



System Report: Agroforestry for Free-Range Pig Production in Denmark

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Specific group	Agroforestry for free-range pig production in Denmark
Deliverable	Contribution to Deliverable 5.13 (5.1): Detailed system description of a case study system
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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. This report was produced in 2015, and additional material will be presented over the remaining two years of the project.

2 Background

The initial stakeholder report (Kongsted, 2014) and the research and development protocol (Kongsted and Hermansen, 2015) provide background data on agroforestry for free-range pig production in Denmark.

Integration of trees with crops and/or livestock production (agroforestry) has been identified as a sustainable way to increase the productivity of land and to provide other ecosystem services and environmental benefits compared to disaggregated agricultural and woodland systems (Smith et al. 2011). We have previously found indications of a reduced risk of nutrient leaching from integrated production of free-range growing pigs and energy crops compared to the current pasture-based system (Sørensen et al. 2013). This is possibly caused by the deep root system of energy crops with large nutrient uptakes across a long growing season (Jørgensen et al. 2005). Additionally, the system seems to have some clear animal welfare benefits because the crops provide the pigs a more natural and stimuli-rich environment with good possibilities for shadow seeking in hot seasons as well as shelter in cold seasons (Horsted et al. 2012). A few Danish organic pig producers have already established energy crops (willow and poplar) in paddocks for lactating sows.

3 Update on field measurements

A comparative study described in the research and development protocol (Kongsted and Hermansen, 2015) began in May 2015 and is planned to continue to April 2016.

4 Description of system

Table 1 provides a general description of the agroforestry system for free-range pig production in Denmark. A description of a specific case study system is provided in Table 2.

Table 1. General description of the agroforestry system for free-range pig production system

General description of system	
Name of group	Agroforestry for free-range pig production in Denmark
Contact	Anne Grete Kongsted and John E. Hermansen
Work-package	5: Agroforestry for livestock farmers
Geographical extent	Agroforestry systems for large-scale free-range pig production are found on three farms in Jutland, Denmark
Estimated area	It is estimated that Danish organic pig producers use approximately 1,800 ha land to rear free-range sows (typically each year half of the area is used for sows whereas the other half is used to produce barley undersown with grass clover. The following year, the procedure is reversed and so forth. The total area of grassland with trees is estimated to 75 ha (10-40 % tree cover, mainly poplar but also to a small extent willow and various fruit trees).
Typical soil types	Podzol
Description	<p>Danish organic pig production characteristics: Pregnant and lactating sows are kept on grassland (grass clover) all year round in paddocks where they have access to insulated huts for protection. The huts are placed directly on the ground and supplied with straw.</p> <p>The paddocks are usually moved to a new field each spring, often in a two-year crop rotation - one year with barley with an under-sown grass-ley and one year with sows on pasture. The stipulated maximum stocking rate corresponds to an estimated excretion of 140 kg N in pigs manure per ha and year (equivalent to 280 kg N ha⁻¹ every second year). Piglets are weaned at seven weeks of age and moved to a barn with access to an outdoor concrete area until slaughter at 110 kg live weight. In Denmark two large scale pig producers have established energy crops (willow and poplar) in paddocks for lactating sows.</p>
Tree species	Poplar and willow
Tree products	The crops will be harvested to produce energy or for wood chips (e.g. for use as rooting material in the barns for growing-finishing pigs)
Crop species	Grass clover
Crop products	The crop are used for free-range pigs approximately every second year. In between the area are used for production of cereals.
Animal species	Pigs
Animal products	Pork
Other provisioning services	Possibility of using willow/poplar leaves as fodder
Regulating services	<p>The trees can provide shade for the pigs in summer and shelter in the winter. The trees can reduce nutrient leaching and ammonia losses from the free-range pig production.</p> <p>The trees will increase carbon storage.</p>
Habitat services and biodiversity	Increased biodiversity and positive effect on wildlife (compared to bare grassland)
Key references	See end of report

Table 2. Description of the specific case study system

Specific description of site	
Area	The case study system comprises 21 paddocks of 333 m ² (0.7 ha). The total farm area is 130 ha, with approximately 30 ha used for pigs. Poplar is established on an area of 6.8 ha (including grass clover without trees).
Address and co-ordinates	Ulvehøjvej 1, 6650 Brørup: 55°34'38.1"N 8°59'36.5"E
Site contact	Anne Grete Kongsted
Site contact email	aneg.kongsted@agro.au.dk
Example photographs	 <p>Figure 1. Individual farrowing/lactation paddocks (one hut in each paddock). Each sow has access to an area with grass clover (10 x 33 m²) including two rows of poplar. Next year two rows of paddocks will be established in the area in the middle.</p>  <p>Figure 2. The paddocks are separated by an electric fence. The fence keeps the sows within the paddocks, but the piglets run between paddocks.</p>

Map of system	 <p data-bbox="472 779 1369 920">Figure 3. A map of the farm and the experimental paddocks with trees (left box) and the control paddocks without trees (the right box). See more information in the Research and development protocol (Kongsted and Hermansen, 2015)</p>
Possible modelling scenarios	
Comparison	Technical analysis of trees vs no trees in the paddocks
Climate characteristics	
Mean monthly temperature	Mean monthly temperature is 8.3 (+/- 6.0 SD)°C
Mean monthly precipitation	Mean monthly precipitation is 62 (+/- 31 SD) mm.
Details of weather station (and data)	Weather station located approximately 4 km from the experimental site
Soil type	
Soil type	Podzol
Soil depth	
Soil texture	A mixture of coarse and loamy sand
Tree characteristics	
Species and variety	Poplar (<i>Populus spp.</i>)
Date of planting	Established in 2009
Intra-row spacing	3.5 m
Inter-row spacing	2.5 m
Tree protection	In half of the experimental paddocks with trees the sows have no access to the trees, only the piglets.
Typical increase in tree biomass	To be explored
Crop/understorey characteristics	
Species	Grass clover
Management	The grass clover was established in spring 2013 and the pigs gained access to the grass land may 2015
Typical grassland yield	1000-2000 kg DM/ha/year

Fertiliser, pesticide, machinery and labour management	
Fertiliser	None (except manure from the free-range pigs)
Pesticides	None (organic production)
Machinery	Feed and water is provided by tractor
Manure handling	Not necessary in field
Labour	The sows are fed once daily. Water is provided and all animals are checked every day.
Fencing	See photos above
Livestock management	
Species and breed	Pigs. The sows are crossbred between Landrace and Yorkshire
Description of livestock system	Lactating sows are outdoor all year round on pasture (grass clover) in individual paddocks. Pregnant sows are moved batch-wise (n = 22-26) to the farrowing/lactation paddocks one week before farrowing. The sows farrow in individual huts provided with straw (see photos above). Piglets are castrated within the first week and weaned after seven weeks. All sows are nose-ringed (to reduce rooting behavior and thereby reduce sward damage).
Date of entry to site	May 2015.
Date of departure from site	Each batch of sows stays in the lactation paddocks for eight weeks (one week before farrowing and seven weeks after). After weaning the paddocks are empty for four weeks until a new batch of sows is moved to the paddocks.
Stocking density	Each individual lactation paddock is 10 x 33 m ²
Animal health and welfare issues	During the summer, potential issues include sunburn and heat stress. The free-ranged system is generally characterized by a higher piglet mortality compared to indoor systems.
Requirement for supplementary feed	The sows are fed <i>ad libitum</i> with supplementary concentrate. Grass constitutes only a very small proportion of total nutrient intakes.
Technical data, livestock	
Production volume	170 sows, 3,737 finishers produced
Litter performance	<i>Per litter</i> Live- and dead born piglets: 13.4 and 0.6 Weaned piglets: 11.0 Total piglet mortality: 21 % Weaned piglets: 133 kg
Feed consumption	2,071 kg concentrate per sow per year (16 % crude protein) Approximately 50 % is used for lactating sows
N and P-balance, paddock level (lactation)	<i>Experimental paddocks (one year)</i> N P (to be determined) <u>Input</u> Feed: 814 kg N/ha Atmospheric deposition: 15 kg N/ha Straw: 5 kg N/ha <u>Output:</u> Piglets weaned: 216 kg N/ha Balance: 618 kg N/ha
Financial and economic characteristics	
Costs	See report regarding production costs in organic pig production: http://vsp.lf.dk/~media/Files/PDF%20-%20Publikationer/Notater%202012/Produktionsoekonomi_SVIN_2012/Hele_pjecen_SVIN_2012.pdf (in Danish)

5 Acknowledgements

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