Adoption dynamics in bioenergy: innovations in bioeconomy
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Production of non-food biomass (3 ECTS)
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View Perspective
Plantations

"energy crops are this"

Farmers, practitioners, agronomist and foresters perspective, production, technology, biology
Management

Cut-back

Harvesting

Cutback machine (CRL) on reverse drive tractor

Continuous bundler (Salix Maskiner)

Boyd, J; Christersson, L; Dinkelbach, L. Growing energy from willow The Scottish Agricultural College, 2000
Plantations
Plantations

"energy crops are this"

Policy maker perspective, goals, objectives, shares
Views and background

Natural Science
Technology
Biology
Engineering

Social Science
Economics
Social studies
Policy making
Goal
Reaching the goal

Yield

Total area planted

**Natural Science**
*Efficiency*
*Management*
*Clonal material*

*odt / ha yr*

**Social Science**
*Adoption studies*
*Policy incentives*
*Profitability*

*ha*

*toe, kwh, MJ*
Policy Tools

1970s: Oil crisis, Swedish government ration gasoline and heating oil

1970: Research grants and investments on bioenergy developments. Includes plantations.

1980s: First commercial plantations

1980-1990s: Plan for de-regulation of Swedish agricultural sector

1990s: Programmes for economic/policy incentives for plantations

1995: Sweden joins the EU. CAP implemented
Policy Tools

Swedish measures to encourage Willow cultivation

a) SUBSIDIES

1991-1996: Generic subsidy of 1200 EUR/ha for farmers that would change from cereal to other activities


+ 530 ECU for fencing

b) TAXATION

Taxes on sulphur and CO₂ in heat production increased.

(biofuels exempted)
Plan & goal

Policy incentives

Subsidies
Taxes
Promotion
Research (public)

(Expressed in e.g. goals, objectives and plans)

Figure 2: Salix in Sweden: Scenarios versus reality


Plan & goal

Target for share of energy from renewable sources in final consumption of energy, 2020
Policy Effects

Policy incentives

Subsidies
Taxes
Promotion
Research (public)

Thresholds and dates:
1986
1991
1995
2014?
Meanwhile in UK…

1990s

2000s
Energy policy: Austria

- capital grants
- local initiatives rooted in a mix of environmental concern
- self-interest of forest-owning farmers
- build-up of know-how and networking among the main stakeholders involved
- 1999 techno-economic performance guidelines as a minimum standard for obtaining grants: improve the technical efficiency and economic viability of plants

Instruments

Policy incentives are not coordinated

The policy incentives are not symmetrical:

placed on the supply side (specific to willow)
not placed on the demand side (are generic for biomass for energy)
Somebody Produces biomass
Dynamics of adoption

Hirsh Zvi Griliches (1930 –1999)

Economist at Harvard University.

Economics of technological change, diffusion of innovations

https://prabook.com/web/zvi.griliches/200937
Dynamics of adoption

Dynamics of adoption

Penetration of Target Market

- Early adopters
- Late majority
- Early majority
- Laggards

Time
Dynamics of adoption

Dynamics of adoption

Dynamics of adoption

Spatial dynamics of adoption

Time & Spatial dynamics of adoption

Dynamics of adoption

Dynamics of adoption

- Dynamics of adoption

- Power plant (wood consumption)

- Kristianstad

- Planted by new growers

- Planted by experienced growers

- 1993

- 1996

- 2000

- 2005
Dynamics of adoption

[Graph showing the dynamics of adoption with a map and a chart indicating the growth of power plants (wood consumption) from 1986 to 2005. Key points marked include 1994 and 1996, showing the expansion planted by experienced growers and new growers.]
Adoption Profiling

Table 9: Influence on Salix activity from certain farm characteristics

<table>
<thead>
<tr>
<th>positive influence</th>
<th>negative influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm Size</td>
<td>Pasture</td>
</tr>
<tr>
<td>Forest land</td>
<td>Tenancy</td>
</tr>
<tr>
<td>Lease to others</td>
<td>Owner very young or very old</td>
</tr>
<tr>
<td>Owner age 50-65</td>
<td>Animal husbandry</td>
</tr>
<tr>
<td>Institutional owner</td>
<td></td>
</tr>
<tr>
<td>Irrigation</td>
<td></td>
</tr>
<tr>
<td>Mechanization</td>
<td></td>
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</tbody>
</table>

### Adoption Economics

Table 7: Comparison for Salix plantations in Northern Ireland between pioneer costs and cost projections based on more mature Swedish experience.

<table>
<thead>
<tr>
<th>Cost factors</th>
<th>Costs for pioneer grower</th>
<th>Cost projections based on Swedish experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment</td>
<td>158</td>
<td>100</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>Fertilisation spreading (high)</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>Fertilisation spreading (low)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Road transports</td>
<td>67</td>
<td>67</td>
</tr>
<tr>
<td>Harvest</td>
<td>114</td>
<td>88</td>
</tr>
<tr>
<td>Field transports</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Administration</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Winding up</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>Sum of costs</strong></td>
<td><strong>437</strong></td>
<td><strong>349</strong></td>
</tr>
</tbody>
</table>

Adoption Yields

Previous studies showed the broad differences in performance for the first and second cycle between growers, under the same geographical conditions.

Adoption Yields

Large differences between trials and commercial level plantations

### Reaching the goal

<table>
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<tr>
<th>Yield</th>
<th>Adoption</th>
<th>Total area planted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural Science</strong></td>
<td><strong>Social Science</strong></td>
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<td>odt / ha yr</td>
<td>ha</td>
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</table>
Reaching the goal: model

Interactions

Management profiles:
Observed a category of farmers that significantly improve yields (25%), other not (25%)

New varieties on the market, machines, methods, guidelines...

Experience:
The plantations were classified according to the previous experience of the grower... learning factor

PRODUCTION CHANGES
Auto-correlation… aka “experience”

+0.5 odt / ha a

Farmers Learn

*It is often forgotten than in a new technology, there is a learning curve that will affect the final outcome*

Improvements

Trends of SRF productivity

- New varieties
- Experienced farmers
- Better overall methods
Productivity change

Best growers, changes in 10 years

The concept of Risk

Figure 5: Prices of wood chips in Sweden from 1985 to 2002. 

Figure 2: Salix in Sweden: Scenarios versus reality


Goal fail?