Flanders
State of
the Art

The LIFE+ project Demeter

Integrated and sustainable soil management to reduce environmental effects

'Guiding farmers towards smart fertilization and a better soil quality in Belgium and the Netherlands'

DEMETER

LIFE10 ENV/BE/0699

UNIVERSITEIT GENT

nmi

FLEMISH LAND AGENCY

LIFE10 ENV/BE/0699

Photo page 1: source LNE

June 2016

OBJECTIVES

The LIFE+ Demeter project developed an integrated approach to tackle environmental problems caused by unsustainable soil management, low soil quality and polluted water, in Flanders and the Netherlands.

The project DEMETER is managed by the Flemish Land Agency (VLM), the Dutch Nutrient Management Institute (NMi) and Ghent University, Faculty of Bioscience Engineering, Department of Soil Management. These three organisations are complementary. The Department of Soil Management is specialised on scientific and practical research on soil and nutrient management and the impact on the environment, while the VLM has more experience on farm level: farm counselling, communication and raising awareness campaigns. The NMI is working on both levels: they carry out applied research on soils and give practical recommendations to farmers.

In the Demeter project these partners wanted to:

- **Increase awareness amongst** all agricultural stakeholders about the benefits and principles of a sustainable soil and nutrient management in daily farm practices.

- **Develop a decision support tool** at field level integrating the major aspects of sustainable soil management: soil organic matter (SOM) optimization and N and P fertilization. The tool translates results of scientific research into practical advice for farmers.

- **Train farmers and advisors** in the use of the tool. This will facilitate adoption of the tool and increase sustainable environmental results.

Figure 1: Training moment with farm advisors

METHOD DEVELOPMENT OF THE DECISION SUPPORT TOOL

Figure 2: Login page Demetertool

Create an account
https://eloket.vlm.be/Demeter

The Demetertool ...

... is a free online open-ended tool,
... works with limited input and a userfriendly interface,
... consists of an OM module and a nutrient module ,
... operates on the field level.

Following input of soil and management information, the Demetertool offers ...

... a longterm prediction of SOM stock evolution,
... a soil balance based N fertilizer advice,
... a simple P-balance for a given crop rotation.

These practical recommendations aim at a more integrated sustainable management of both nutrients and soil organic matter on an individual plot scale.
To maximize its usefulness, the tool was tested by scientists, by 80 Flemish and Dutch farmers and 20 farm counsellors of the Flemish Land Agency.

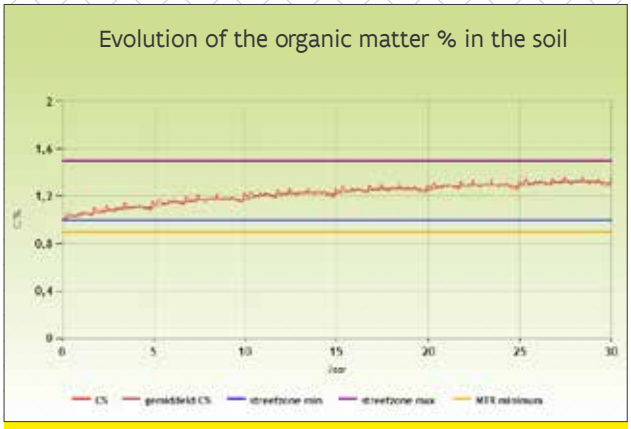

Figure 3: Longterm prediction of SOM stock evolution

VALIDATION OF THE DECISION SUPPORT TOOL – FIELD MONITORING STUDY (2013-2015)

- 80 farms in Flanders and the Netherlands;
- 1 or 2 fields per farm;
- Soil analysis: %C, pH, plant available P, K and Mg, mineral N in the soil profile;
- Manure analysis: total N and P content;
- Collection of information about farm and soil management;
- Individual recommendation report for each field in Flanders.

The applied fertilization was compared to the recommended dose. The residual nitrate in the soil profile at the end of the growing season was measured.

Figure 4: Belgian pilot farms in the Flemish region

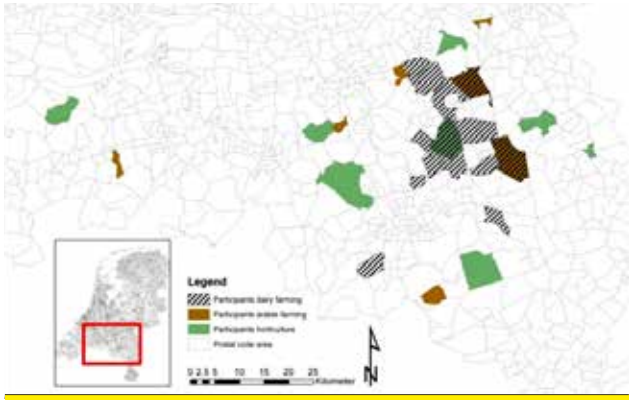

Figure 5: Dutch pilot farms in the Netherlands

Figure 6: Farm advisor taking soil samples

FARM GUIDANCE

- Flemish farmers were visited and guided by the counsellors of the Flemish Land Agency individually. During these visits, the counsellors advised the farmers about a more sustainable soil and farm management.

- During these sessions, measures to improve their sustainable soil management and fertilization were discussed amongst the farmers. The groups were guided by a farm advisor.

Figure 7: Farm guidance

RESULTS

Since 2015, the **decision support tool (Demetertool)** is online. This freely available tool offers farmers a hands-on report (figure 9) about both the SOM evolution and the nutrient management (N and P) on their land.

Farmers can change their inputs in the tool all the time and make simulations to calculate how much they can improve their soil quality significantly, even by taking simple measures s.a. catch crops, changing rotations and manure types, ...

Figure 8: NMi group farm guidance

DEMETER *Together to a sustainable soil management*

Long term simulation of organic matter in the soil and advice to sustainable soil management

General information

Date: 27-5-2016

Name farmer	Johannes Veldman
Adress farmer	Flanders
Field Name	Chapel field (texture = Loam)

Long term simulation of soil organic matter

Initial soil carbon content (% C) 0,8
Depth of soil sampling 30 cm
Crop rotation:

	Crops and catch crops	Application of organic material
Year 1 *(2016)*	winter wheat, harvested in August, crop residues incorporated	pig slurry in August, 10 tons/ha
Year 2 *(2017)*	phacelia incorporated in february Brussels sprouts, harvested in November	pig slurry in April, 15 tons/ha
Year 3 *(2018)*	pea, harvested in June beans, harvested in September	pig slurry in June, 15 tons/ha
Year 4 *(2019)*	winter wheat, harvested in August, crop residues incorporated	pig slurry in August, 10 tons/ha
Year 5 *(2020)*	phacelia, incorporated in February potato, harvested in August	pig slurry in March, 15 tons/ha

Expected long term evolution of soil organic matter if above crop rotation will be applied:

Target ranges for soil organic carbon content determined by UGhent

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N balance of field 'Chapel field'

Crop in 2016 winter wheat
Previous crop in 2015 potato
Catch crop during winter /
Applied organic material /
Mineral N in the soil /

Date of soil sampling:
29-1-2016

Depth (in cm)	Nitrate N in kg N/ha	Ammonia N in kg N/ha	Total mineral N N in kg N/ha
0-30 cm	5	6	11
30-60cm	11	4	15
60-90cm	18	7	25

Balance for 'winter wheat'	in kg N/ha
N uptake crop*	209
N buffer	30
Totaal need of N	239
- measurement of mineral N in the soil	27
- mineralization of crop residues (potato)	0
- mineralization of catch crop (no catch crop before the wheat)	0
- mineralization of permanent grassland destruction (not for this field)	0
- mineralization of soil organic matter	27
- mineralization of organic material if already applied	0
- depostion of N	11
- Total supply of N	65
Remaining need of N	**174**

* N uptake if crop yield is 9,5 tons/ha.

P balance of field 'Chapel field'

Plant available P in the soil is **35** mg P per 100 g soil (~1.523 kg P/ha).
The amount of P in the soil is classified as 'high'.
P balances are calculated over a whole crop rotation period. The P balances considers the application of organic materials as P input and P uptake by crops as P output.

Year of rotation	Year 1		Year 2		Year 3		Year 4		Year 5	
expressed as kg/ha	P_2O_5	P	P_2O_5	P	P_2O_5	P	P_2O_5	P	P_2O_5	P
Input of P with application of organic materials	50	22	75	33	75	33	50	22	75	33
Output of P due to export of crops	70	31	46	20	64	28	67	29	51	22
Balance	**-20**	**-9**	**29**	**13**	**11**	**5**	**-17**	**-7**	**24**	**10**

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Figure 9: Recommendation report generated by the decision support tool

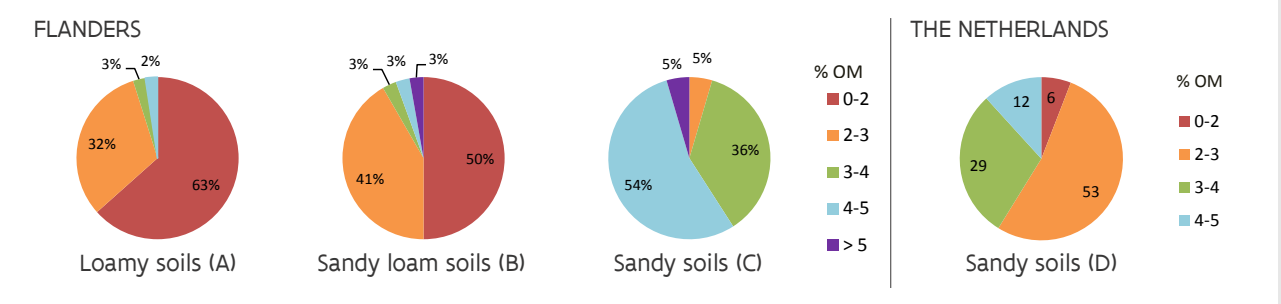
At the start of the study, 50% of the fields in Flanders had a SOM content below the optimal zone for crop production. The long term OM evolution (30 years) at that moment (based on the conventional crop and soil management of the farmers) showed that 30% of these fields were still under the limit after 30 years and 20% reached the optimal zone after 30 years.

In the last year of the study the simulation was repeated with the implemented changes to crop and soil management due to individual training of the farmers by the counsellors. The new simulation showed that now 25% of the fields reached the optimal zone for OM in the soil after 30 years. This is a gain of 5% due to the proposed measures of the decision support system.

The fields in the **monitoring study** had a loamy, sandy loam or sandy texture in Flanders and a sandy texture in the Netherlands. In Flanders SOM content was low in the loamy and sandy loam soils: 63 and 50% of these fields had an OM content lower than 2%, respectively.

In the Netherlands, 6% of the participating fields had an OM content lower than 2% OM and 59% below 3% OM (figure 10).

Figure 10: Distribution of the SOM content of the selected loamy soils (A), sandy loam soils (B) and sandy soils (C) over several classes in Flanders and the Netherlands (D)

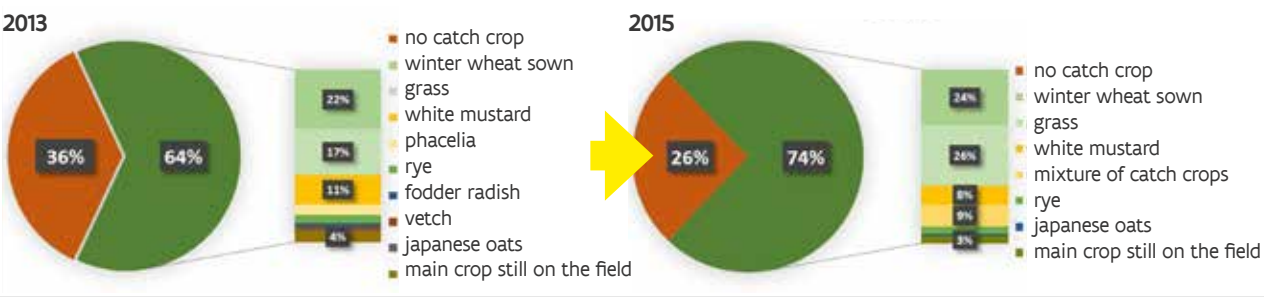


During the 3 monitoring years, individually guided farmers applied the recommended amount of N (generated with the Demetertool) on 36% of the fields, applied less N than recommended on 30% of the fields, and more N than recommended on 34% of the fields.

These results were compared with the amount of residual nitrate in the soil. Fields on which more N than the N-advice was applied, had more chance (39%) to exceed the limit of 90 kg nitrate-N/ha for residual nitrate in the soil. This is a limit in Flanders which indicates a risk of nitrate leaching. The chance to exceed the limit of 90 kg nitrate-N/ha for fields with the recommended and lower N-application was 33% and 19% respectively.

To enhance the carbon evolution in the soil and decrease the risk of nitrate leaching during winter, the growth of catch crops after harvest of the main crop is a good practice. At the start of the monitoring study, catch crops were sown on 64% of the participating fields. At the end of the monitoring study this amount had increased to 74%.

Figure 11: Evolution of % catch crops during the monitoring study (2013 - 2015)



EXPERIENCES OF PARTICIPATING FARMERS: What farmers learned and experienced

Figure 12: Farmer Geert Deconinck and farm advisor Stefaan Geerts

"I didn't change anything, I wanted to evaluate my current soil management."

"Very usefull to study the results of the Demetertool together with the counsellor: SOM evolution, N balance, P balance."

"Now I use more manure instead of slurry on the fields with lowest C content."

"I prefer that the counsellor uses the tool and shows the results to me."

"Interesting information, better understanding of SOM and fertilization advice"

"I have more attention for SOM content and catch crops, I bought new machinery to process the catch crops."

COMMUNICATION TRANSFER AND COMMUNICATION OF RESULTS

The Demeter project communicated it's results in several ways. The partners promoted the project during several conferences and agricultural fairs. Also social media such as Facebook and Twitter was used to promote the project. Posters, flyers, video material, ... were created to support the communication strategy. Several articles and press releases about the project were published.

On the project website most of these items and communication materials can be found:

https://www.vlm.be/nl/projecten/Europeseprojecten/Demeter/Paginas/default.aspx

Figure 13: Agricultural fair - press conference Demetertool

Figure 14: Information package 'A successful harvest on a healthy soil'

The field monitoring study and guidance of the farmers resulted in the information package: "A successful harvest on a healthy soil" (figure 14).

Until now, this package contains information sheets about 17 topics: Catch crops, Soil acidity, Plant nutrients, Working with the Demetertool, Soil structure and compaction, Crop rotation, Organic matter, N-fertilization of vegetable crops, Phosphorous in the soil, ...

Figure 15: Networking moment for stakeholders and policy makers

CONCLUSION

- A decision support tool which advices farmers to optimize nutrient and soil organic matter management at the level of the field has been developed and is freely available to farmers and other users in Belgium and the Netherlands. The tool offers farmers a hands-on report about both the SOM evolution and the nutrient management (N and P) on their land.
- The use of the tool and training of farmers will increase awareness amongst farmers for more sustainable soil management that will maintain or increase soil organic matter whilst minimizing nutrient loss risks to ground and surface water.
- Farmers can change their inputs in the tool all the time and make simulations to calculate how much they can improve their soil quality significantly, even by taking simple measures s.a. catch crops, changing rotations and manure types, ...
- The field monitoring study and guidance of the farmers resulted in the information package: 'A successful harvest on a healthy soil'. It is widely spread amongst farmers and students. This and other communication materials were used during the project. After the end of the project, dissemination of project results wil continue in Belgium, the Netherlands and on a broader scale towards agricultural stakeholders, farmers, advisors, policy makers, ...

Figure 16: Farmer Geert Deconinck and farm advisor Stefaan Geerts

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