Agroforestry field in Normandy (Yann Pivain)

Alley cropping - Agroforestry (France)

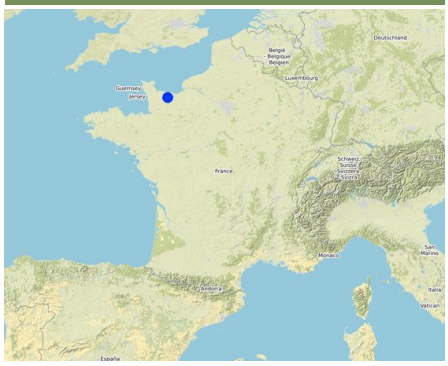
agroforesterie intra parcellaire

DESCRIPTION

The implementation of agroforestry in a cereal field can help aid biodiversity, that will in turn support natural pest control, improve the resilience to water and climate stress through improved infiltration, provide more shade and less wind-stress, and will improve soil health, among other benefits.

Agroforestry, that is the incorporation of trees into agriculture, is a traditional land management practice in Normandy using apple trees inter-grazed by cows on pasture. However, between 1960 and 2000, the restructuring of agricultural land, and technical and technological developments, have led to the disappearance of agroforestry in Normandy. Since the beginning of the 21 century, the integration of trees into the system has started to be reintroduced, not only in grassland systems, but also in crop fields.
The integration of trees into the system is effective for countering:
- Biological degradation: by enhancing biodiversity though improved refuge for insects and birds, providing food for them, breeding opportunities and connectivity corridors across the landscape. This leads to greater biological regulation of crop pests among other benefits.
- Climate related stress: both at the local level (decrease of wind speeds, reduction of evapotranspiration, shade for animals) and at the global level (carbon storage, substitution of fossil energies by renewable energy).
- Water degradation: through the qualitative and quantitative regulation of water at the watershed scale as a benefit of improved rainfall infiltration and less fertilizer lost in runoff.
- Soil erosion by water and chemical deterioration: through the conservation of soils with reduced runoff.
- Soil erosion by wind: through the protection of exposed areas.
and:
- Providing benefits through beautification of the living environment.
As part of the agroforestry SLM technology, trees are planted on grassed strips which are 24 to 30 m apart within the field of cereals. Trees are spaced 8 to 10 m within the strips. This configuration has been adapted to allow mechanized agriculture. The main tree species used are Quercus, Sorbus, Tilia, Prunus and Robinia. Land users, with some support from the local community, financed the re-introduction of agroforestry into Normandy. Soil was prepared using machinery (single line ploughing), mulch was applied and tree seedlings were protected against wild animals.
Despite these financial and management benefits. the SLM technology has not yet been taken up widely. Therefore, the aim is to promote better adoption of agroforestry practices by Normandy farmers. This is becoming more important as the use of external inputs (e.g. fertilizers and pesticides) is increasingly expensive for both farmers and society - and the introduction of agroforestry can both help reduce these costs with more natural pest control and less runoff of fertilisers from the fields.
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

LOCATION



Location: Normandy, France

No. of Technology sites analysed: single site

Geo-reference of selected sites
- -0.62465, 49.16925
- -0.62465, 49.16925

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

In a permanently protected area?: No

Date of implementation: 2017; less than 10 years ago (recently)

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

information.

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: Yes - Agroforestry

Cropland
- Annual cropping: cereals - barley, cereals - maize, Several species over the years, varies by farm

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

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 - Wt: loss of topsoil/ surface erosion, 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
- agroforestry
- windbreak/ shelterbelt
- integrated pest and disease management (incl. organic agriculture)

SLM measures

agronomic measures - A2: Organic matter/ soil fertility

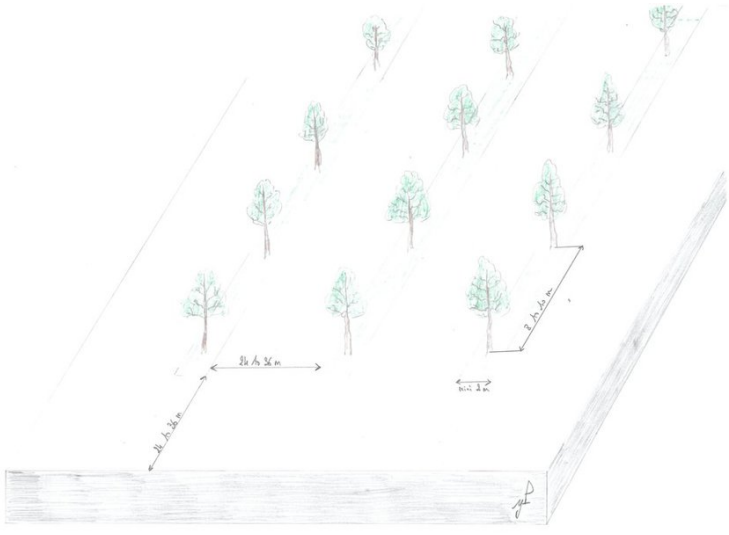
vegetative measures - V1: Tree and shrub cover

management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications

The agroforestry trees are planted on grassed strips of at least 2 m width, 24 to 36 m apart, in a 17 ha field of cereals.
The trees are spaced 8 to 10 m apart.
The configuration is adapted to mechanised agriculture.
The main species used: Quercus, Sorbus, Tilia, Prunus and Robinia. Any dead trees are replaced in the first 3 years.



Author: Yann Pivain

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **1 ha**; conversion factor to one hectare: **1 ha = 1ha = 2.47 acres**)

Most important factors affecting the costs

Time necessary for maintenance. Good training to do quality work.

- Currency used for cost calculation: €
- Exchange rate (to USD): 1 USD = 0.9 €
- Average wage cost of hired labour per day: 120

Establishment activities
1. Choice of the planting site, the design/layout and the species (Timing/ frequency: Spring)
2. Soil preparation (clearing of land, harrowing) (Timing/ frequency: After harvest of crops)
3. Application of mulch to planting strips (Timing/ frequency: After harvest of crops)
4. Tree whips planted in plough slot (approx. 10cm deep), protection spirals fitted and area recovered with mulch (Timing/ frequency: From Nov to Jan)

Establishment inputs and costs (per 1 ha)

Specify input	Unit	Quantity	Costs per Unit (€)	Total costs per input (€)	% of costs borne by land users
Labour					
Design & layout of planting	days	0.5	120.0	60.0	100.0
Surface preparation (clearing & harowing)	days	0.1	120.0	12.0	100.0
Mulch application	days	0.2	120.0	24.0	100.0
Planting	days	0.5	120.0	60.0	100.0
Equipment					
Tractor with harow & Plough	days	0.3	50.0	15.0	100.0
Plant material					
Tree whips	piece/ha	30.0	3.0	90.0	20.0
Mulch	piece/ha	30.0	2.0	60.0	20.0
Construction material					
Base spiral protection	piece/ha	30.0	2.0	60.0	20.0
Total costs for establishment of the Technology				**381.0**	
Total costs for establishment of the Technology in USD				*423.33*	

Maintenance activities
1. Tree maintenance (pruning by hand as required) (Timing/ frequency: from Jun to Dec all year around)
2. Grass strip mowing (using tractor) (Timing/ frequency: after crop harvest)

Maintenance inputs and costs (per 1 ha)

Specify input	Unit	Quantity	Costs per Unit (€)	Total costs per input (€)	% of costs borne by land users
Labour					
Tree pruning	days	2.0	120.0	240.0	100.0
Grass mowing	days	1.0	120.0	120.0	100.0
Equipment					
Tractor & mower	days	1.0	50.0	50.0	100.0
Total costs for maintenance of the Technology				**410.0**	
Total costs for maintenance of the Technology in USD				*455.56*	

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: 650.0
No dry season or marked rainy season. Rain falls fairly regularily.
Name of the meteorological station: Les Andelys

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
- [x] > 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
- [x] Yes
- [ ] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

Relative level of wealth
- [ ] very poor
- [ ] poor
- [ ] average
- [x] 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
- [x] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

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

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

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

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	Less land available for cropping
crop quality	decreased	increased	No change seen
wood production	decreased	increased	Wood produce now integrated
product diversity	decreased	increased	Wood product added
land management	hindered	simplified	Tree lines set for as much ease of mechanical use as possible, yet still does disrupt ease of crop management
farm income	decreased	increased	Loss of crop area, yet some less inputs required (i.e. pesticide)
diversity of income sources	decreased	increased	Wood and cereal crop combined
workload	increased	decreased	Tree maintenence takes longer than when working a single crop field

Socio-cultural impacts

SLM/ land degradation knowledge	reduced	improved	Improved skill set with learning & training in agroforestry

Ecological impacts

water quality	decreased	increased	Trees act as buffer strips for better quality water with less run-off
surface runoff	increased	decreased	Trees act as buffer strips for better quality water with less run-off
excess water drainage	reduced	improved	Improved soil infiltration
soil moisture	decreased	increased	Improved soil infiltration and moisture capacity
soil loss	increased	decreased	Trees act as buffer strips for better quality soil with less run-off erosion
soil accumulation	decreased	increased	Trees act as buffer strips for better quality soil with less run-off erosion for bette accumlation
soil compaction	increased	reduced	Stips of trees require less passes of tractor in field
nutrient cycling/ recharge	decreased	increased	Trees can use deeper nutrient stores
soil organic matter/ below ground C	decreased	increased	Increased carbon below ground with larger tree rooting systems
vegetation cover	decreased	increased	Diversity of vegetation between tree grass strips
biomass/ above ground C	decreased	increased	Trees hold more above ground C
plant diversity	decreased	increased	With trees and diversity of vegetation between tree grass strips
beneficial species (predators, earthworms, pollinators)	decreased	increased	Natural pest control through habitat for predators with trees
habitat diversity	decreased	increased	More space for habitat
pest/ disease control	decreased	increased	Natural pest control through habitat for predators with trees
flood impacts	increased	decreased	Increased infiltration reduces flood impacts
drought impacts	increased	decreased	Improvements in soil moisture capacity
wind velocity	increased	decreased	Trees act as shelter belts for crops

Off-site impacts

groundwater/ river pollution	increased	reduced	Less and cleaner water run off due to buffer strips
wind transported sediments	increased	reduced	Shelter belt reduces wind erosion
damage on public/ private infrastructure	increased	reduced	

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

Climate-related extremes (disasters)

local windstorm	not well at all	very well
heatwave	not well at all	very well

drought	not well at all			✓			very well
general (river) flood	not well at all		✓				very well
flash flood	not well at all		✓				very well
storm surge/ coastal flood	not well at all		✓				very well
landslide	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
- 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

- Reduced wind speeds and wind erosion.
- Creation of reception areas for biodiversity.

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

- Creation of climate zone "temperate" favorable to crops and / or animals.
- Biodiversity increase leading to functional benefits of agricultural production.
- Mixed landscape provides a positive social experience
- Creation of training and and workshops to share implementation and production of artwork wood and / or energy wood.

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

- Cost and maintenance time → Engage interested local community to support
- Possible financial instability of the subsidy payments with regards to hedges → unknown

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

- Possible financial instability of the subsidy payments with regards to hedges → Unknown

REFERENCES

Compiler
Alan Radbourne

Reviewer
William Critchley
Rima Mekdaschi Studer

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Resource persons
Yann Pivain - SLM specialist
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Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_5645/

Linked SLM data
n.a.

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- 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

- Agroforesterie, des arbres et des cultures, Fabien Liagre / Christian Dupraz, éditions France Agricole, 2008 (ISBN 978-2-85557-150-8): Online / 45 €