Hedge along the edge of fields establishmedin 2018-2019. Embankment built for hedgerow planting and protection, Ploermel (Christiane Joubioux)

Hedgerow establishment on an agro-pastoral farm for dairy cows (France)

Bocage

DESCRIPTION

Low-maintenance hedgerows were established in 2003 at the ridges of an agro-pastoral farm common in Brittany to protect water quality, ensure animal well-being, maintain biodiversity, and for energy, timber and litter production.

Brittany is an area in the north-west of France. Brittany's agriculture includes well-known products such as: fish, beef, pork, poultry, vegetables and milk. The technology is applied at Danilo Noël farm, located in the commune of Mauron in Morbihan. The region has an average annual rainfall of 650-700 mm and annual temperature of around 11°C. The climate of Mauron is warm and temperate, with the farm located in the basin known as Ploërmel. 'Bocages' in France refer to small forests and decorative elements such as hedgerows or ornamental garden structures that border agricultural fields .

The fields of the Danilo Noël farm are grouped together in a rotational system of fodder crop and short-term pastoral leys, divided into fenced paddocks. They are located between two 'talwegs', with slopes of 5 or 6 %. An analysis carried out in 2000 by the water management organization 'Grand Bassin de l'Oust', shows that 85% of the plots are at high and medium risk of plant protection product runoff due to the slope and water run-off.

Following this evaluation of the farm, the 'Bocage' (small hedged pasturelands) was developed starting during the winter of 2003/2004, with the planting of 800 meters of woody features (hedges and trees) along the slopes of the talweg. Other slope plantings were carried out on the edge of the paddock in 2014/2015 (1500 meters) and 2018/2019 (1650 meters).

Earth bunds were established along the contour, either with a shovel (in 2003 and 2014) or with a forest plough (in November 2018), with hedge and tree whips (1-2 year old growth) planted 1 meter apart in single rows diectly into the shovel or plough furrow and a small amount of fertiliser and wire tree guards added. There was no irregation installed.

The technology was applied in three differnt phases combining to form one overall long-term plan. The tree species chosen for the hedgerow are local species (oak, beech, cherry, birch, myrobolan plum, chestnut, hazelnut, etc.). For the last two phases of the programs (2014 & 2018), emphasis was placed on the presence of melliferous species (for honey production) and the spread of flowering species (fruit trees, burdock, blood dogwood, medlar, etc.).

Buffering of fields with hedgerows aims to protect surface water quality and prevent land degradation by slowing surface water runoff and hence reducing soil erosion, nutrient and plant-protection product (pesticide) export and improving water infiltration into the soil and groundwater recharge. The reduction of soil erosion in turn improves productivity with a better surface cover and nutrient retention for improved plant establishment and growth. Additionally, maintenance and/or improvement of biodiverstiy can be attained as well as providing shelter for animals supports their well-being.

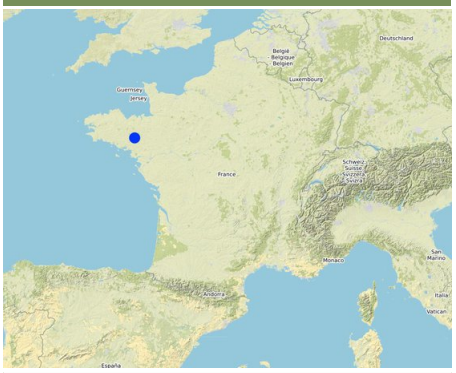
Major activities of the technology include: Tipping of trees (old and new) in spring/summer, soil preparation at the site of the future hedge in autumn and creation of the embankment (earth bund along the contour), tree planting over winter and laying of mulch and installation of game guards.

Benefits of the hedgerows/ shelter belts are reorganization and improvement of the field to reduce flooding, protect water quality , improve welfare of the livestock, Increase biodiversity of wildlife, including insects, birds and game. Additional honey bee forage supported the installation of an apiary (18 colonies) by a professional beekeeper in May 2019.

The only weakness of the technology in the eyes of the land owner was the extra cost/workload associated with the maintenance of the hedgerows.

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: Brittany, France

No. of Technology sites analysed: single site

Geo-reference of selected sites
- -2.32978, 47.91762

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

In a permanently protected area?: No

Date of implementation: 2003

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

Soil preparation for hedgerow planting (Christiane Joubioux)

Planting on embankment (Christiane Joubioux)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [ ] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [x] 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: Yes - Agro-pastoralism (incl. integrated crop-livestock)

Cropland

- Annual cropping
- Hedge plantation

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

Grazing land

- Improved pastures

Animal type: cattle - dairy
Is integrated crop-livestock management practiced? Yes
Products and services: milk, grassland, corn silage, wheat

Species	Count
cattle - dairy	62

Water supply

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

Purpose related to land degradation

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

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wo: offsite degradation effects

biological degradation - Bh: loss of habitats

water degradation - Hs: change in quantity of surface water, Hp: decline of surface water quality

SLM group

- agroforestry
- windbreak/ shelterbelt
- integrated crop-livestock management

SLM measures

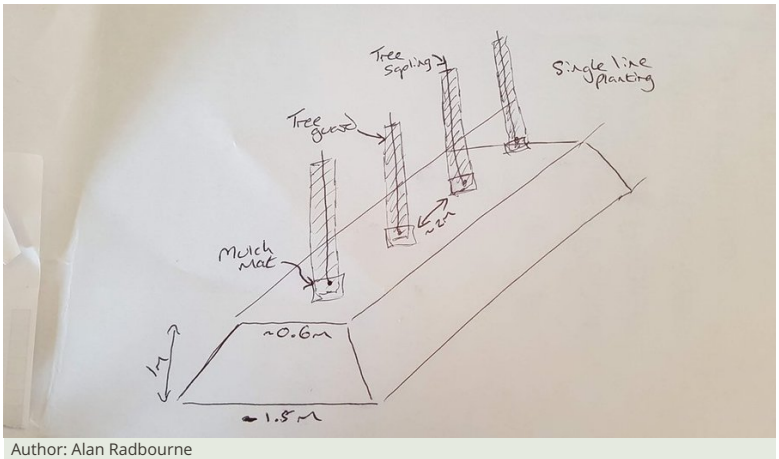
vegetative measures - V1: Tree and shrub cover

structural measures - S2: Bunds, banks, S9: Shelters for plants and animals

TECHNICAL DRAWING

Technical specifications

Example section of planting on embankment. Single line planting of tree saplings on top of embankment, mulch mat around foot of plant, tree guard installed.



Author: Alan Radbourne

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit (unit: **meter** volume, length: **1650**)
- Currency used for cost calculation: **€**
- Exchange rate (to USD): 1 USD = 0.9 €
- Average wage cost of hired labour per day: €10.15 on 1 January 2020, i.e. €1,539.42 monthly on the basis of the legal working week of 35 hours.

Most important factors affecting the costs
- consistency of management - hedge width - Existence of outlets for wood (self-consumption, local industries, etc.)

Establishment activities
1. Tip saplings to form seedling transplants for new plants (Timing/ frequency: spring-summer year 0)
2. Soil preparation at the site of the future hedge (Timing/ frequency: September to October year 0)
3. Creation of the embankment using excavator or forestry plough to establish soil bunds. Vertical compaction of slopes and shaping. (Timing/ frequency: September to October year 0)
4. Tree planting using several deciduous species adapted to the envionmental conditions. (Timing/ frequency: December to March (year 0-1))
5. Laying of biodegradable mulch at the foot of each plant to provide nutrients and moisture retention (Timing/ frequency: December to March (year 0-1))
6. Installation of game guards to protect againt wildlife (deer, hare, rabbit). (Timing/ frequency: December to March (year 0-1))
7. Creation of grass strips at the foot of the slope to stabilise embankment (Timing/ frequency: December to March (year 0-1))

Establishment inputs and costs (per meter)

Specify input	Unit	Quantity	Costs per Unit (€)	Total costs per input (€)	% of costs borne by land users
Labour					
Tip saplings	metre	1650.0	0.35	577.5	
Soil preparation	metre	1650.0	0.8	1320.0	
Creation of the embankment & grass strips	metre	1650.0	1.8	2970.0	
Tree planting, mulching & protection	metre	1650.0	2.0	3300.0	
Equipment					
Excavator / Forest plough	metre	1650.0	0.5	825.0	
Biodegradable mulch	metre	1650.0	0.3	495.0	
Tree guards	metre	1650.0	0.7	1155.0	
Total costs for establishment of the Technology				**10'642.5**	
Total costs for establishment of the Technology in USD				*11'825.0*	

Maintenance activities
1. Hedge pruning and training (Timing/ frequency: Winters for 10-15 years)
2. Lateral pruning of the flower part of the hedges (Timing/ frequency: as required between two wood harvests (with a chainsaw))
3. Slope maintenance (brush clearing and grazing) (Timing/ frequency: once a year)
4. Wood harvest: re-growing of out-sticking branches (Coppice and shrubs) (Timing/ frequency: 15 years after planting, then every 10-15 years)

Maintenance inputs and costs (per meter)

Specify input	Unit	Quantity	Costs per Unit (€)	Total costs per input (€)	% of costs borne by land users
Labour					
Hedge pruning and training	meter	1650.0	0.25	412.5	100.0
Equipment					
Mechanical intervention: annual clearing	meter	1650.0	0.35	577.5	100.0
Construction material					
Thermal brushcutter for landscaping and forestry work (investment to be amortized)	meter	1650.0	0.6	990.0	100.0
Other					
Maintenance of the embankment	meter	1650.0	0.15	247.5	100.0
od storage, chipping, transport of chips	meter	1650.0	0.25	412.5	100.0
Total costs for maintenance of the Technology				**2'640.0**	
Total costs for maintenance of the Technology in USD				*2'933.33*	

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: 700.0
The farm is situated in the commune of Ploërmel in the Morbihan which lies in the early pedoclimatic zone.
The average annual rainfall is between 650-750 mm over the period 1971-2000.
The average annual temperature is around 11.5°C over the period 1971-2000.
Name of the meteorological station: Ploermel
The Ploërmel basin is the most continental of the Morbihan with colder winters, warmer summers and rainfall between 650 and 750 mm/year.

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

Habitat diversity
- ☐ high

- [ ] medium
- [ ] low

- [x] medium
- [ ] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

Off-farm income
- [x] 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
- [x] individual/ household
- [ ] groups/ community
- [ ] cooperative
- [ ] 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
- [ ] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [ ] individual, not titled
- [x] individual, titled

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

Water use rights
- [x] open access (unorganized)
- [ ] 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	diversification of production
crop quality	decreased	increased	remained same
fodder production	decreased	increased	Shelter belts protection of crops
fodder quality	decreased	increased	remained same
animal production	decreased	increased	Well-being improves production
wood production	decreased	increased	New output product on land
product diversity	decreased	increased	Wood produced
land management	hindered	simplified	Increased labour but more sustainable water and land management
expenses on agricultural inputs	increased	decreased	New machinery and labour costs associated with diversified management
farm income	decreased	increased	Increased output production
diversity of income sources	decreased	increased	Addition of woody crop output
workload	increased	decreased	Increased workload with hedgerow management

Socio-cultural impacts

land use/ water rights	worsened	improved	
recreational opportunities	reduced	improved	quality of life
SLM/ land degradation knowledge	reduced	improved	

Ecological impacts

water quality	decreased	increased	Improved water quality in streams due to reduced surface run-off with hedgerow buffer strips
surface runoff	increased	decreased	Decreased run-off with hedgerow buffering
excess water drainage	reduced	improved	Rooting system reducing flooding
soil loss	increased	decreased	Reduced soil erosion from buffered strips
soil organic matter/ below ground C	decreased	increased	Hedgerow inceasing below ground C
vegetation cover	decreased	increased	longer cover of vegetation with hedgerows
biomass/ above ground C	decreased	increased	hedgerows increase above ground C
plant diversity	decreased	increased	Woody crops added
animal diversity	decreased	increased	Biodiversity increases with hedgerow habitat creation
beneficial species (predators, earthworms, pollinators)	decreased	increased	Bees, insects and birds as predators of pests
habitat diversity	decreased	increased	Habitat creation in hedgerows

pest/ disease control	decreased	increased	cultivation aids
flood impacts	increased	decreased	Buffer strips & rooting systems improving infiltration
drought impacts	increased	decreased	Buffer strips limit water loss in drought
wind velocity	increased	decreased	buffer strips provide crop and animal shelter

Off-site impacts

downstream flooding (undesired)	increased	reduced	regulation of belt slope eriosion
groundwater/ river pollution	increased	reduced	Reduced soil, nutrient and plant protection run-off polluting watercourses
buffering/ filtering capacity (by soil, vegetation, wetlands)	reduced	improved	hedges slow flow as a buffer
wind transported sediments	increased	reduced	shelter and sedimant capture
impact of greenhouse gases	increased	reduced	Intake from hedges

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 decrease	not well at all	very well

Climate-related extremes (disasters)

local rainstorm	not well at all	very well
heatwave	not well at all	very well
cold wave	not well at all	very well
drought	not well at all	very well
general (river) flood	not well at all	very well
landslide	not well at all	very well

Other climate-related consequences

extended growing period	not well at all	very well	Answer: not known
reduced growing period	not well at all	very well	Answer: not known
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
- ✓ 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

Due to a concern the maintenence costs would outweigh the benefit return the parcels of land have been rearranged to suit a more efficient system.

To which changing conditions?

- climatic change/ extremes
- changing markets
- labour availability (e.g. due to migration)
- ✓ economic concern of operating system

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Improvement and reorganisation of the plot with a reduction of wetlands.
- Protection of the animals against bad weather and welfare of the herd.
- Protection of water quality.
- Increase in wildlife: insects, birds, game, etc.
- Additional benefits of the hedges are the possibility of installing apiary (18 colonies) by a professional beekeeper in May 2019.

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

- Hydraulic and water chemical control with combination of hedge and embankment.
- Improvement of the landscape and the living environment favourable to the preservation of heritage and the development of tourism: hiking circuits.
- Ecological functions with the preservation of biological diversity: "ecological corridors".
- Economic functions with multiple outputs, such as firewood, timber, hederow crop (i.e. berries) and increased pollen source for bees

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

- Hedge maintenance: extra cost and workload → Delegation to a specialised company.

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

- Time intensive upkeep (i.e. training of saplings) that maybe overlooked and thus not produce highest quality output → Outsource labour work (yet additional expense)
- Lack of outlets for wood from hedgerows → - self-consumption of wood: installation of plate boilers on farms, or heating networks, use of wood for animal bedding
  - developing territorial channels for the valorisation of wood from hedgerows
- Need for training and support for operators → Sustainable management plan for hedges and trees on the farm, and monitoring.

REFERENCES

Compiler
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Reviewer
Rima Mekdaschi Studer

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Resource persons
Christiane Joubioux - co-compiler
Noël Danilo - land user
Isabelle Senegas - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_5681/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- Association des Chambres d'agriculture de l'Arc Atlantique (AC3A) - France
- UK Centre for Ecology & Hydrology (CEH) - United Kingdom

Project
- European Interreg project FABulous Farmers

Key references
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- Réussir une haie bocagère: Chambre d'agriculture de la Manche
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- Guide technique des pratiques favorables à la biodiversité en agriculture - 2009: Chambre d'agriculture de l'Hérault

Links to relevant information which is available online
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