Short rotation coppice strips
integrated with site-typical crop rotation

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Erosion and loss of biodiversity in agricultural landscapes

Northern and Eastern Germany are characterised by
- agricultural landscapes with big fields
- a low proportion of trees and hedgerows
- close crop rotations with more than 50 % cereals

- Unprotected agricultural landscapes are susceptible to wind and water erosion
- Lack of structural elements and low crop variability contribute to biodiversity loss
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Agroforestry with fast growing trees

→ Alley cropping
→ Tree species: poplar, willow, black locust
→ Site typical crop rotation
→ Short rotation periods: < 20 years

Questions:
How do SRC strips influence microclimate / field crop yield, quality, diseases / soil nutrients / biodiversity?
How is the economic performance of the agroforestry system?
Joint research project „AgroForstEnergie“ - Economic and ecological evaluation of agroforestry systems under practical conditions

New: woody biomass not used for production of fruit or high grade wood but energy wood

- **Production**
- **Agro Forst Energie**
- **Erosion control**
- **Biodiversity**

- 2007-2015
- **Partners:**
  - Brandenburg University of Technology Cottbus-Senftenberg
  - Julius Kühn Institute (JKI) and Thünen Institute (TI) Braunschweig
  - Thuringian State Institute for Agriculture Jena (Coordination)
- Investigation of 5 agroforestry systems at different locations
Follow-up project: **BonaRes-SIGNAL** –

Sustainable intensification of agriculture through agroforestry (2015-2019, BMBF)

"Soil as a Sustainable Resource for the Bioeconomy – BonaRes"

as part of the National Research Strategy BioEconomy 2030
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Field Dornburg, Thuringia, Middle Germany

- Field size: 51 ha
- Tree planting: March 2007
- 7 poplar strips A-G
- Distance between strips: multiple of working width
- Strips A-C:
  - 10,000 plants/ha
  - Harvest every 3-5 years
- Strips D-G:
  - 2,222 plants/ha
  - Harvest every 8-10 years
- Additional tree species in plots
- Crop rotation:
  wheat – barley – rapeseed
Positive impacts for water quality

- 10 % of the field (5 ha) are cultivated with fast growing trees (SRC)
- 90 % (45 ha) are cultivated with a site-typical intensively managed crop rotation (spring barley, winter rape, winter wheat)
- SRC-strips require a minimized management (no fertilization, no pestizides, herbizides only during establishment)

→ The amount of substances which may affect water quality negatively if entering water bodies is reduced by 10 percent.

- SRC strips may reduce wind and water erosion by reducing wind speed and by working as buffer strips against water erosion

→ This leads to a reduction of sediment and nutrient shift which in the long term results in lower sediment and nutrient input in water bodies.
Positive impacts for water quality

Also possible: Single SRC strips to reduce erosion and as barriers against nutrient and sediment inputs in watercourses

Stabilisation of erosion gullies

Reduction of slope length

Tree lined riparian strips

Scientific project: SRC along a watercourse to avoid nutrient contamination
Positive impacts for water availability

- Tree strips are located against the prevailing wind direction to reduce windspeed in this originally structurally poor agrarian landscape
- The reducing effect on windspeed was measurable
Positive impacts for water availability

*Wind velocity*
— *impact of the width of the crop alleys on a windy day*

INFO: measuring day: 31st of January 2014; Ø tree height: 3.15 m

Ø Wind velocity in % related to the open field:
Center 24m: 42   Center 48m: 57   Center 96m: 72
Positive impacts for water availability

• Tree strips are located against the prevailing wind direction to reduce windspeed in this originally structurally poor agrarian landscape
• The reducing effect on windspeed was measurable
• Reduced windspeed is assumed to lead to lower evapotranspiration rates and thereby to a higher water availability
• Slightly higher soil water contents in the upper soil compared to the control were measured especially during dry conditions
Positive impacts for water availability

**Soil water content**
- differences along a 144 m crop alley under dry conditions

INFO: measuring date: 20.03.2014; gravimetric measurement, soil depth: 0-10 cm, 10-20 cm, 20-30 cm, averages with standard errors; Ø tree height: 6.30m
Positive impacts for water availability

- Tree strips are located against the prevailing wind direction to reduce windspeed in this originally structurally poor agrarian landscape.
- The reducing effect on windspeed was measurable.
- Reduced windspeed is assumed to lead to lower evapotranspiration rates and thereby to a higher water availability.
- Slightly higher soil water contents in the upper soil compared to the control were measured especially during dry conditions.

→ Higher water availability for adjacent crops is possible.

→ But: SRC trees are known for their high water consumption and evapotranspiration.

→ The influence of SRC strips on water relations in agricultural areas is very complex and linked to temperature and wind speed conditions as well as to water availability (groundwater, precipitation, also runoff water).
Reasons or main drivers for implementing the project/practice/policy

1. Alley cropping systems with fast growing trees may help enhancing structurally poor agrarian environments by integrating structural elements which also leads to benefits for biodiversity by providing habitat for plants and animals.

2. Alley cropping systems may positively alter wind speed, soil water content, soil fertility. In the long term, they may contribute to the conservation of soil productivity and to ensure food production for many decades to come.

3. Alley cropping systems are believed to better adapt to the impacts of climate change compared to conventional agriculture.

4. SRC-strips provide a sustainable source of energy wood for at least 20 to 40 years. The produced wood chips or fuelwood can be used for local heating or heating plants.

5. Furthermore, the production of wood leads to an income diversification for the farmer.
Key enabling factors

1. The arable land on which to implement the alley cropping system was provided by a local farmer. The implementation of the SRC strips was founded by the Thuringian Ministry of Agriculture.

2. The scientific work was possible due to the funding of the Federal Ministry of Food and Agriculture under the program “Renewable raw materials” of the Agency Renewable Resources.
Achieved outcomes

1. The study investigated the occurrence of flora and fauna (birds, butterflies, ground beetle) in the alley cropping system compared to a control field. Biodiversity was significantly enhanced by providing habitat for additional plant and animal species.

*Plant species occurrence in different system compartments*

INFO: data collection in sampling plots (2 m²); crop 2013: winter rape, crop 2014: winter wheat; Ø tree height 2013: 5.10 m, 2014: 6.30 m; number of species in reference field: 8 in 2013 and 2014 resp.
Achieved outcomes

1. The study investigated the occurrence of flora and fauna (birds, butterflies, ground beetle) in the alley cropping system compared to a control field. Biodiversity was significantly enhanced by providing habitat for additional plant and animal species.

2. Several microclimatic effects occur due to the significant reduction of wind speed by tree strips, including higher soil water content.

3. The study investigated as well the economic outcome of the alley cropping system. Due to higher operating costs compared to a conventional crop, a significant higher yield would be necessary to compensate. In this stage of the investigation it seems that higher yields (of trees and crops) compared to a monoculture are possible due to a better utilization of resources and changes of the microclimatic regime, but can hardly be measured because of the complexity and size of the system. Additionally, site location and climatic condition seem to have a prominent impact on the yield of alley cropping systems compared to conventional monocropping.

4. Lectures, posters and articles (mainly in German) informed interested stakeholders and led to an increasing publicity of this new agriculture management strategy.
Main challenges encountered

Agroforestry systems like alley cropping are **ecologically advantageous**. This was **recognized by European policy** and taken account of by the possibility of gaining **subsidies for the establishment of agroforestry systems** (Art. 23, Regulation (EU) No 1305/2013), and by **naming agroforestry as an ecological focus area** (Art. 46, Regulation (EU) No 1307/2013). In spite of this, **Germany did not set up the necessary conditions for German farmers to use this opportunities**.

Since especially the establishing of SRC strips is cost intensive, and economic profitability may eventually be gained in the long term, but not in short time frames (as farmers are used to work in), **without providing subsidies hardly any new agroforestry systems will be established in Germany**.
Potential for scaling-up and replicability

The studied system can be scaled up and replicated easily, given the circumstances of providing financial incentives for the farmers.
Thank you for your interest!

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Further information: www.agroforstenergie.de/en

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