Controlled drainage and adjustable weirs in agricultural parcels in Flanders, Belgium

Year of issue

2025

Summary

This case study documents applied research in Flanders that tested and scaled controlled drainage and simple adjustable weirs on arable land. The LEADER Drainage Plus pilot (2016 to 2019) converted nine parcels totalling 35 ha from conventional systems to level-controlled drainage, installing control pits and combining on-farm demonstrations with monitoring and modelling led with the Belgian Soil Service. The goal was to retain winter water in the root zone, reduce downstream peaks, and improve yields in a region facing summer drought and wetter winters. The project showed that, on suitable flat and permeable fields, controlled drainage increased crop growth, with income gains from about €100 up to several hundred euro per hectare depending on crop and year, and it triggered wider farmer uptake.

Follow-up regional work expanded monitoring and practical guidance (Van Landbouw tot Waterbouw) and OP-PEIL is mapping where conversion is technically and economically viable; weirs were promoted as fast, no-land-take devices to hold ditch water with siting criteria. Field rules of thumb were consolidated: a 10 cm groundwater rise can add roughly 30 to 35 mm evapotranspiration and about 1 t/ha dry matter; maize water stress can be postponed up to two weeks; indicative local storage is about 500 m^3 per hectare. Barriers included permit complexity for each weir, costs and the legacy preference for fast evacuation. Typical costs reported are about €2,000 per hectare when reusing drains, about €4,500 per hectare for full renewal, and about €4,500 per weir. A major outcome was policy change: Flanders created a subsidy for controlled drainage (75 percent support up to €2,000 per hectare) and 100 percent subsidy for weirs with limited budgets, directly linked to the early pilots. Today the pilot is finished, follow-ups delivered monitoring and guidance, and conversions continue where site conditions and farmer motivation align.

Photo Gallery



Location

51.2, 5.5

Sector

Hydromorphology

Installation Date

2016-2022

Implementation status

Completed

Overview

Location of the project

Various pilot sites in Flanders, Belgium.

Sponge measures implemented in the case study

Peak flow control structures

Controlled Drainage

Objectives

Retain winter water locally for crop use in summer

Reduce drought stress and downstream peak flows

Improve yields and farm income

Demonstrate feasibility and build farmer awareness

Involved partners

Authority type	Authority name	Authority role	Comments	Authority responsibility
NGO	Boerennatuur Vlaanderen	Initiation of the measure	formerly agrobeheercentrum Eco² vzw project promoter, coordination, farmer engagement, administration, communication	Responsible
Architects / Engineers	Bodemkundige Dienst van België (BDB)	Monitoring	monitoring, modelling, technical studies	Supporting
Farmers	Participating farmers in Kempen en Maasland	Implementation	—	Responsible

Site Information

Climate Zone

Cool temperate moist

Temperature (°C)

10.50 °C

Elevation range

20-100 m

Slope range

Flat fields < 0.5 %

Groundwater level

Depends on site, often around 80 cm

Vegetation class

Arable crops and grassland on pilot parcels.

Water quality status

Nitrate often high in ditches and control pits at monitored parcels; phosphate occasionally detected.

Design and Implementation

Project scale

Meso

Project scale specifications

Multi-site pilots across farms totaling 35 ha within a regional LEADER area, an dup to 82 ha with the most recent project.

Project area

82 ha

Principles

Install water control structures at drainage outlets to set outflow level and switch between full, partial, or no drainage depending on crop needs. For weirs, install adjustable boards or orifice-weirs in ditches to hold back water without land take.

Factor constraints

Flat fields, suitable soil permeability, and adequate receiving ditch capacity
Existing drains in good condition and not too old
Drain gradient limits and small ground-level differences per drain run
Accessible locations for weirs, typically at least 300 m spacing between weirs

Financing

Total cost

157649.00 €

Total cost information

Conversion costs depend on reusability of existing drains

Approx. 2,000 €/ha when existing system can be reused

Approx. 4,500 €/ha when full renewal is needed

Indicative cost per weir around 4,500 €

Flanders subsidy reported for conversions: 75 percent support up to 2,000 €/ha, developed following Drainage Plus experience

Weirs: 100 percent subsidy reported, but budget amounts limited

Financing authorities

Authority name	Type of funding	Comments	Financing share
European Union	EU-funds: Cohesion and regional development funds	via LEADER/CLLD 51,236 €	33 %
—	National funds	51,236 €	33 %
—	Private funds	25,177 €	16 %
—	Other	30,000 €	19 %

Compensations

No

Policy and Governance

Policy description

Flanders faces both drought and flood stress. Water availability per capita is low, with limited large rivers and high population density and activity; climate change is shifting rainfall toward drier summers and wetter winters, so retaining winter water locally is needed. Historically, the region engineered deep, fast-evacuating drainage networks, and some farmers still prefer to “get rid of water fast,” which conflicts with retention goals. Administrative hurdles persist: drain permits in agricultural zones are seen as overly complex, and each weir requires a permit. The pilots demonstrated benefits and built an evidence base that informed farmers and policymakers, contributing to creation of the Flanders subsidy for controlled drainage.

Land ownership

Private farmland. Participation voluntary, with an agreement with the association.

Target remarks

Reduce drought stress by retaining winter water for crop use

Lower downstream peak flows and pressure on drainage networks

Improve yields and resilience at farm scale

Pressure remarks

Increasing summer drought and higher winter rainfall in Flanders; high water demand and dense human activity.

Part of a wider plan

No

Public consultation

No

Consultation activities

Activity stage	Activity type
Other	Field demonstrations on farms

Has contractual arrangements

Yes

Contractual arrangements

Arrangement type	Responsibility
Contractual agreement	Farmer : gives monitoring rights to the association and takes care of maintenance needs Association : handles the complex paperwork and finances the works

Impacts and Monitoring

Monitoring System

Monitoring parameters

Drainage Plus: water levels recorded twice per month on four converted parcels, analysed with modelling

Follow-up project: continuous groundwater logging with divers at eight locations from Nov 2019 to Apr 2021; twice-yearly water quality sampling; extended simulations 2007–2021 of groundwater, drought stress, and plant-available water with a water balance model

Maintenance

Maintenance requirements

Controlled drainage requires keeping control pits free of sediment; flushing is less easy if dirt accumulates Weirs need regular cleaning and clear marking to avoid damage from machinery; sediment removal as needed

Impact Assessment Methodology

Biophysical impact assessment method

Site measurements of groundwater and temperature
Modelling of groundwater levels for undrained, conventional, and controlled scenarios
Water balance model producing drought stress index and plant-available water
Conversion of evapotranspiration changes to biomass and to financial value using published water productivity relationships and crop prices

Socio-economic Impacts

Direct benefits

Yield and revenue gains when applied correctly. Drainage Plus synthesis and follow-up modelling show average gains around 100–several hundred €/ha depending on crop and year. Example modelled results: average 121.9 €/ha for grassland at a monitored site; potatoes averaging 325.9 €/ha, up to nearly 1,500 €/ha in very dry 2020. Awareness and uptake among farmers increased across Flanders.

Biophysical impacts: Hydrology

Information on retained water

Level-controlled drainage increased plant water availability and crop evapotranspiration in dry periods
Reported rule of thumb from interviews: +10 cm groundwater can yield 30–35 mm extra evapotranspiration and higher biomass
Storage effect indicative: about 500 m^3 per hectare retained locally
In maize, farmers reported up to two extra weeks without water stress
Local water retention and drought mitigation at field scale
Potential reduction of downstream peak flows

Biophysical impacts: Water & Soil Quality

Information on water quality overall

At monitored sites, nitrate frequently high; phosphate occasionally detected, with values reported in 2021 campaigns at Bree and Pelt sites as examples
Overall effect of measures on water quality not quantified

Lessons Learned

Key lessons

Controlled drainage and simple weirs work, but only where fields are flat, soils permeable and drains are in good condition; pre-site visits are essential because the technique is not universally applicable. Operational discipline and maintenance of control pits and weirs matter. Permit procedures for drains and for each weir are a barrier and need simplification. Demonstrations, monitoring and modelling convinced farmers and policymakers, leading to uptake beyond the pilot area. Costs can be significant, yet gains are highest in dry years, so economics depend on climate.

Barriers

Barrier type	Barrier role	Comments
Legal obligations / restrictions	Main barrier	Complex permit procedures for drains and weirs
Lacking financing sources	Secondary barrier	Costs and ageing or unsuitable drainage layouts
Attitude of relevant stakeholders	Main barrier	Attitudinal barriers among some farmers preferring fast evacuation to controlled drainage

Drivers

Driver type	Driver role	Comments
Past flooding events	Main driver	Climate pressures of summer drought and winter surpluses
Availability of subsidies	Main driver	Availability of subsidies following Drainage Plus
Organisation committed to it	Secondary driver	Motivated farmers and local willingness to pilot

Success factors

Success factor type	Success factor role	Comments
Conducted assessments (incl. economic)	Main factor	Pre-site assessments and field visits

Success factor type	Success factor role	Comments
Communication activities	Main factor	On-farm demonstrations and communication
Conducted assessments (incl. economic)	Secondary factor	Technical support from drainage company and BDB monitoring/modelling

Cost effectiveness

Reported average gains from modelling and synthesis range roughly 100 to 300+ €/ha per year, higher in very dry years

Transferability

Transferable where fields are flat, soils have adequate permeability, drains are in good condition, and access for structures is available
Opportunity mapping and guidance under OP-PEIL to identify suitable areas in Flanders

Sources

Sources

Van Landbouw tot Waterbouw – Technisch Eindrapport

Webinar: Peilgestuurde drainage & subirrigatie (online info session, 15/02/2021)

Boerennatuur Vlaanderen – website

Drainage Plus – Promoting controlled drainage (EU CAP Network good practice page)

Drainage Plus factsheet

OP-PEIL: Opportunities for controlled drainage in Flanders (project page)