Mature hedgerow along a field margin (Yann Pivain)

Hedgerows as shelter belts along agricultural fields (France)

gestion des haies

DESCRIPTION

Hedgerows are important to shelter the functional biodiversity necessary for natural regulation of crop pests. The extent of this effect depends on hedgerow management at farm level.

Hedgerows are typical landscape features of rural Normandy. They surround agricultural fields, whether cultivated or under grassland. Hedges were already prominent in Normandy during the 19th century, and they reached a peak between the first and second world wars. However, since the 1960s, the restructuring of agricultural land and technical and technological developments in agriculture have led to the disappearance of hedgerows. The challenge since the beginning of the 21st century has been to maintain the existing hedgerows and to establish others. This is important in the light of today's agri-environmental and climate issues.

The technology of replacing, restoring or planting new hedgerows has been applied in an area of mixed farming for the benefit of crop and animal protection, watercourse and soil erosion buffering and protection, and landscape and habitat connectivity improvements. The technology has been applied in a locality by a small number of farmers over a number of recent years.

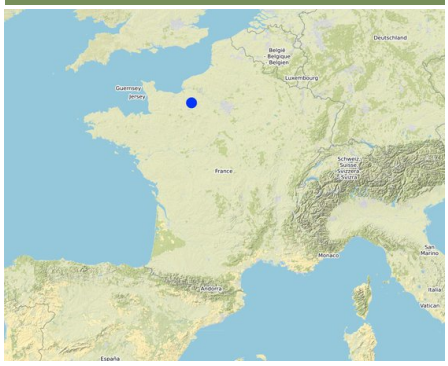
Hedgerows are planted on the periphery of the fields with species spaced at 0.5 to 1 m apart. There are between 1 and 3, sometimes even 4 different vegetative types used in establishing the hedgerows - herbaceous, bushy, and shrubby plants and trees. The current average length is 36 metres of hedge per hectare. The position of ancient hedgerows in the landscape is the result of the history of parcels of land. In contrast, over the last ten years, agri-environmental criteria have been taken into account in selecting planting sites. The main local species used for new hedges are: Fraxinus, Quercus, Tilia, Carpinus, Acer campestre, Crataegus, Corylus and Ilex. Each hedge is considered to have an influence ranging from 50 to 200 m away from it in terms of windspeed, runoff, and biodiversity.

Hedgerows play a very important role in preventing:
- Biological degradation through maintaining and increasing wildlife biodiversity and stimulating biological regulation of crop pests
- Climate-induced impacts both at the local level (decrease of wind speeds, decrease of evapotranspiration, shade for animals) and at global level (carbon storage, substitution of fossil energies by renewable energy)
- Water degradation through maintaining and improving qualitative and quantitative regulation of water at the watershed scale
- Soil erosion by water and chemical deterioration through the conservation of soils
- Soil erosion by wind

Despite these benefits, this SLM technology has not yet been taken up widely. It is more than necessary to restart hedgerow management with Normandy farmers, especially as the use of external inputs (e.g. fertilizers and pesticides) is increasingly expensive for both farmers and society.

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

LOCATION



Location: Normandy, France

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 0.55241, 48.99538
- 0.55241, 48.99538

Spread of the Technology: evenly spread over an area (approx. 10-100 km2)

In a permanently protected area?: No

Date of implementation: less than 10 years ago (recently)

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

www.fabulousfarmers.eu and www.nweurope.eu/Fabulous-Farmers for more information.

Hedgerow (Yann Pivain)

Hedgerow on field margin (Yann Pivain)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- ✓ improve production
- ✓ reduce, prevent, restore land degradation
- conserve ecosystem
- protect a watershed/ downstream areas – in combination with other Technologies
- ✓ preserve/ improve biodiversity
- reduce risk of disasters
- ✓ 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

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

Grazing land

- Improved pastures

Animal type: cattle - non-dairy beef
Is integrated crop-livestock management practiced? No

Species	Count
cattle - non-dairy beef	20

Forest/ woodlands

- Tree plantation, afforestation: temperate continental forest plantation. Varieties: Mixed varieties

Tree types (mixed deciduous/ evergreen): n.a.
Products and services: Fuelwood, Nature conservation/ protection

Water supply

- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation

- ✓ prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

soil erosion by water - Wg: gully erosion/ gullying

soil erosion by wind - Et: loss of topsoil

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

biological degradation - Bh: loss of habitats, Bs: quality and species composition/ diversity decline, Bp: increase of pests/ diseases, loss of predators

SLM group

- windbreak/ shelterbelt
- improved ground/ vegetation cover
- integrated pest and disease management (incl. organic agriculture)

SLM measures

vegetative measures - V1: Tree and shrub cover

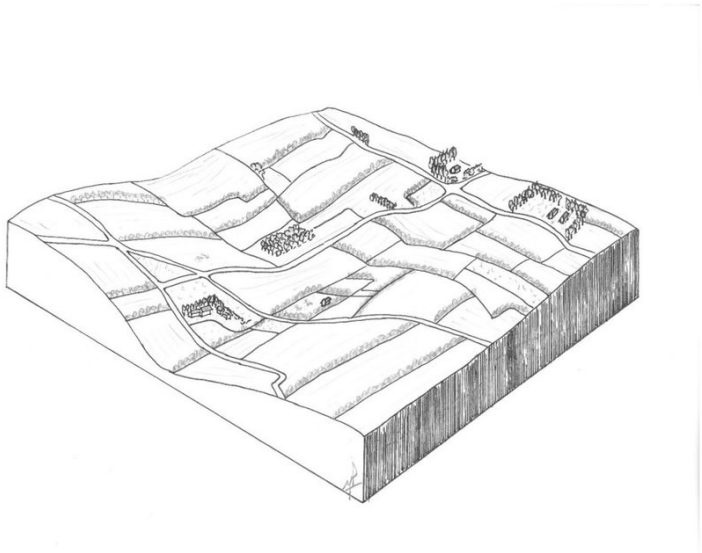
structural measures - S11: Others

management measures - M3: Layout according to natural and human environment, M5: Control/ change of species composition

TECHNICAL DRAWING

Technical specifications
Hedgerows are planted on the periphery of the plots. The trees are spaced 0.5 to 1 m apart. The height varies from 1.5 m to more than 20 m. There are between 1 and 3, even 4 different vegetative strata (herbaceous, bushy, shrubby, tree). The local average length is 36 m of hedge per hectare (the departmental average is 19 m / ha). The position of old hedges is more the result of the history of parcels (properties) than linked to agri-environmental criteria. Over the last ten years, agri-environmental criteria have been taken into account in choosing planting sites. The main local species: Fraxinus, Quercus, Tilia, Carpinus, Acer campestre, Crataegus, Corylus and Ilex.

Each hedge is considered to have an influence ranging from 50 to 200 m away from it (in terms of wind, runoff, biodiversity).



Author: Yann Pivain

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit (unit: **per 1 km of new / replanted hedgerow**)
- Currency used for cost calculation: **€**
- Exchange rate (to USD): 1 USD = 0.9 €
- Average wage cost of hired labour per day: 120

Most important factors affecting the costs
Time necessary for maintenance, Good training to do quality work

Establishment activities
1. Decide on planting site, the design/layout of the hedge and the species (Timing/ frequency: Spring)
2. Soil preparation through clearing of land and harrowing (Timing/ frequency: After harvest of crops)
3. Application of mulch to planting strip (Timing/ frequency: After harvest of crops)
4. Planting of trees & protections (e.g. deer guards) (Timing/ frequency: November to January)

Establishment inputs and costs (per per 1 km of new / replanted hedgerow)

Specify input	Unit	Quantity	Costs per Unit (€)	Total costs per input (€)	% of costs borne by land users
Labour					
Design and planning	person-days	0.3	120.0	36.0	50.0
Surface preparation for planting	person-days	0.1	120.0	12.0	100.0
Application of mulch	person-days	0.3	120.0	36.0	100.0
Planting trees	person-days	11.0	120.0	1320.0	100.0
Equipment					
Tractor with harrow	machine-days	0.1	50.0	5.0	100.0
Plant material					
Trees	Piece	1000.0	2.0	2000.0	50.0
Tree protection (i.e. wild animal guards)	Piece	1000.0	0.5	500.0	80.0
Mulching	Piece	1000.0	1.3	1300.0	80.0
Total costs for establishment of the Technology				**5'209.0**	
Total costs for establishment of the Technology in USD				*5'787.78*	

Maintenance activities
1. Hedgerow maintenance (cutting/pruning) (Timing/ frequency: From June to December every 3rd year)
2. Wood harvest (20 years after planting) (Timing/ frequency: December to March)

Maintenance inputs and costs (per per 1 km of new / replanted hedgerow)

Specify input	Unit	Quantity	Costs per Unit (€)	Total costs per input (€)	% of costs borne by land users
Labour					
Hedgerow maintenance (cutting/pruning)	day	0.2	120.0	24.0	100.0
Equipment					
Maintenance cutter	day	0.2	50.0	10.0	100.0
Total costs for maintenance of the Technology				**34.0**	
Total costs for maintenance of the Technology in USD				*37.78*	

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
Average annual rainfall in mm: 850.0
No dry season or marked rainy season. The rains fall fairly regularly
Name of the meteorological station: Evreux (27000)

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)
- ☐ very deep (> 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%)

Groundwater table
- ☐ on surface
- ☐ < 5 m
- ☐ 5-50 m
- ☑ > 50 m

Availability of surface water
- ☐ excess
- ☑ good
- ☐ medium
- ☐ poor/ none

Water quality (untreated)
- ☐ good drinking water
- ☑ 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
- ☑ No

Occurrence of flooding
- ☑ Yes
- ☐ No

Species diversity
- ☐ high
- ☑ medium
- ☐ low

Habitat diversity
- ☑ high
- ☐ medium
- ☐ low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- ☐ 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
- ☐ average
- ☑ rich
- ☐ very rich

Level of mechanization
- ☐ manual work
- ☐ animal traction
- ☑ mechanized/ motorized

Sedentary or nomadic
- ☑ Sedentary
- ☐ Semi-nomadic
- ☐ Nomadic

Individuals or groups
- ☑ individual/ household
- ☐ groups/ community
- ☐ cooperative
- ☐ employee (company, government)

Gender
- ☑ women
- ☑ men

Age
- ☐ children
- ☑ youth
- ☑ middle-aged
- ☐ elderly

Area used per household
- ☐ < 0.5 ha
- ☐ 0.5-1 ha
- ☐ 1-2 ha
- ☐ 2-5 ha
- ☐ 5-15 ha

Scale
- ☐ small-scale
- ☑ medium-scale
- ☐ large-scale

Land ownership
- ☐ state
- ☐ company
- ☐ communal/ village group
- ☑ individual, not titled

Land use rights
- ☐ open access (unorganized)
- ☐ communal (organized)
- ☐ leased
- ☑ individual

- [ ] 15-50 ha
- [ ] 50-100 ha
- [x] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

- [x] individual, titled

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

Access to services and infrastructure

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

Crop production	decreased	increased	Possible loss of some cropland replaced with hedgerows, although most hedging in this instance was reinstating old field boundaries - i.e. where historic boundary lines existed but were removed for machenery or to enlarge field size.
crop quality	decreased	increased	Greater crop protection and more beneficial species improve crop quality
animal production	decreased	increased	Shelter belts improve animal welfare leading to better weight gain.
wood production	decreased	increased	Hedgerows can be coppiced for wood crop.
risk of production failure	increased	decreased	Shelter belt reduces risk of crop failure from weather extremes (i.e. wind)
product diversity	decreased	increased	Wood crop added to diversity of products
production area (new land under cultivation/ use)	decreased	increased	Although loss of crop land, this is replaced with wood crop diversity
land management	hindered	simplified	Smaller parcels of land make land management more restrictive for large machinery.
expenses on agricultural inputs	increased	decreased	Balance of increased time and management of a diversity of crops, yet less crop management with improved pest control and phyicsl stress reduction from more shelter.
farm income	decreased	increased	No change in balance of less crop production but addition of woody crop.
diversity of income sources	decreased	increased	Diversity added with option of woody crop
workload	increased	decreased	Smaller field parcels make crop management harder having to use smaller machinery and there is an addition of hedgerow maintenence workload.

Socio-cultural impacts

Ecological impacts

water quality	decreased	increased	Hedgerows act as buffer strips capturing wash off from fields before it reaches the water course
surface runoff	increased	decreased	Hedgerows act as buffer strips capturing wash from fields
excess water drainage	reduced	improved	Improved soil infiltration in hedgerows helps drain excess water
soil moisture	decreased	increased	Improved soil infiltration in hedgerows helps maintain soil moisture capacity
soil loss	increased	decreased	Hedgerows act as buffer strips capturing soil wash from fields

soil compaction	increased	reduced	Reduced machinery size (in places) reduces compaction, plus less soil compaction by hedgerows.
soil organic matter/ below ground C	decreased	increased	Increased organic matter in hedgerows
vegetation cover	decreased	increased	More year round cover
biomass/ above ground C	decreased	increased	Increased wih hedgerows
plant diversity	decreased	increased	More diverse species with planting for hedgerows
animal diversity	decreased	increased	Increased habitat diversity and area for more animal presence and diversity
beneficial species (predators, earthworms, pollinators)	decreased	increased	Encouragement of beneficial species with habitat creation in hedgerows that can aid natural pest and disease control through the presence of predator species that control pest species.
habitat diversity	decreased	increased	Within hedgerow habitat addition
pest/ disease control	decreased	increased	Encouragement of beneficial species with habitat creation in hedgerows that can aid natural pest and disease control through the presence of predator species that control pest species.
flood impacts	increased	decreased	Improved soil infiltration reduces flooding risk
wind velocity	increased	decreased	Shelter belts reduce wind velocity over crops

Off-site impacts

groundwater/ river pollution	increased	reduced	Hedgerows act as buffer strips capturing wash off from fields before it reaches the water course
buffering/ filtering capacity (by soil, vegetation, wetlands)	reduced	improved	Hedgerows act as buffer strips capturing wash off from fields before it reaches the water course
wind transported sediments	increased	reduced	Shelter belts reduce wind velocity over crops and bare soil for less erosion & transportation
damage on neighbours' fields	increased	reduced	Shelter belts reduce wind velocity over crops and bare soil for less erosion & transportation
impact of greenhouse gases	increased	reduced	Increased tree cover supports a reduction in GHG

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

annual temperature increase	not well at all	very well
annual rainfall increase	not well at all	very well

Climate-related extremes (disasters)

local rainstorm	not well at all	very well
local windstorm	not well at all	very well
drought	not well at all	very well
forest fire	not well at all	very well
land fire	not well at all	very well
general (river) flood	not well at all	very well
epidemic diseases	not well at all	very well
insect/ worm infestation	not well at all	very well

Other climate-related consequences

extended growing period	not well at all	very well
reduced growing period	not well at all	very well
sea level rise	not well at all	very well

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology
- [ ] single cases/ experimental
- [x] 1-10%
- [ ] 11-50%
- [ ] > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?
- [x] 0-10%
- [ ] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Has the Technology been modified recently to adapt to changing conditions?
- [x] Yes
- [ ] No

To which changing conditions?
- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)
- [x] Over the last ten years, agri-environmental criteria have been taken into account in choosing planting sites

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view
- Reduced winds and wind erosion
- Creation of spaces for wildlife leading to increased biodiversity

Strengths: compiler's or other key resource person's view
- Creation of climate zone "temperate" favourable to crops and / or animals
- More space for biodiversity and habitat, particularly those that provide a beneficial return for agricultural production
- Diversification to add woody crops
- Connected landscape and habitats through hedgerow linkages to each other and woodlands.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome
- Cost and maintenance time → Use harvested wood/material to cover increased costs for farmer to maintain hedgerows
- Competition between cropping areas for natural resources → Increase the technical understanding of tree management / crop fringes
- Unclear EU financial support for hedge management (instability of the common agricultural policy) → Unknown / public or private payment for ecosystem services and goods

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome
- Unclear EU financial support for hedge management (instability of the common agricultural policy) → Unknown / public or private payment for ecosystem services and goods

REFERENCES

Compiler
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Resource persons
Yann Pivain - SLM specialist
Eric Odienne - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_5644/

Linked SLM data
n.a.

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- UK Centre for Ecology & Hydrology (CEH) - United Kingdom

Project
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Key references
- Les haies Rurales : rôles, création, entretien / Fabien LIAGRE / 2006 / ISBN 2-85557-137-5: Edition France Agricole / 40 €