Governing the expansion of short rotation coppices – a matter of infrastructure and personal attitude
Introduction

Background and Motivation

• further increase due to EU energy targets (18% RE in 2020\(^1\))

• number of CHP*-and heating plants will be more than doubled until 2020\(^2\)

• forest resources are limited\(^3\)

* combined heat and power plants

→ Need for alternative bioenergy sources

\(^1\)Directive 2009/28/EC, \(^2\)DBFZ 2011, \(^3\)BFN 2010
Introduction

*Short rotation coppices (SRC)*

Current research:
- Physiological characteristics (Kopp 2001, Verwijst 1999, Philipott 1996)
- Financial efficiency (Kasmioui & Ceulemans 2012)

→ General approval, but only gradually evolving in Germany
Introduction

Research questions

- What are barriers to the expansion of SRC?
- How can these be overcome by governance options?
Methods

Why *agent-based models* (ABMs)?

Land use change in socio-ecological system depends on...

- individual decisions of land users
- spatial heterogeneity
- temporal dynamics

“…how macro phenomena are emerging from micro level behaviour among a heterogeneous set of interacting agents.” (Holland 1992)

→ ABMs as suitable tool to model the expansion of SRC
Methods

*From 1 land user to many*

Individual land user:

Landscape with many individual land users:
Methods

Agents' interaction via the market
Methods

Spatial heterogeneity

(2) Biophysical properties of the soils

Soil quality

Soil quality of wood chips

Indicator for the transport costs of wood chips

![Soil quality and transport costs map](image)
Methods

*Agents' interaction via the market*
Methods

*How do they decide?*

Homo economicus – i.e. profit maximization

\[
\text{Profit}_\text{AnnualCrops} = \text{Price}_\text{AnnualCrops} - \text{Costs}_\text{AnnualCrops}
\]

Profit by market and by other agents

\[
\text{Profit}_\text{SRC} = \text{Price}_\text{SRC} - \text{Costs}_\text{SRC}
\]

Factors affecting profit:
- Distance to next infrastructure
- Soil quality

Methods

Discounting future incomes

“...caring less about a future consequence” (Frederick 2002)

→ Relevance for SRC decision
Methods

*One simulation run*

1 year

after 50 years

...
Methods

Governance options

1. Spatial planning instruments
   - different allocation settings for infrastructures

2. Long-term contracts (Sherrington 2008)
   - constant yearly payments
Results

Emerging land use patterns

Year: 1.

Year: 25

Year: 50

Landscape A

annual crops
short rotation coppices
fallow
Results

The role of infrastructure

Low transport costs  High transport costs

Landscape A

Landscape B

0% 54% more

annual crops  short rotation coppices  fallow
Results

The role of personal attitude

Discount rate low

Discount rate high

Discount rate high + Long-term contract

Year: 50

70% less

86% more

annual crops  short rotation coppices  fallow
What are barriers to the expansion of SRC?
Financial competition with annuals
High personal discount rate of land users

How can these be overcome by governance options?
Adequate allocation of infrastructures
Long-term contracts
Discussion and Outlook

Next development steps

- Development of method to model SRC expansion
  - Test further governance options
  - Test further decision impacts

- Multi-criteria assessment of emerging land use patterns
  - Security of food and energy supply
  - Social fairness
  - Provisioning of ecosystem services
Acknowledgements & References

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References:


Acknowledgements & References


Net present value:

\[
\begin{align*}
T_0 & \quad T_1 \quad T_2 \quad T_3 \\
-700 & \quad +250 & \quad +250 & \quad +250 \\
+235 & \quad (1+i)^{-1} & \quad +222 & \quad (1+i)^{-2} & \quad +209 & \quad (1+i)^{-3} \\
\end{align*}
\]

\[ i = \text{discount rate} \]

\[ = -34 \]
Appendix

Spatial heterogeneity

(1) Soil quality

Source: Roßberg 2007 (graphic adapted)