view over the trial fields in 2018 (Gert Van de Ven)

Crop rotation (Belgium)

vruchtwisseling / teeltrotatie

DESCRIPTION

The use of crop rotation in dairy farms to provide fodder on a healthy sandy soil

Belgium has favourable conditions for agriculture: moderate temperatures, evenly distributed precipitation, and a long growing season. Today, ~28 % of the country is under cultivation. Farming engages only 2 % of the total labour force, but it produces sufficient quantities to make Belgium a net food exporter. About 2/3 of the farms are intensively cultivated units of less than 10 hectares (25 acres).

The Functional Agro-Biodiversity (FAB) measure on avoiding monocultures and implementing crop rotations was established on a trial field in Belgium, Geel. The region is characterised by sandy soil and the main crop is maize, mostly in monoculture. Main reasons to stick in the monoculture of maize are the lack of knowledge of the alternatives, specifically on feed value of the crops and storage of the harvested product.

In this trial field different crops are placed in small fields (18 x 25 m) next to each other. The crops are always chosen to be part of the fodder for the dairy cattle. The different root types ensure a better soil structure. The diversity in plants make the field less susceptible for diseases and weeds and give a better uptake of the nutrients that are available in the soil. After one year, we already saw a 50% reduction in weeds compared to the monoculture maize.

The soil is less degraded and even soil carbon sequestration is possible. The latter is not only beneficial for climate regulation but also provides a spongy soil which can capture the water more easily, but also stores the water and makes it available to plants in drier periods. This makes the land more resilient to extreme weather conditions. The difference in sowing time and harvesting time give a higher range in choice for the type of cover crops and give less chance for weeds to develop in the same way year after year. In the reference year 2017 (maize in all the fields), we already saw an additional yield of 10% where crop rotation had been implemented.

The compilation of this SLM is a part of the European Interreg project FABulous Farmers which aims to reduce the reliance on external inputs by encouraging the use of methods and interventions that increase the farm's Functional AgroBiodiversity (FAB). Visit www.fabulousfarmers.eu and www.nweurope.eu/Fabulous-Farmers for more information.

LOCATION

Location: Geel, Antwerpen, Belgium

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 4.96043, 51.1791
- 4.96043, 51.17832

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?: No

Date of implementation: 2016

Type of introduction
- [ ] through land users' innovation
- [ ] as part of a traditional system (> 50 years)
- [x] during experiments/ research
- [ ] through projects/ external interventions

View on the trial fields in 2018 (Gert Van de Ven)

View on the trial fields in 2019 (Katrien Geudens)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] reduce risk of disasters
- [x] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [ ] create beneficial economic impact
- [ ] create beneficial social impact

Land use
Land use mixed within the same land unit: No

Cropland
- Annual cropping: cereals - barley, cereals - maize, cereals - sorghum, cereals - wheat (spring), fodder crops - clover

Number of growing seasons per year: 1
Is intercropping practiced? No
Is crop rotation practiced? Yes

Water supply
- [x] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

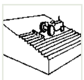
Purpose related to land degradation
- [x] prevent land degradation
- [x] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

Degradation addressed

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

SLM group
- rotational systems (crop rotation, fallows, shifting cultivation)

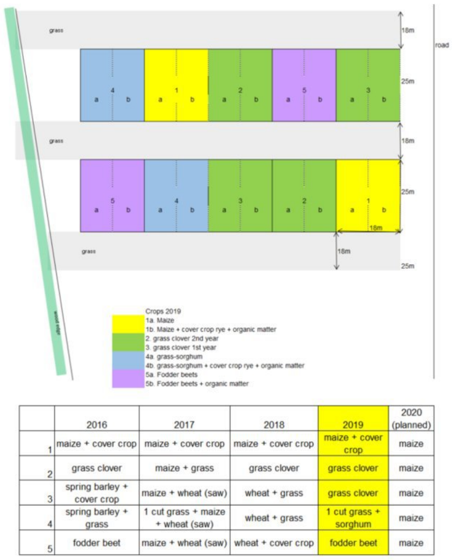
SLM measures



agronomic measures - A1: Vegetation/ soil cover

TECHNICAL DRAWING

Technical specifications
The crop rotation field trial is set-up in two replicates. 5 fields per replicate are planted with a mixture of crops (bottom table). The crop rotation in 2019 is illustrated exemplary. Previous crop rotations on each field (field numbers 1 to 5) are detailed in the table. For 2020, a maize monoculture is planned to assess the impact of crop rotation trials on yields and ecosystem services.



	2016	2017	2018	2019	2020 (planned)
1	maize + cover crop	maize + cover crop	maize + cover crop	maize + cover crop	maize
2	grass clover	maize + grass	grass clover	grass clover	maize
3	spring barley + cover crop	maize + wheat (saw)	wheat + grass	grass clover	maize
4	spring barley + grass	1 cut grass + maize + wheat (saw)	wheat + grass	1 cut grass + sorghum	maize
5	fodder beet	maize + wheat (saw)	wheat + cover crop	fodder beet	maize

Author: Katrien Geudens

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area
- Currency used for cost calculation: €
- Exchange rate (to USD): 1 USD = 0.91 €
- Average wage cost of hired labour per day: n.a

Most important factors affecting the costs

n.a.

Establishment activities

n.a.

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (€)	Total costs per input (€)	% of costs borne by land users
Other					
Estimate of all-inclusive costs for a 4 yr rotation (workforce/equipment/material)	ha/4yrs	1.0	2000.0	2000.0	100.0
Total costs for establishment of the Technology				**2'000.0**	
Total costs for establishment of the Technology in USD				*2'197.8*	

Maintenance activities

n.a.

NATURAL ENVIRONMENT

Average annual rainfall

- < 250 mm
- 251-500 mm
- ✓ 501-750 mm
- 751-1,000 mm
- 1,001-1,500 mm
- 1,501-2,000 mm
- 2,001-3,000 mm
- 3,001-4,000 mm
- > 4,000 mm

Agro-climatic zone

- humid
- ✓ sub-humid
- semi-arid
- arid

Specifications on climate

n.a.

Slope

- ✓ flat (0-2%)
- gentle (3-5%)
- moderate (6-10%)
- rolling (11-15%)
- hilly (16-30%)
- steep (31-60%)
- very steep (>60%)

Landforms

- ✓ plateau/plains
- ridges
- mountain slopes
- hill slopes
- footslopes
- valley floors

Altitude

- ✓ 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- 1,001-1,500 m a.s.l.
- 1,501-2,000 m a.s.l.
- 2,001-2,500 m a.s.l.
- 2,501-3,000 m a.s.l.
- 3,001-4,000 m a.s.l.
- > 4,000 m a.s.l.

Technology is applied in

- convex situations
- concave situations
- ✓ not relevant

Soil depth

- very shallow (0-20 cm)
- shallow (21-50 cm)
- moderately deep (51-80 cm)
- deep (81-120 cm)

Soil texture (topsoil)

- ✓ coarse/ light (sandy)
- medium (loamy, silty)
- fine/ heavy (clay)

Soil texture (> 20 cm below surface)

- ✓ coarse/ light (sandy)
- medium (loamy, silty)
- fine/ heavy (clay)

Topsoil organic matter content

- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

- [x] very deep (> 120 cm)

Groundwater table
- [ ] on surface
- [x] < 5 m
- [ ] 5-50 m
- [ ] > 50 m

Availability of surface water
- [ ] excess
- [x] good
- [ ] medium
- [ ] poor/ none

Water quality (untreated)
- [ ] good drinking water
- [x] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to: both ground and surface water

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

Species diversity
- [ ] high
- [x] medium
- [ ] low

Habitat diversity
- [x] high
- [ ] medium
- [ ] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [x] subsistence (self-supply)
- [ ] mixed (subsistence/ commercial)
- [ ] commercial/ market

Off-farm income
- [ ] less than 10% of all income
- [ ] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [ ] poor
- [x] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [ ] manual work
- [ ] animal traction
- [x] mechanized/ motorized

Sedentary or nomadic
- [x] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [ ] individual/ household
- [ ] groups/ community
- [ ] cooperative
- [x] employee (company, government)

Gender
- [ ] women
- [x] men

Age
- [ ] children
- [ ] youth
- [x] middle-aged
- [ ] elderly

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [ ] 5-15 ha
- [ ] 15-50 ha
- [x] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

Scale
- [ ] small-scale
- [x] medium-scale
- [ ] large-scale

Land ownership
- [x] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [ ] individual, not titled
- [ ] individual, titled

Land use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] individual

Water use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] individual
- [x] No access to water on the field (normally not necessary).

Access to services and infrastructure

		1	2	3	
health	poor			✓	good
education	poor			✓	good
technical assistance	poor			✓	good
employment (e.g. off-farm)	poor			✓	good
markets	poor			✓	good
energy	poor			✓	good
roads and transport	poor			✓	good
drinking water and sanitation	poor			✓	good
financial services	poor			✓	good

IMPACTS

Socio-economic impacts

		1	2	3	4	5	6	7	
Crop production	decreased					✓			increased
crop quality	decreased					✓			increased
fodder production	decreased					✓			increased
fodder quality	decreased					✓			increased
product diversity	decreased				✓				increased
land management	hindered			✓					simplified
workload	increased				✓				decreased

Socio-cultural impacts

		1	2	3	4	5	6	7	
food security/ self-sufficiency	reduced					✓			improved

Ecological impacts

		1	2	3	4	5	6	7	
soil moisture	decreased					✓			increased
soil cover	reduced					✓			improved
soil compaction	increased					✓			reduced
nutrient cycling/ recharge	decreased					✓			increased
soil organic matter/ below ground C	decreased					✓			increased

vegetation cover	decreased				✓				increased	
plant diversity	decreased					✓			increased	
beneficial species (predators, earthworms, pollinators)	decreased					✓			increased	
habitat diversity	decreased					✓			increased	
pest/ disease control	decreased			✓					increased	The crops are less susceptible to pests. The damage caused (loss of yield) is less than the cost of protection.
drought impacts	increased					✓			decreased	

Off-site impacts

buffering/ filtering capacity (by soil, vegetation, wetlands)	reduced					✓			improved

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative			✓					very positive
Long-term returns	very negative						✓		very positive

Benefits compared with maintenance costs

Short-term returns	very negative			✓					very positive
Long-term returns	very negative						✓		very positive

CLIMATE CHANGE

Gradual climate change

seasonal rainfall increase	not well at all				✓		very well	Season: summer

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- ☐ single cases/ experimental
- ☑ 1-10%
- ☐ 11-50%
- ☐ > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- ☐ 0-10%
- ☐ 11-50%
- ☐ 51-90%
- ☑ 91-100%

Has the Technology been modified recently to adapt to changing conditions?

- ☐ Yes
- ☑ No

To which changing conditions?

- ☐ climatic change/ extremes
- ☐ changing markets
- ☐ labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Higher resilience to climate change
- Higher resilience to plagues and diseases
- Increased soil carbon stock
- Increased yields and income

Strengths: compiler’s or other key resource person’s view

- Increased soil carbon stock
- Increased food security

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Feed value of the "new" crop → Analysis of the crops in standardised tables
- More cultivation training/exercise necessary → Getting better training/knowledge by joining demonstrations or networks, and use available literature
- Investment costs (other than machinery)

Weaknesses/ disadvantages/ risks: compiler’s or other key resource person’s view → how to overcome

- More planning time needed for the different crops → Learn from previous years and other farmers experience

REFERENCES

Compiler
Sabine Reinsch

Reviewer
Rima Mekdaschi Studer
Renate Fleiner

Date of documentation: Sept. 12, 2019

Last update: Feb. 14, 2020

Resource persons
Gert Van de Ven - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_5578/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- UK Centre for Ecology & Hydrology (CEH) - United Kingdom

Project
- European Interreg project FABulous Farmers

Links to relevant information which is available online
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