Increasing water retention through afforestation, landscaping and reducing the stream gradient in Xiropotamos River Basin, Greece

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Summary

In the Xiropotamos River Basin, near the town of Naoussa in Central Macedonia, Greece, a set of natural water retention measures was implemented to address severe erosion, flash flooding, and reduced water availability. The area, affected by deforestation and land degradation, required restoration to stabilize soils and improve hydrological regulation.

The project, initiated in 2004 and approved under national environmental terms in 2013, combined afforestation, riverbed reshaping, and small-scale retention structures. Around 70 hectares of degraded land were reforested with native tree species to reduce runoff and increase infiltration. In parallel, a 2 km stretch of the river was reprofiled to reduce its slope, and a series of check-dams and retention basins were constructed to slow water flow and trap sediments.

Implementation was led by the Municipality of Naoussa with the support of a private contractor, and the public development agency AN.KO A.E. contributed to forest technical works in the mountainous upstream areas. The intervention stands out as one of the first in Greece to combine forest hydrological engineering with landscape restoration at basin scale.

The project helped decrease peak flows, reduce sediment transport, and improve local water retention. It also provided environmental co-benefits by restoring vegetation cover and stabilizing the catchment. Its approval under Greek environmental regulations highlights its formal recognition and alignment with national water and forest policy objectives.

Photo Gallery



Location

40.63, 22.06

Project

NWRM

National ID

Greece_01

Sector

Forest

Implementation status

Completed

Contact

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Overview

Location of the project

The Xiropotamos River Basin is situated near the town of Naoussa, in Central Macedonia, Greece. The project concerns areas within the mountainous catchment and a 2 km stretch of the river itself.

Country

Greece

NUTS2 Code

Δυτική Μακεδονία (Dytiki Makedonia)

Sponge measures implemented in the case study

Maintenance of forest cover in headwater areas

Check dams

Stream bed re-naturalisation

Objectives

Reduce runoff velocity and peak flows through terrain modifications.
Increase water retention and infiltration via restoration and vegetation.
Mitigate soil loss and improve hydrological regulation at sub-basin scale.

Involved partners

Authority type	Authority name	Authority role
Regional / sub-national water authority	The Decentralised Administration of Epirus and Western Macedonia, Directorates General of Land Planning and Environmental Policy, Directorate of Environment, Land Planning of Western Macedonia, Department of Environment and Land Planning	Determination of design details of the measure

Site Information

Climate Zone

Warm temperate dry

Precipitation

609.80 mm

Temperature (°C)

11.60 °C

Runoff

1.93 mm

Elevation range

375

Vegetation class

The dominant vegetation appears to be forest (native tree cover) rather than grassland.

WFD Ecological status

Good

WFD Chemical status

Failing to achieve good

Design and Implementation

Project scale

Meso

Project scale specifications

The intervention was carried out at the river basin level, specifically in the Xiropotamos sub-basin near Naoussa (Central Macedonia, Greece). It involved integrated actions across a 2 km stretch of the river and 70 hectares of the surrounding catchment, including reforestation, riverbed reshaping, and construction of check-dams and retention basins.

Project area

2800

Area subject to Land use change or Management/Practice change (ha)

2800.00 ha

Constraints

The constrains include the implementation of such measures in protected areas and the limitations that are for this reason necessary

Favourable preconditions

The necessary preconditions are the climate conditions and the hydrology of the area.

Financing

Total cost information

The measures have not been implemented yet in the area

Costs investment information

The measures have not been implemented yet in the area

Costs operation maintenance information

The measures have not been implemented yet in the area

Policy and Governance

Policy description

The specific interventions aim at slowing down the stream velocity with retaintion dams and reduction of stream gradient. Additionally the application aimed at reducing soil erosion through afforestation and planting in order to improve the soil properties and mitigate flood risk.

Policy targets

Runoff control

Peak-flow reduction

Erosion Control

Improved Biodiversity

Part of a wider plan

No

Public consultation

No

Has contractual arrangements

No

Impacts and Monitoring

Impact Assessment Methodology

Performance impact assessment method

Unknown

Performance impact estimation information

Non applicable

Socio-economic Impacts

Direct benefits information

The direct benefits include the reduction of the flood risk, the mitigation of soil erosion, the improvement of the micro-environment as well as the aesthetic restoration of the area.

Ancillary benefits information

Ancillary benefits include the increase of infiltration / percolation and recharge of aquifers; this water can be used for different purposes (e.g agriculture) as well as for ecosystem services. Also the aesthetic improvement of the area has positive societal impacts

Biophysical impacts: Hydrology

Information on retained water

The volume of retained water was increased due to the small scale dams as well as the improvement in the area vegitation after the afforestation/plantation

Information on increased water storage

The measures slowed down the stream flow and increased the retaining of water for longer period enabling the infiltration/percolation and recharge of aquifers.

Information on runoff reduction

The measures improved the runoff control as the velocity of water volume was reduced leading to decreasing the intensity and frequency of floods.

Biophysical impacts: Biodiversity

Improved biodiversity

Yes

Information on improved biodiversity

The measures are expected to have positive impact on the biodiversity of the area

Biophysical impacts: Water & Soil Quality

Information on water quality overall

Not relevant for this application

Soil quality overall improvements

Positive impact-SQ improvement

Information on soil quality overall improvements

The measures have a direct impact on the overall soil quality as afforestation / plantation of the area succeeds in improving the soil properties leading to increased soil storage capacity. Soil erosion have reduced the soil capacity to store and retain water thus an improvement in the soil properties (e.g. soil moisture) can have a positive impact on the soil infiltration capacity.

Biophysical impacts: Others

Ecosystem impact climate regulation

No information available

Information on ecosystem impact climate regulation

The micro-climate and micro-environment is expected to be positively affected by the implemented measures; however the degree of impact is not assessed

Lessons Learned

Key lessons

The Xiropotamos River Basin project demonstrates how a combination of afforestation, riverbed reshaping, and small-scale retention structures can be used to address erosion and flash flooding in a mountainous Mediterranean context. By targeting a degraded sub-basin with limited vegetation cover and a steep gradient, the intervention focused on restoring natural water retention processes through relatively low-tech, nature-based solutions.

One of the key lessons is the importance of integrating forest and hydrological engineering in a basin-scale approach. The coordinated use of reforestation and check-dams allowed for both slope stabilization and a reduction in peak flows. This approach may be replicable in similar environments where erosion control and water retention are priorities.

The project also shows the value of institutional collaboration. It involved local authorities (Municipality of Naoussa), a public development agency (AN.KO A.E.), and national oversight through environmental approval by the decentralised administration. This structure helped align the intervention with regional and national environmental policy.

However, a major limitation is the lack of long-term monitoring data. Without quantifiable evidence of hydrological, ecological, or socio-economic impacts, it is difficult to fully assess the project’s effectiveness or guide adaptive management. This highlights the need for structured follow-up and impact assessment in similar projects.

Finally, the case underscores the potential of pilot-scale, EU-funded initiatives to test nature-based solutions in real-world settings. Yet, it also suggests that such efforts must be accompanied by transparent documentation and accessible evaluation data to inform broader policy and practice.

Barriers

Barrier type	Barrier role	Comments
Lacking coordination between authorities	Main barrier	The regional with the local authorities for the permissions etc

Drivers

Driver type	Driver role	Comments
Other	Main driver	The improved mountainous hydrology of the area.

Success factors

Success factor type	Success factor role	Comments
Attitude of decision makers	Main factor	The decision makers approved the relevant environmental impact assessment

Transferability

This measure is transferable to other Mediterranean or mountainous regions facing erosion and flash flooding. Its success depends on careful site selection, use of native vegetation, and integration of hydrological and forestry techniques. Attention must be paid to local soil stability, rainfall patterns, and community involvement. Long-term monitoring is essential to assess effectiveness and guide adaptation.

Sources

Sources

Approval for environmental terms for implementation of forest hydroeconomy works in mountainous areas in part of the river basin of Xiropotamos

Πτυχιακή εργασία: “Διερεύνηση της ποιότητας του νερού της Λίμνης Καστοριάς

Στρατηγική Μελέτη Περιβαλλοντικών Επιπτώσεων (ΣΜΠΕ) ΣΧΟΟΑΠ Δήμου Αργιθέας Νομού Καρδίτσας

Σχέδιο Διαχείρισης των Λεκανών Απορροής Ποταμών του Υδατικού Διαμερίσματος Κεντρικής Μακεδονίας