Research and Development Protocol for Agroforestry in the Spreewald Floodplain, Germany

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Work-package	2: High Nature and Cultural Value Agroforestry
Specific group	Agroforestry in the Spreewald flood plain, Germany
Milestone	Milestone 4 (2.3) Part of experimental protocol for WP2
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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 the second objective. It contributes to the initial research and development protocol (Milestone 4, (2.3)) for the participative research and development network focused on the use of agroforestry in high natural and cultural value (HNCV) areas.

2 Background

Spreewald is located at about 100 km southeast of Berlin. The Spreewald region is currently a habitat for numerous plant and animal species, several of which are extinct or endangered in other areas. It was designated a biosphere reserve in 1990 and was recognized by UNESCO as such in March 1991. The Spreewald region amounts to approximately 3000 km^2 of which the Biosphere Reserve occupies about 475 km^2. In the Spreewald Reserve the main areas include pastureland (37.5%), forest (27.4%) and agricultural land (24.3%) (Beesk 2013). The main tree species is black alder (*Alnus glutinosa*) which occupies about 2800 ha of the area (Schumacher 2002). The agricultural land is of low productivity, i.e., the average index of potential productivity is 27 (LAGS 1996). Common agricultural crops are vegetables, including cucumbers which are a famous product from the area. The trademark “Spreewald” is successfully used for gherkin and horseradish. Grassland is managed through cattle grazing or mowing. Products are either milk or meat.

The area is protected by Natura 2000, all of the reserve is considered a Special Protected Area, and 27% is considered an important flora-fauna-habitat. Due to nature protection regulations, the utilization of the products within the tree row is prohibited (e.g., BbgBaumSchV 2004, BbgNatSchG 2013). Hence, the farmers are not allowed to harvest the old trees for their biomass without a special permission. The farmers are not obliged to maintain the hedgerows either. As a consequence, the hedges are not maintained and their rejuvenation is further hindered by the presence of cattle. Rejuvenating these hedgerows demands a new approach to not only facilitate their establishment and maintenance, but also to identify funding opportunities to reduce high financial burden to farmers.

3 System description

The trial will take place at the Filower site in Spreewald (Figures 1, 2 and 3). The research site is characterized by a mosaic of landscape features including hedgerows. This structure is typical to the Spreewald. The research site is about 109 ha and is located in the district of Leipe (Beesk 2013) (Table 1). The grassland area between the tree rows is extensively managed as a meadow through grazing and mowing. Grazing takes place between May and October (Waage and Knorr 2008). Mowing is completed once or twice a year.

According to Rubo and Hilgendorf (2009), the main tree species at the Filower site is black alder (*Alnus glutinosa* (L.) Gaertn.). As secondary species black poplar (*Populus nigra* L.), bird cherry or hackberry (*Prunus padus* L.), willow (*Salix* spp.), and durmast oak (*Quercus petraea* Liebl.) were identified. The most common shrub species were glossy buckthorn (*Frangula alnus* Mill.), buckthorn (*Rhamnus alaternus* L*.)* and wild rose (*Rosa canina* L.). An herbal understory layer was not present due to grazing.

In addition to grazing pressure, trampling and tree aging significantly reduced natural rejuvenation. The black alder was still able to renew itself due to its ability to resprout after coppicing (cutting). This natural regeneration was reflected by the majority of young trees (<25 years) being of this species (Rubo and Hilgendorf, 2009). Poplars have the ability to resprout after coppicing as well, but grazing and trampling pressure could have been too high resulting in mostly mature (>25 years) poplar trees. Poplar dieback resulted in great amounts of deadwood, which potentially can be used to protect newly planted or harvested trees.

Figure 1. Filower site in Spreewald (red colour delineates the trial areas)

Figure 2. Trampling damage at the Filower site. Source (Beesk 2013)

Figure 3. Old poplar tree at the Filower site. Source (Beesk 2013)

Table 1. Description of the site, with soil, tree, understorey, livestock, and climate characteristics for the study site at Filower

Site characteristics	
Area (ha):	109
Co-ordinates:	51°52'N;14°4'E (51.87186654N, 14.07097541E)
Site contact:	Michael Petschick
Site contact email address	michael.petschick@lugv.brandenburg.de

Soil characteristics	
Soil type (German classification)	Normgley, Auengley, Niedergley (WBR classification: Gleysole?)
Soil depth	To be confirmed
Soil texture	To be confirmed
Additional characteristics	Groundwater depth between 10 and 80 cm

Tree and shrub characteristics	
Tree species	**Trees:** black alder (*Alnus glutinosa* (L.) Gaertn.) black poplar (*Populus nigra* L.) bird cherry or hackberry (*Prunus padus* L.) willow (*Salix* spp.); durmast Oak (*Quercus petraea*) **Shrubs:** glossy buckthorn (*Frangula alnus* Mill.) buckthorn (*Rhamnus alaternus L.)* dog rose (*Rosa canina* L.)
Density (spacing)	To be confirmed
Protection	None

Understorey characteristics	
Species	Grass
Coverage	Complete
Additional details	Grass managed by grazing with cattle and mowing.

Livestock characteristics	
Species	Cattle
Stocking density	3 per ha

Climate data	
Mean monthly temperature	9.4°C
Mean annual precipitation	570 mm
Details of weather station (and data)	Data from 01/01/1981-31/01/2010 (available here) for the Luebben-Blumenfelde weather station (id: 3083, 51°56'N, 13°53'E)

4 Trial design

4.1 Description of site

The investigation will take place in two different parts of the Filower area where heterogeneous hedgerows were found (Figure 4). In area "I" the dominant tree species is black alder. In area "II" the field is predominantly occupied by long-lived trees such as oak. Although, the concept will be developed at the Filower site, but should be applicable to other nature conservation areas in the region.

Figure 4. Map of research area at the Filower site (red colour delineates the trial area), showing study areas I and II

4.2 Factors to consider in tree harvesting

In developing the treatments, which are focused on different harvesting and regeneration methods, the following factors were be taken into account (Figure 5):

- *Distance between tree rows*: for hedgerows very close to each other cutting down the whole row is possible while for hedgerows farther away from each other cutting down every sixth to fourth tree (depending on the width) to be replaced by a long lived tree will be considered.
- *Gaps within rows*: some hedgerows are already very fragmented. They can be used as the first planting areas, but it should be also considered that gaps in tree rows are important habitat for breeding birds and increase the aesthetic value of the landscape.
- *Width of hedgerows*: the width of a hedgerow should not exceed 15 m, therefore, the additional structures that spread beyond that width could be harvested as well.

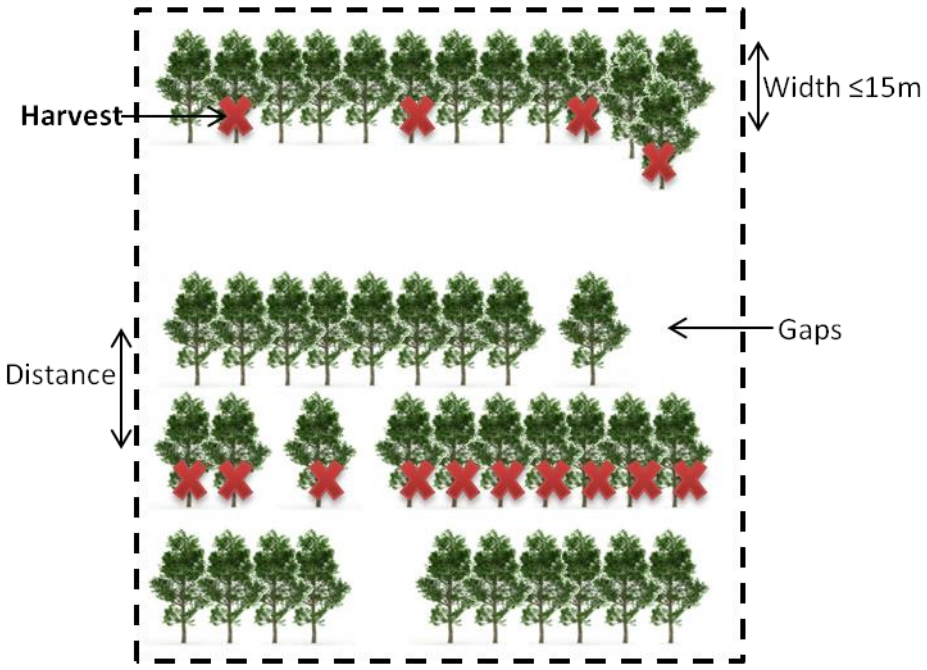

Figure 5. Factors considered for in establishing the harvesting treatments. The red crosses indicate harvested trees

4.3 Factors to consider in tree establishment

The second component of the treatments is the proposed tree establishment method. The key factors to be considered are a) the ecological functions sought, b) the amount of funding available, and c) the costs of tree protection:

- *Ecological functions/suitability and services*: the social and ecosystem services provided by the hedge structure such as wind reduction, wildlife habitat, and areas of high cultural value for tourism will be focused on. Renewal/planting strategies will be developed using traditional knowledge (e.g., DVL 2000, Kurt and Gandert 1956) and in collaboration with the farmers, personnel from the Spreewald Biosphere and other stakeholders. A simplified multispecies design is presented in Figure 6. Representative species for the groups of long lived trees, fast growing trees and shrubs are also given. The selection of species will depend on site characteristics. A vegetation survey will be carried out to assess species suitability.
- *Funding*: for funding purposes the biomass potential from harvested biomass will be quantified, including whole tree rows, single trees or tree rows which spread beyond the width of 15m (see section 6). In addition, available funding mechanisms will be reviewed. Another important aspect is whether the harvested biomass belongs to the farmer or the land owner (this is mentioned in the lease agreements).
- *Protection*: the cost effectiveness of fencing is considered as well.

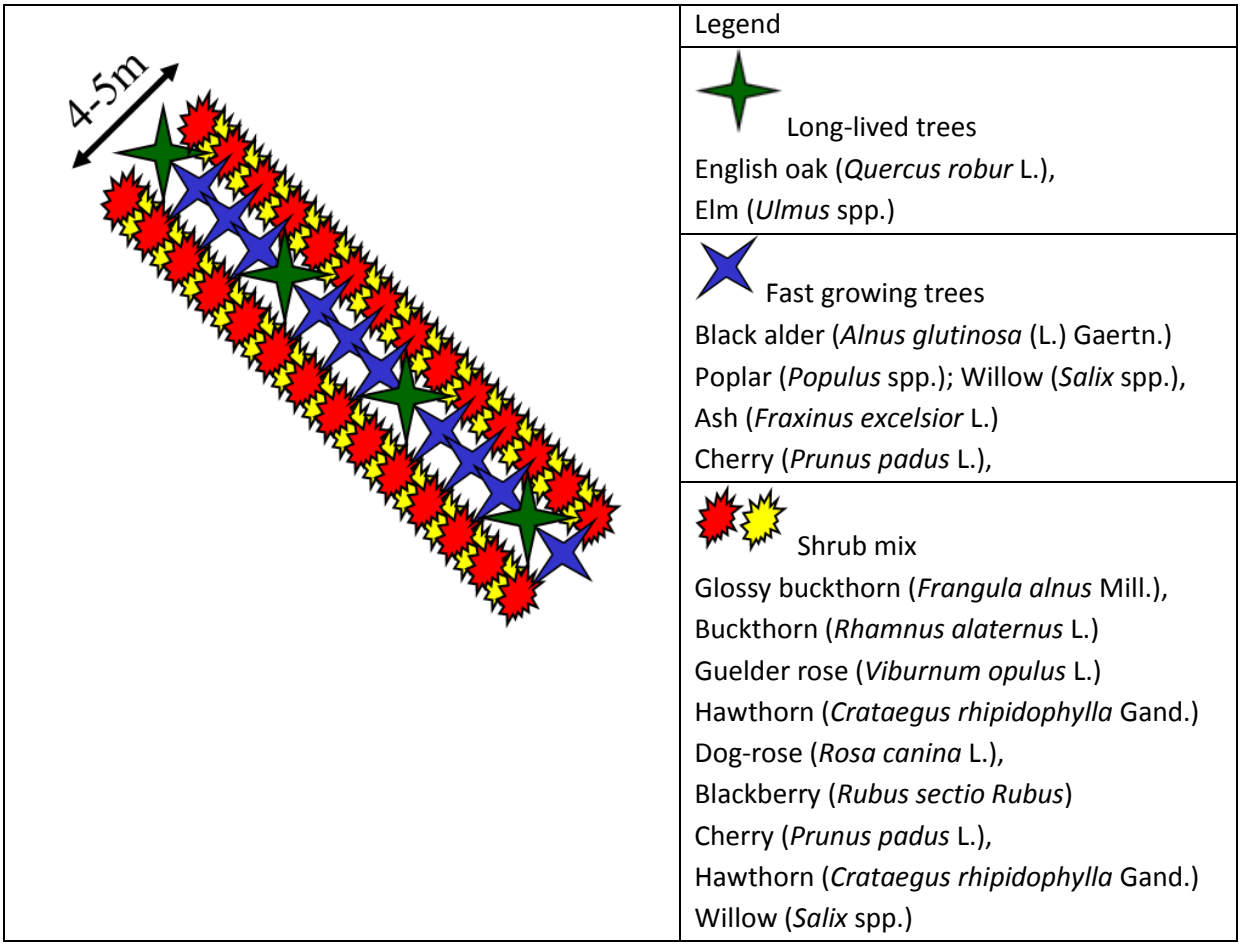

Figure 5. Example of a multispecies design, and local species that can be used (Bank, 2012)

4.4 Selection of treatments

On the basis of the above, five treatments were identified (Table 2).

Table 1. Description of the five treatments

Treatment	Area	Harvesting/rejuvenation method	Regeneration method
A	I	Whole row harvesting when rows are close together	One third to one fifth of the rows can be harvested and subsequently left for natural regeneration
B	I	Whole row harvesting when rows are close together	One third to one fifth of the rows can be harvested and subsequently left for natural regeneration and **protected with fences**
C	I & II	Gap filling combined with single tree harvesting	Gaps and/or harvested trees will be filled/replaced with long lived trees and subsequently left for natural regeneration
D	I & II	Gap filling combined with single tree harvesting	Gaps and/or harvested trees will be filled/replaced with long lived trees and **protected with fences**
E	I & II	Business as usual	No protection

Note: Areas I and II are depicted in Figure 4.

5 Measurements and activities

There are a range of potential measurements (Table 3). Some specific measurements for individual treatments have been established (Table 4). Example recording sheets are included in Appendix A.

Table 3. Example measurements to be made at the site

Component	Description of measurements
Site characteristics	• Investigate site conditions in terms of soil characteristics, weather (local weather station), and water availability.
Tree biomass: live matter	• Previously established allometric equations will be used. These equations established the relationship between diameter and dry weight. If allometric equations are lacking either forestry equations will be used or allometric equations will be established if regulations allow. • Diameter and height measurements for tree measurement plots will be carried out for both harvested and non-harvested plots to measure regrowth and survival.
Tree biomass: deadwood	• All dead branches will be collected from measurement plots. • Quantify the impact of using dead wood branches to protect roots of long lived trees. • Quantify cost saving of using dead branches instead of fencing.
Design and selection of new tree species	• Carry out vegetation surveys using designated measurement plots. • Select appropriate species for rejuvenation. • Arrange selected species according to the conditions, e.g., trees vs shrubs, fast growing vs long lived.
Cattle damage	• Photographs of any damage to be taken • The extent of any damage for the five treatments will be recorded on a 1-5 scale: 1. Leaf and bud browsing 2. Light branch grazing 3. Small end branches broken 4. Small areas of trunk/root damage (<30 mm radius) 5. Large areas of trunk/root damage (>30 mm radius and torn branches).
Costs and benefits	• Revenues from harvested/dead wood biomass • Costs of biomass harvesting • Cost of fence and fencing • Labour cost of dead branches collection • Cost of installing and using a bio-burner
	• Research agroforestry product potential for the Spreewald • Assess agroforestry product markets for dead wood and harvested wood. • Assess use of the Spreewald trademark or other certification system • Determine willingness to pay for Agroforestry products and services using the method of choice experiment

Table 4. List of measurements to be taken in the five treatments

Measurement	Treatment				
	A	B	C	D	E
Dead branch collection	✓	✓	✓	✓	✓
Dead wood root protection					✓
Diameter and height of trees	✓	✓	✓	✓	✓
Vegetation survey	✓	✓	✓	✓	
Distance between tree rows/width of tree rows	✓	✓	✓	✓	
Photographic record of hedge condition to assess cattle damage	✓	✓	✓	✓	✓
Cost and revenue of harvesting	✓	✓	✓	✓	
Cost of fencing material, including labour		✓		✓	

6 Acknowledgements

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Appendix A. Example recording sheets

Table A.1. Tree measurements

Tree number	Diameter	Height
1.		
2.		
3. etc		

Table A.2 Quantify deadwood

Date	Number of branches	Branches type*

*tree, shrub

Table A.3. Costs and benefits

Date	Type of operation*	Inputs used~	Cost of inputs	Revenues

*harvesting, planting ~seedlings, fence, labour etc