LIFE CO2SAND

Increasing climate resilience and carbon sink of sandy soils on agricultural land.
LIFE20 CCA/NL/001625

Project objectives
LIFE CO2SAND aims to demonstrate the effectiveness of increasing resilience and carbon sink capacity of sandy farmland by enriching it with clayey/loamy soil. This approach is to contribute to dealing with three climate and environmental challenges:

1. Agriculture has started suffering the consequences of climate change. Crop yields decline during prolongued droughts. Sandy soils are particularly vulnerable. The agricultural sector therefore faces the challenge of making these sandy soils, in interaction with farming systems, resilient to the effects of climate change.

2. Pursuant to the national Climate Agreement, the Dutch agricultural sector is to realise sequestration of an additional 0.5 Mtonnes CO_2 -eq/year as per 2030 by an increase of soil organic matter and a decrease of N_2O emissions on farmland.

3. It is estimated that annually 1 Mtonne fertile clayey and loamy soil released at Dutch public works is disposed of as if it were waste. This is excellent soil to use for increasing resilience of sandy farmland. In addition, Australian research reveals that, over a 29 years' time span, sandy soils enriched with clay and loam sequestered on average 1.9 tonnes CO_2 -eq/year more as compared to sandy soils without such enrichment.

Our specific project objectives are:

- Realise 5 demonstration fields in Gelderland;
- Achieve replication to 70 fields, 700 ha in total, on the Dutch and European Sand Belt by 2025;
- Adapt planning and contracting procedures to enable inclusion of repurposing fertile soil right from the start of urban planning and public works.

Actions and means involved
A1 Preparation.
Determine amounts and sources of clay, acquire permits and authorisations if required, conclude agreements.

Set up demonstration fields
Set up demonstration fields involving the primary target audience – farmers and land owners. Apply yearly a small clay layer on 5 demonstration fields, until the topsoil holds 8% lutum.

Realise a transformation
Realise a transformation in thinking and behaviour in policy implementation, resulting in reuse of fertile soil/clay becoming unquestionable. Released clay from public works will then be handled as valuable material for vital and climate adaptive soils. Develop a value model connecting the approach to policy objectives. Integrate the approach in procurement strategies for public works and in local and regional environmental policies.

Replication. Guiding:

- Farmers in treating their own fields, 70 in total, in other regions in the Dutch and European Sand Belt;
- Farmers and authorities elsewhere in NL/EU in setting up new demonstration fields
- Target audiences in matching clay to be released from public works with sandy fields to be treated, in total 400,000 m3;
- Governments and site managers in integrating high-quality re-use of fertile soil in policy and business operations.

Monitoring and evaluation of the impact on climate action
Monitoring indicators for resilience and mitigation: mineral composition, organic matter, moist, nutrient and mineral content. Baseline, end of project, evaluation including modelling of long term impact on water retention and availability and on carbon sequestration.

Socio-economic impact assessment.
Monitoring and evaluation of the social readiness of the approach. Monitoring the values stakeholders attribute to the approach. Evaluating ecosystem services, social costs and benefits resulting from the implementation actions, and their links to stakeholders, applying the value model as developed in Action C2.

Communication/informing and consulting.
Stakeholder analysis and communication strategy. Communication aimed at awareness raising of stakeholders and general public, and on acquiring support of stakeholders.

Dissemination/activating.
Dissemination of the approach and assisting in its implementation e lsewhere in NL/European sandbelt. Presentations on 4 symposia and subsequent coaching and knowledge transfer to interested audience. Organisation of an international final symposium in 2026.

Develop selection criteria for when the demand of clay exceeds the supply.

Quantified expected results and impacts
We will demonstrate the approach on 5 fields of on average 10 ha each, spread over the Dutch province of Gelderland. For these 50 ha we expect to use 29,000 m3 clayey soil released from public works to upgrade these sandy soils with respect to their water retention,

water availability and carbon sequestration capacity. We have calculated with 25 cm topsoil to contain 8% lutum (clay, mineral particles <2 µm) after concluding the implementation actions.

We expect the project to result in higher resilience to the effects of climate change on these 50 ha, to be indicated by the water retention capacity and the amount of plant available soil water as derived from the water retention curves, the latter estimated to increase with 10 mm. This implies crops' need for irrigation would delay 5 days and hence water abstraction would diminish by 100 m3 / ha = 5000 m3 / 50 ha during drought periods.

In addition, we expect an increase in carbon sequestration into soil organic matter with 95 tonnes CO2 eq /ha/year over these 50 ha for the decades to come.

With the demonstrations, we intend to realise a transformation in thinking and behaviour, not only on farm level, but especially among the land use, urban planning and public works sectors including related policy makers. We aim at realising a yearly increase of the area of adapted sandy soils. Within the project's time span we expect to achieve replication on 70 farms covering 700 ha. Further, we expect farmers and governments to continue with the approach, in the Netherlands reaching a replication rate of effectively 2000 ha/year after the project's end.

EU policies addressed
LIFE CO2SAND aims to contribute to both a climate-resilient and a low-carbon, resource-efficient economy.

LIFE CO2SAND supports the implementation of the EU's 2050 climate neutrality and adaptation
objectives, the European Green Deal's climate and the related policies and measures, including the European Climate Pact. The project aims at increasing both infiltration and water retention capacity of sandy soils on agricultural land, enhancing resilience of farmers to the effects of climate change. It thus falls within climate adaptation policy priority 4: resilience of agricultural, forestry and tourism sectors. Expected effects of the project enhancing resilience include better water availability to crops and grassland during periods of droughts, and hence higher production / less losses. The project falls within policy priority 3 as well: sustainable management of water in drought-prone areas/improving rainwater management and resilience to drought.

The project also contributes to mitigation objectives, by increasing the capacity of these sandy soils to function as a carbon sink. This matches the EU policy focus on land use, agriculture and forestry, and its focus on conservation and enhancement of natural carbon sinks. The project contributes to the transition to a low emission economy and to reaching the EU target of climate neutrality by 2050 and at least 40% greenhouse gas emission reduction for 2030 compared with 1990 levels, by increasing the capacity of sandy soils on agricultural land to function as a carbon sink.

The Dutch contribution to reaching the EU target has been laid down in the Climate Agreement (Klimaatakkoord). It states that the joint ambition of the parties involved is to realise an additional sequestration of 0.5 Mton CO_2 -eq per year by increasing soil organic matter content and reducing emissions of N_2O from soils.

Importance for biodiversity

The biodiversity crisis and the climate crisis are intrinsically linked. Climate change accelerates the destruction of the natural world through droughts, flooding and wildfires, while the loss and unsustainable use of nature are in turn key drivers of climate change. Just as the crises are linked, so are the solutions. Sustainably managing grasslands and agricultural soils is essential for emission reduction and climate adaptation.

Soil texture and structure strongly influences the activity of soil biota. Loam and clay soils favour microbial and earthworm activity, whereas sandy soils, with lower water retention, are less favourable.

Our envisaged modification of soil texture can directly and indirectly impact on biological regulators.

- Soil texture directly affects physiology of nematodes. This varies among species. Some species reproduce better in coarse-textured soils, others in fine-textured ones such as in loamy sand with intermediate percentages of clay and silt.
- Indirect effects of modifications in soil texture are due to the impact on soil water retention. Resulting higher and better sustained soil moisture is expected to positively influence nematode abundance and community composition.

Soil texture can also strongly affect the total biomass of soil earthworms, who in turn are beneficial for soil structure. Soils with high silt contents offer a favourable environment for earthworms and facilitate a high population density and biomass. Sandy soils poor in silt are a less appropriate environment because of too low water retention.