System report: Weed Survey in Northern Silvoarable Group in France

Project name	AGFORWARD (613520)
Work-package	4: Agroforestry for arable farmers
Specific group	Agroforestry for Arable Farmers in Northern France
Deliverable	Contribution to Deliverable 4.10 (4.1): Detailed system description of a case study system
Date of report	15 January 2016
Authors	Régis Wartelle, Delphine Mézière, Marie Gosme, Lise Ia-Laurent
Contact	r.wartelle@picardie.chambagri.fr
Approved	Jaconette Mirck (21 March 2016)

Contents

AGFORWARD (Grant Agreement N° 613520) is co-funded by the European Commission, Directorate General for Research & Innovation, within the 7th Framework Programme of RTD. The views and opinions expressed in this report are purely those of the writers and may not in any circumstances be regarded as stating an official position of the European Commission.

1 Context

The AGFORWARD research project (January 2014-December 2017), funded by the European Commission, is promoting agroforestry practices in Europe that will advance sustainable rural development. The project has four objectives:

1. to understand the context and extent of agroforestry in Europe,
2. to identify, develop and field-test innovations (through participatory research) to improve the benefits and viability of agroforestry systems in Europe,
3. to evaluate innovative agroforestry designs and practices at a field-, farm- and landscape scale, and
4. to promote the wider adoption of appropriate agroforestry systems in Europe through policy development and dissemination.

This report contributes to Objective 2, Deliverable 4.10: "Detailed system description of case study agroforestry systems". The detailed system description includes the key inputs, flows, and outputs of the key ecosystem services of the studied system. It covers the agroecology of the site (climate, soil), the components (tree species, crop system, management system) and key ecosystem services (provisioning, regulating and cultural) and the associated economic values. The data included in this report will also inform the modelling activities which help to address Objective 3. This report was produced in 2016.

2 Background

The initial stakeholder group, which focused on silvoarable systems, mentioned weeds as an issue for crop management, and unravelling the impact of trees on weed infestations in silvoarable systems has been identified as one of the key research topics for work-package 4 (Burgess et al. 2014; Cirou and Hannachi, 2014; Gosme 2014; Malignier et al., 2014; Wartelle 2014). Because of an obvious lack of knowledge about weed communities in these systems, diagnosis is first required. Burgess et al (2013) is one of the few studies that have described weed composition and abundance in both the understory vegetation and the arable crop. Thus research is needed to assess the impact of tree hedgerows on weed communities and their effect on arable crops in alleyways. It is expected that weed communities in silvoarable systems are modified because of i) the tree understory at the edge of cropped alleys, and ii) competition with the trees for light and water. Consequently the effects of weeds on crops may be different compared to weed communities of arable crops without trees

3 Update on field measurements

Weed survey described in the research and development protocol (Degrumelle 2015) began with a first survey in the summer of 2015 and will continue until the end of 2016. Seven fields were surveyed in 2015. The plan is to survey the same fields in 2016.

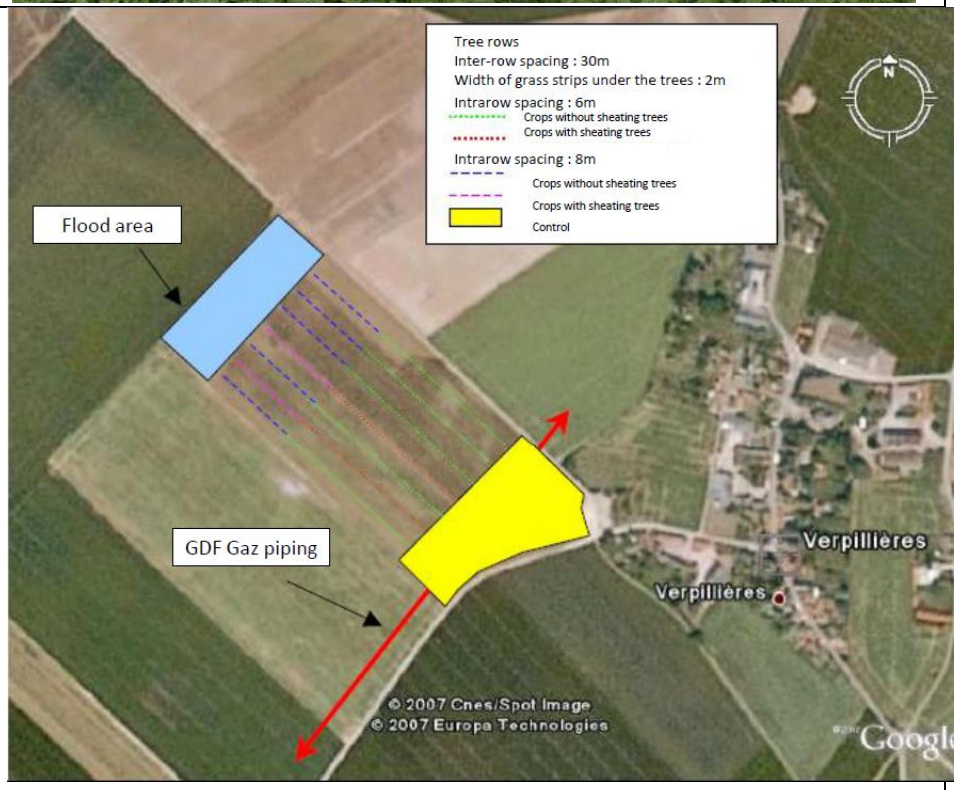
In 2016 the weed survey will be carried out at two different dates: 1) at the onset of spring vegetation and before tree budbreak (ca. February-April), and 2) after budbreak when tree leaves are well developed and when crops are flowering (ca. May-beginning of June). We will try to have a third weed survey in autumn before crop sowing.

4 System description

Table 1. General description of the silvoarable agroforestry case studies systems

General description of system	
Name of group	Northern silvoarable systems in France
Contact	Régis Wartelle
Work-package	4: Agroforestry for arable farmers
Geographical extent	Modern alley cropping agroforestry systems are still rare, but an increasing number of farmers have been planting these systems since about 2010. The oldest Northern French field was planted in 2007 and is located in Sain-Maur, Oise, Picardie, France.
Estimated area	The total area of the silvoarable fields in Northern France is about 100 ha. Each field is about 5 ha to 30 ha.
Typical soil types	Luvisols, Cambisols
Description	Alley cropping agroforestry systems. The cropping system comprises typical crops such as wheat, barley, potatoes, sugar beet, and oilseed rape. The crops are organically or conventionally managed with ploughing or minimum tillage. The crops are under the responsibility of local tenant farmers. The trees are managed by the estate on the advice of Centre Regional Propriété Forestière. Fields were planted between 2008 and 2014, at 26 to 50 m inter-row width (28 to 110 trees ha).
Tree species	Between six and twelve species per field including *Juglans regia*, *Acer platanoides*, *Prunus avium*, *Sorbus torminalis, Sorbus domestica, Malus sp.* and *Pirus sp*.
Tree products	Timber wood
Crop species	Cereals, potatoes, sugar beet, oilseed rape, faba bean
Crop products	Grains and other products
Animal species	None
Animal products	None
Other provisioning services	None
Regulating services	Trees may provide a microclimate which buffers from extreme values of temperature, which may increase the quantity of harvest by protecting crops against drought, and improve the quality of harvest because crops suffer less thermal stress. Trees can promote nutrient cycling, increase carbon storage, and reduce nitrogen leaching in autumn-winter.
Habitat services and biodiversity	Many animal species can use the trees and the herbaceous vegetation on the tree lines for habitat resulting in increased biodiversity.
Cultural services	Herbaceous vegetation on tree lines can host patrimonial vegetation. Trees contribute to landscape amenities.
Key references	Degrumelle 2015 and unpublished results.

Table 2. Description of the specific case study system

Specific description of site	
Area	11 ha (Established in 2008/2009)
Co-ordinates	49°40’3.96”N, 2°48’42/373”E
Site contact	BTU contact: Régis Wartelle
Site contact email	r.wartelle@picardie.chambagri.fr
Example photograph	
Map of system	 Tree species are Norway maple (*Acer platanoides),* wild service tree (*Sorbus torminalis),* hybrid walnut tree (*Juglans × intermedia*), wild cherry (*Prunus avium*), wild pear tree (*Pirus sp.*), wild apple tree (*Malus sp.*), sycamore (*Acer pseudoplatanus*), black locust (*Robinia pseudoacacia)*

Possible modelling scenarios	
Comparison	Technical and economic analysis of alley cropping v monoculture
Climate characteristics	
Mean monthly temperature	10.7 °C
Mean annual precipitation	669 mm
Details of weather station (and data)	Data from 01/01/1981-31/01/2010 (available at meteofrance.com)
Soil type	
Soil type	Luvisol, cambisol
Soil depth	approximately 6 m (until groundwater level)
Soil texture	Compact silt
Additional soil characteristics	Argile : 17.4% ; Groundwater 8 m below soil surface ; Humidity : rather cool
Aspect	
Tree characteristics	
Species and variety	Norway maple (*Acer platanoides),* wild service tree (*Sorbus torminalis),* hybrid walnut tree (*Juglans × intermedia*), wild cherry (*Prunus avium*), wild pear tree (*Pirus sp.*), wild apple tree (*Malus sp.*), sycamore (*Acer pseudoplatanus*), black locust (*Robinia pseudoacacia)*
Date of planting	2008-2009
Intra-row spacing	6 to 8 m
Inter-row spacing	30 m
Hedgerow spacing	
Tree protection	Individual protection
Crop/understorey characteristics	
Species	Sugar beet (*Beta vulgaris*), oilseed rape (*Brassica napus*), potatoes (*Solanum tuberosum*), winter wheat (*Triticum durum*), faba beans (*Vicia faba)*
Management	Conventional arable crop management with the usual mixture of ploughing and herbicide spraying to keep down the weeds
Typical crop yield	
Fertiliser, pesticide, machinery and labour management	
Fertiliser	Assumed that this is not modified by tree hedgerows
Pesticides	Regular spraying of crops during the year to control weeds and pests
Machinery	Need for tractor access in crop alleys to allow soil preparation and spray application
Manure handling	Not necessary in field
Labour	Crops: no additional labour requirements
Fencing	Not required
Financial and economic characteristics	
Costs	Experimental grant for implementation within Picardie Region

Figure 1. View of a silvoarable system with wind turbines in distance

5 Description of tree component

The Picardy case studies fields comprise about 70 ha under agroforestry, divided in seven fields. About 6 to 12 species of trees were planted in each field; the first one in 2007 and the last one in 2014. Each field has at least two rows of trees, with a space of 25 m to 75 m between them. Moreover, there is within rows, a space of 5 m or more (for wood production) between trees. An example tree mixture is: Norway maple (*Acer platanoides),* wild service tree (*Sorbus torminalis),* hybrid walnut tree (*Juglans × intermedia*), wild cherry (*Prunus avium*), wild pear tree (*Pirus sp.*), wild apple tree (*Malus sp.*), sycamore (*Acer pseudoplatanus*), and black locust (*Robinia pseudoacacia)*

6 Description of crop component

Rotation is typical from the region, with wheat as the main crop of the rotation. Most of the time, the first crop in the rotation is oilseed rape, followed by wheat or barley, and potatoes or sugar beet. Production potential is normal to high for the region, depending of the depth and quality of the soil.

7 Initial results

Some initial results are shown in Table 3.

Table 3. Initial weed assessment results

	Conventional crop management	Organic crop management
Influence of rows	A few transects were measured for the presence of weeds. In recently planted fields: there were as many weeds near tree rows as in crop alleys. In older fields: there were more weeds near grass strips. It seems that there is an influence of tree rows and grass strips on the presence of weeds over the years.	Important weed dispersal into the field with grass strips under the trees (stock of weeds), especially near the tree strips. Best results were obtained from mulching.
Other factors	No influence of the type of crop.	Influence of the type of crop and the environment (excluding the effect of the hedges)
Agrochemical use	No differences for weed killing between conventional fields and fields with trees.	

8 Acknowledgements

The AGFORWARD project (Grant Agreement N° 613520) is co-funded by the European Commission, Directorate General for Research & Innovation, within the 7th Framework Programme of RTD, Theme 2 - Biotechnologies, Agriculture & Food. The views and opinions expressed in this report are purely those of the writers and may not in any circumstances be regarded as stating an official position of the European Commission.

9 References

Burgess PJ, Incoll LD, Hart BJ, Beaton A, Piper RW, Seymour I, Reynolds FH, Wright C, Pilbeam DJ, Graves AR (2003). The impact of silvoarable agroforestry with poplar on farm profitability and biological diversity. Final report to DEFRA, Cranfield University, UK.

Cardinael R, Chevallier T, Barthès BG, Saby NPA, Parent T, Dupraz C, Bernoux M, Chenu C (2015). Impact of alleycropping agroforestry on stocks, forms and spatial distribution of soil organic carbon – A case study in a Mediterranean context. Geoderma 259-260, 288-299.

Cirou E, Hannachi Y (2014). Initial Stakeholder Meeting Report: Agroforestry for arable farmers in Western France. 14 November 2014. 9 pp. Available online: http://agforward.eu/index.php/fr/systemes-agroforestiers-ouest-de-la-france.html

Degrumelle G (2015). Diagnostic de parcelles en agroforesterie à l'échelle de la région Picardie 111 pp.

Malignier N, Canet A, Van Lerberghe P (2014). Initial Stakeholder Meeting Report: Agroforestry for arable farmers in the South-West of France. 23 December 2014, updated 20 February 2015. 8

pp. Available online: http://agforward.eu/index.php/fr/systemes-agroforestiers-sud-ouest-de-la-france.html

Mézière D, Boinot S (2015). Research and development protocol for weed management in Mediterranean silvoarable group in France. 9 June 2015. 9 pp. Available online: http://agforward.eu/index.php/fr/systemes-silvoarables-mediterraneens-en-france.html

Wartelle R (2014). Initial Stakeholder Meeting Report: Agroforestry for arable farmers in Northern France. 16 December 2014. 10 pp. Available online: http://agforward.eu/index.php/fr/systemes-agroforestiers-nord-de-la-france.html