System Report: Agroforestry for Ruminants in the Netherlands

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Work-package	5: Agroforestry for Livestock farmers
Specific group	Agroforestry for Ruminants in the Netherlands
Deliverable	Contribution to Deliverable 5.13 (5.1): Detailed system description of a case study system
Date of report	20 November 2015
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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 5.13: "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, livestock, 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.

2 Background

Silvopastoral systems used to be common in the Netherlands. For example dairy production was combined with fruit orchards near fertile river banks. In other regions like Friesland and Zeeland, hedgerows around small pastures were used as natural fencing. Wooded banks traditionally had many different purposes like building materials, energy and fodder. However during the twentieth century, associated with the intensification of land use, specialisation of farms and redistribution of land among farmers, many silvopastoral systems have disappeared. In the case of dairy farms in The Netherlands, trees were often removed in meadows since they suppressed grass productivity. In the 1950s the Dutch government even handed out felling premiums for cutting down of trees in pastures (Hartmans et al. 2005).

Although the recent Common Agricultural Policy stimulates measures for enhancing biodiversity in the rural landscape, in Northern Europe the implementation of agroforestry systems on modern farms is rare. This is also the case for the Netherlands, which is densely populated and where there is a high demand for land and farm rents are relatively high. Many dairy farms are also intensifying farming practices following the recent removal of milk quotas.

Despite these developments, several dairy farmers in the province 'Noord-Brabant' have implemented small scale agroforestry on their farms (van Eekeren et al. 2012). At one farm, willow and elder trees were planted in a trial field as 'fodder trees', which the cows could use for three dimensional grazing. As leaves contain higher levels of mineral and trace elements, browsing of leaves might be a natural supplement for cows (Luske and van Eekeren 2014). The dairy farmer was interested to monitor the preference of the cows for different tree species and to quantify how much the cows would eat from the trees (Luske 2014). In 2015, this trial field was used to monitor the preference of the cows for willow and elder leaves and twigs.

3 Update on field measurements

The trial field with willow cuttings in the spring of 2013. The trees were protected from browsing for more than two years. In April 2015 two and a half of the willow rows were cut at knee height. The other trees were not managed and reached a height of 4 m. From 1 May until 29 September 2015, the cows were allowed to enter the trial field and to browse from the fodder trees every other day. The trees were inspected for browsing marks three times during the growing season (on 27 May, 9 July and 19 November).

4 Description of system

Table 1 provides a general description of existing agroforestry systems in the Netherlands. A description of a specific case study system is provided in Table 2.

Table 1. General description of the existing agroforestry systems in The Netherlands

General description of system	
Name of group	Agroforestry for ruminants in The Netherlands
Contact	Boki Luske
Work-package	5: Agroforestry for livestock farmers
Associated WP	4: Agroforestry for arable farmers (those growing short rotation coppice)
Geographical extent	As mentioned before, hedgerows and wooded banks used to be common in the Netherlands. At the moment there are four regions in The Netherlands were hedgerows and wooded banks are still integrated with dairy production on a landscape scale: 1) Noordelijke Friese Wouden (ca 25000 ha) 2) Achterhoek (ca 10000 ha) 3) Maasheggen (ca 2000 ha) 4) Nisse (ca 1000 ha) The four regions provide typical examples of Dutch cultural heritage. To protect the typical landscape features from further degradation, some parts of these regions are not registered as agricultural land anymore, but as natural areas. Conservation managers from nature organisations maintain the vegetation, or sometimes organic farmers are hired to maintain the landscape. In all four regions farmers receive additional grants, because the maintenance of the trees or hedgerows costs more than the economic benefits for the farmer. In the province of Noord-Brabant around the Loonse en Drunense Duinen (where our test site is located), wooded banks still exist on agricultural land. They are maintained and restored in the area as part of a European and national nature conservation project (The National Ecological Network) where all nature reserves are connected by ecological connection zones. Farmers receive compensation grants, as the land value decreases when allotment changes from 'agriculture' to 'nature'. However, farmers do not always think this compensation grant is sufficient, which is slowing down the process of creation of ecological connection zones.
Estimated area	38,000 ha
Typical soil types	Varied

Description	The trial field for fodder trees has a different design than the above mentioned traditional silvopastoral systems of the Netherlands. Instead of pastures with borders of hedgerows or wooded banks, the tree rows were planted within the pasture. To study the potential of short rotation coppice for fodder purposes, fast growing tree species were selected, which were planted in high densities in twin rows. As the particular pasture was very wet, which was problematic for grass yields and grazing, species were selected that are able to grow in wet conditions. The trees at the same time may help natural drainage. This approach is new to the Netherlands, and there is a need for demonstration systems and data on performance in order to increase awareness.
Tree species	Two short rotation coppice (SRC) species: • Willow (two varieties of *Salix viminalis* with different tree morphology, one growing in a upright form and one with a branched out form, 'Klara') • Alder (*Alnus glutinosa*)
Tree products	Tree fodder (leaves and twigs) Woodchip for bioenergy and/or mulch/compost
Crop species	Grass species such as perennial ryegrass (*Lolium perenne*)
Crop products	Grass can be grazed directly by livestock (or cut to provide animal feed, silage or hay).
Animal species	Dairy cows
Animal products	Dairy
Other provisioning services	Management of natural areas (other pastures)
Regulating services	In winter the trial field pasture is too wet for the cows to have access. The trees may regulate water levels in the soil due to higher evapotranspiration levels. In summer the trees provide shade for the cows. Above and below ground, the trees can increase carbon storage. The tree rows support biodiversity, by contributing to the variation in landscape and vegetation and different habitat types. Nitrogen-fixing trees such as alder can increase soil fertility.
Habitat services and biodiversity	Tree species such as willow can provide additional resources for invertebrates such as bumblebees early in the season. The tree row represents a stable habitat so can provide shelter and resources for animals, as well as acting as corridors linking up other semi-natural habitat patches. These species may be beneficial, neutral or detrimental to provisioning services.
Cultural services	Introducing trees into a livestock system may increase job opportunities and skills with regards tree management. If fodder trees are planted on larger scale than this test site, they change the open landscape into a partly wooded with more variety.

Table 2. Description of the specific case study system

Specific description of site	
Area	Test site consists of 9000 m^2 with tree rows which forms part of the pastures of organic dairy farm 'De Kerkhoeve'
Co-ordinates	51°38'15.65"N; 5°12'27.58"W
Site contact	Boki Luske
Site contact email	b.luske@louisbolk.nl
Example photograph	 Figure 1. Tree row of willow (branched out form) that has been browsed by the dairy cows (Picture taken on 9 July 2015)
Map of system	 Figure 2. Aerial view of the farm with silvopastoral trial site and the surroundings

Figure 3. Aerial view of the silvopastoral trial site and the farm

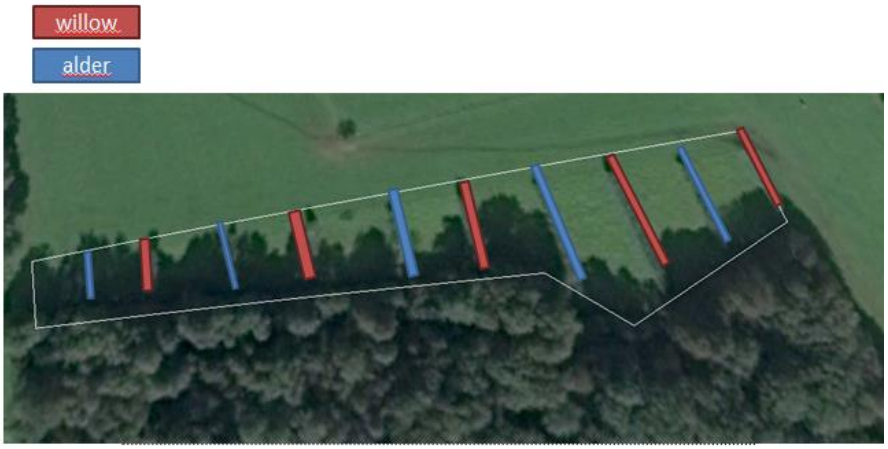

Figure 4. Silvopastoral system design with five willow and five alder rows (twin rows)

Possible modelling scenarios	
Comparison	Pasture production without trees
Climate characteristics	
Mean monthly temperature	10.1°C
Mean annual precipitation	738 mm
Details of weather station (and data)	Met Office weather station at Gilze-Rijen, accessed from the Met Office website on 17 of November 2015 (https://weerstatistieken.nl/gilze-rijen/2014/januari)
Soil type	
Soil type	Sandy soil
Soil depth	Not determined
Soil texture	Soil measurements were taken on 17 June 2013: Clay: 3% CEC: 55

Additional soil characteristics	N total: 1710 C: N ratio: 12 : 1 PPAE: 2.3 pH: 5.6 Organic matter content: 4.2% Soil is too wet for grazing in autumn and winter period.
Tree characteristics	
Species and variety	Willow (*Salix viminalis*: 2 varieties) Common alder (*Alnus glutinosa*)
Date of planting	April 2013
Intra-row spacing	0.25 m between trees 0.7 m between twin rows
Inter-row spacing	24m between centre of twin rows
Tree protection	None. Weed control was done by mowing
Typical tree yield	Not yet determined
Typical increase in tree biomass	Not yet determined
Crop/understorey characteristics	
Species	Grassland, including perennial ryegrass (*Lolium perenne*) and clover (*Trifolium repens, Trifloium pratense*) Nettle (*Urtica dioica*) developed under the rows with alder trees, probably due to nitrogen fixation by the trees.
Management	Cattle introduced for the first time in April 2015. 2.5 twin rows of willow have been harvested in april 2015 (at knee height). Yield was not determined.
Typical grass yield	Not determined
Fertiliser, pesticide, machinery and labour management	
Fertiliser	Cattle grazing
Pesticides	None (organic)
Machinery	Tractor and mower
Manure handling	Not necessary in the field
Labour	Animals checked daily during milking (also by milk robot)
Fencing	Test site with fodder trees is next to a small piece of forest (south side), north and west of the test site are pastures accessible to the cows. On the east side are pastures of a different farm. There is electric fencing in between the forest and the neighbouring farm. Twin rows of fodder trees are protected with a single line (first electric, but later non-electric).
Livestock management	
Species and breed	Holstein dairy cows.
Description of livestock system	Cattle are outdoors from March/April to Oct/Nov depending on weather, soil and water conditions. The animals are part of an organic dairy farm, with dairy cows and milking unit (robot) on the main farm (first building north of the test site). When an individual cow needs to be milked it walks by it self to the milking unit in the stable. The cows may pass by the fodder trees several times a day.
Date of entry to site	From 1 April 2015, every other day the cows have access to the fodder trees and the surrounding pastures.
Date of departure	Until 29 September 2015

from site	
Stocking density	130 cows and calves have access to the trial field and time the surrounding pastures at the same
Animal health and welfare issues	The tree rows were used for shelter from heat in during summer. Especially the young calves (that were kept with the mother cow in the heard the first weeks of their life) used the trees for shelter.
Requirement for supplementary feed	Protein and mineral supplements are provided after milking (half a doses per day, 100 grams of mixture minerals)
Technical data, livestock	
Production volume	Not determined
Herd performance	Not determined
Feed consumption	Not determined
N-balance	Not determined
Financial and economic characteristics for maintenance	
Costs	Management cost for mowing the grass of the trial field was slightly higher, because it took some more time to mow around the tree rows (1 hour per year) Costs for weed management were slightly higher (2 hours per year) Grass yield was the same or even higher as the old situation. Before, the grass was hardly grazed due to wet soil conditions of the trial field. In the new situation the pasture between the tree rows is popular for grazing (and browsing). The calves used the tree rows for lying down.

5 Plans for 2016

In summer 2015, the tree rows of the trial field were inspected for browsing marks three times. The results will be presented in the near future. In the summer of 2016, only several young cows (not yet in production) will get access to the trial field. Only a part of every tree row will be accessible for them for browsing. By this we want to quantify in more detail the browsing of the trees and the potential mineral uptake.

6 Acknowledgements

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