable solution (cost-benefit ratios) for effective and sustainable trapping of sediments.

SCHEDULE

	PROJECT LIFESPAN
1998 to 2009	Experimentation concerning erosion control on black marl slopes.
2010 to 2013	Study about the innovative use of biological engineering for erosion and sedimentation control in the watersheds of the Bouinenc and Durance. Identification of plant species able to revegetate eroded marly ravines exposed to the south and testing of the strength of biological engineering structures in ravines bigger than 1 ha. Full-scale test of the application of biological engineering, at the scale of a multi-kilometre river basin (Bouinenc, 40 km^2). Action plan and assessment of the ecological rehabilitation of eroded marly ravines for the lasting retention of sediments in the whole Durance's watershed.

GOVERNANCE ADOPTED

A steering committee met at least once a year throughout the project. The members of this committee were representatives of the Durance Valley mixed planning syndicate (SMAVD), the Provence-Alpes-Côte d'Azur Regional Food, Agriculture and Forest Directorate, the Provence-Alpes-Côte d'Azur Regional Environment, Planning and Housing Directorate, Électricité de France (EDF), the Ministry of Agriculture, the Prefecture of the Provence- Alpes-Côte d'Azur region, the Mountain Terrain Restoration (RTM) service of the Alpes-de-Haute-Provence department, the mixed planning syndicate of the Bléone (SMAB), and finally the Rhône, Mediterranean and Corsica Water Agency. The committee also invited expert operators and researchers in these fields from: the Alpes-de-Haute-Provence branch of The French National Forest Office, companies Géophyte and Zygène and the Draix-Bléone Scientific Interest Group (SIG).

BENEFITS AND CONTRIBUTIONS OF THE PROJECT

BENEFITS REGARDING TARGET ADAPTATION ISSUES

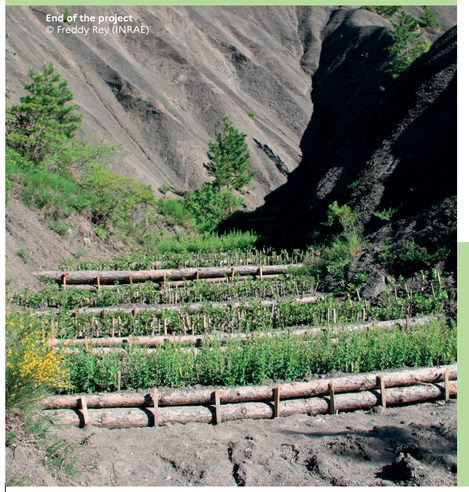
- Erosion: the monitoring of several hundred vegetation engineering structures (out of the 1578 constructed) demonstrated they efficiency for trapping and fixing marly sediments. The monitoring showed that 20% plant cover was sufficient to almost completely stop the sediment production of a ravine of about 1 hectare.
- Flooding: the trapping of fine sediments should rebalance their transit in the Durance and reduce the flood risk.

BENEFITS FOR BIODIVERSITY

- There are many spontaneous species: about 50 species were counted right from the first year and as many as 65 in subsequent years although the terrain was initially bare. Among the spontaneous species, four were tested with regard to sediment trapping. The deciduous species (Lavender and Box) showed better trapping rates than the conifers (Austrian Pine and Juniper).

OTHER BENEFITS PRODUCED

- Improved living environment: these actions have improved the landscape quality of the site in parallel with adaptations for receiving the public (decks, paths, footbridges and observation points), adopting an approach to organising areas around the "water journey".
- Education: the site is now an educational resource for schoolchildren and students.



End of the project
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MONITORING INDICATORS

Adapting to climate change

- Effectiveness of structures: monitoring of quantities of eroded matter retained upstream of structures (resistance of structures and vegetation to high water levels, capacity of vegetation to trap and fix marly sediments).

Biodiversity

- Number of species and species richness: assessed over several years by counting seedlings and determining the (spontaneous) species diversity established in the sediment deposits, upstream of the structures.

Other

- Evolution of ground cover: assessed by photo monitoring and field surveys.