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Nordic Association of Agricultural Scientists

NJF Seminar 406

Environmental and landscape aspects in short rotation forestry on agricultural land: a Nordic perspective

Uppsala, Sweden, 10-12 September 2007

NJF Nordic Association of Agricultural Scientists

norden

The workshop was part of the project *Short rotation forestry (SRF) on agricultural land and its possibilities for sustainable energy production in a Nordic perspective.* This project was supported financially by the Nordic Council of Ministers, working group ‘Environment strategies in Agriculture & Forestry (MJS)’.

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Illustration cover page:
Agricultural landscape with willow SRF plantations near Enköping, Sweden
(Photo: M. Weih)

Contents

[1] Complete contact details to authors are given under "List of participants" (p. 52).

Seminar organisation

The seminar was organised by

• Dr. Martin Weih and Dr. Nils-Erik Nordh, Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden

• Managing Director Eddie Johansson, Ena Energi AB, Enköping, Sweden

The seminar was arranged at the facilities of the Ecology building, Swedish University of Agricultural Sciences (SLU), Uppsala, Sweden.

SLU
Swedish University of Agricultural Sciences

During the workshop, oral presentations (above) were intermixed with lively discussions both within and between (below) the workshop sessions. (Photos: M. Weih)

NJF Nordic Association of Agricultural Scientists

NJF seminar 406

Environmental and landscape aspects in short rotation forestry on agricultural land: a Nordic perspective

Uppsala, Sweden, 10-12 September 2007

Programme

10 September

08:00-09:00	**Registration**
09:00-09:05	**Welcome** Tammsalen R. Sigvald, NJF
09:05-12:00	**Perspectives on SRF** Tammsalen
09:05-09:30	***Economy, biodiversity and landscape issues in SRF on agricultural land: How can we meet the needs?*** *M. Weih, SLU*
09:30-09:45	***SRF as an alternative to generate income: Growers perspective*** *L. Helgstrand, local farmer*
09:45-10:15	***COFFEE BREAK***
10:15-10:30	***A creative designer's view: landscape perspective on SRF*** *E. Skärbäck, SLU*
10:30-10:45	***Risks and possibilities of SRF from a nature conservation perspective*** *S. Sohlberg, Swed. Environ. Protection Agency*
10:45-11:00	***Legislation, interpretation, regulation: An agricultural administrator's view on SRF*** *I. Svedinger, Swed. Ministry of Agricult., Food and Fisheries*
11:00-11:15	***Generating surplus from SRF: An entrepreneurs perspective*** *E. Johansson, Ena Energi AB*
11:15-12:00	***Discussion***
12:00-13:00	**LUNCH**
13:00-17:00	**Country reports** Tammsalen
13:00-13:20	***Finland*** *T. Kähkönen, University of Joensuu*
13:20-13:40	***Denmark*** *M. Gylling, Institute of Food and Resource Economics*
13:40-14:00	***Norway***

T. Sogn, University of Life Sciences

14:00-14:30 ***COFFEE BREAK***

14:30-14:50 ***Latvia***
A. Lazdinsh, Silava

14:50-15:10 ***Estonia***
A. Adler, SLU

15:10-15:30 ***Lithuania***
A. Aviziensis, Sodui, UAB

15:30-15:50 ***Poland***
A. Wrobel, Warsaw Agricultural University

15:50-16:10 ***Summary country reports***
T. Kähkönen & N-E. Nordh, University of Joensuu & SLU

16:15-17:00 ***Discussion (with coffee!)***

17:00-17:30 **Sustainable management of SRF plantations: Do we need recommendations and guidelines?**
Tammsalen
N-E. Nordh & S. Larsson, SLU & Lantmännen Agroenergi AB

19:00-21:00 **DINNER**
downtown Uppsala

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11 September

09:30-10:30 **Drive to Enköping**

10:30-12:00 **Short excursion (Landscape and biodiversity aspects of SRF)**

12:00-13:00 **LUNCH**

13:00-15:00 **Guiding at Ena Energi heat and power plant and SRF plantations**

15:00-16:00 **Drive back to Uppsala**

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12 September

09:00-09:30 **Sustainable agriculture and SRF: Symbiosis or oxymoron?**
Tammsalen
G. Rudquist, Swed. Society for Nature Conservation

09:30-12:00 **Discussion and workshop on practical guidelines for the sustainable management of SRF plantations (based on a draft of guidelines produced by the company Lantmännen Agroenergi AB). Coffee will be served!**
Tammsalen

12:00-13:00	**LUNCH**
13:00-14:00	**Final discussion and end of seminar** Tammsalen

Economy, biodiversity and landscape issues in SRF on agricultural land: How can we meet the needs?

Martin Weih, Swedish University of Agricultural Sciences (SLU), Sweden

There is an increasing demand for bioenergy crops, both in the energy sector, but increasingly also for fuel to the traffic sector. High-density plantations of fast-growing trees grown on fertile land for the production of bio-fuels are today realised at commercial scale in Sweden. In future, short rotation forestry (SRF) is likely to become increasingly important also in many other Nordic countries. Intensive SRF plantations have raised concerns about environmental, biodiversity and landscape issues.

There are various reasons for why farmers do grow, or refrain from growing short rotation forestry (SRF) plantations on agricultural land. Among the most important arguments against growing SRF plantations are often invoked market and economy arguments. For example, profitability of SRF plantations is frequently required to be *better* compared to traditional agricultural crops. Also sustainability and/or environmental arguments are often used to argue against SRF plantations on agricultural land. For example, the monocultural status of SRF plantations, with its anticipated negative effects on biodiversity, is frequently pointed out and *greater* claims in terms of environmental benefits are asserted for SRF plantations compared to traditional agricultural crops. Thus, the consideration of environmental and landscape aspects is often claimed prior to the planning and establishment of SRF plantations, but hardly any concrete assessment criteria (e.g., guidelines) are available to farmers so far. Although some information about environmental and landscape aspects of SRF plantations is available in the scientific literature since many years, this information is poorly communicated among political stakeholders and farmers.

The representatives of commercial, nature conservation and landscape design communities have often different preferences for the localization, shape and management of SRF plantations on agricultural land. For example, commercial growers focus strongly on aspects that maximise the characters of a biomass factory on agricultural land. In contrast, nature conservation communities have a strong focus on biodiversity aspects and frequently aim to develop SRF plantations to species-rich deciduous woodlands, whereas landscape designers prefer a strong focus on development towards a sort of landscape and recreation parks on agricultural land. In addition, the different preferences need to be seen in the context of different physical, cultural and legislation environments across different Nordic and Baltic regions. A major challenge is thus the question how to shape economically viable plantations that in the best possible way utilize the available possibilities to maximize environmental and landscape benefits in a given regional context. This question will be a central issue of the workshop.

SRF as an alternative to generate income: Growers perspective

Lars Helgstrand, local farmer near Enköping, Sweden

SRF as an alternative to generate income
NJF-seminar 07-09-10

Lars Helgstrand
lars@agmedia.se

After 25 years with Salix…
I have learned:

- it can generate income
- it can be removed very easy
- it is very good for the environement
  – it cleans and loosen the soil
- it is very nice for the wild animals
  – the elks are a great problem for us
- there are still a lot to learn
- it is harmfull to the drainage system
- we need good varieties for our climate

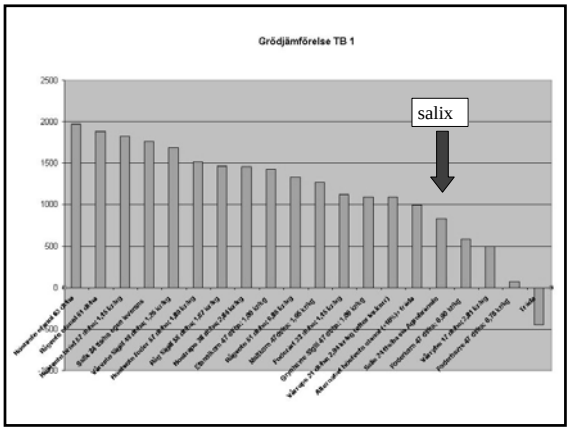
We run the farm Lundby:
My brother Johan, you will meet tomorrow, his wife Bodil,
my wife Birgitta (and me)

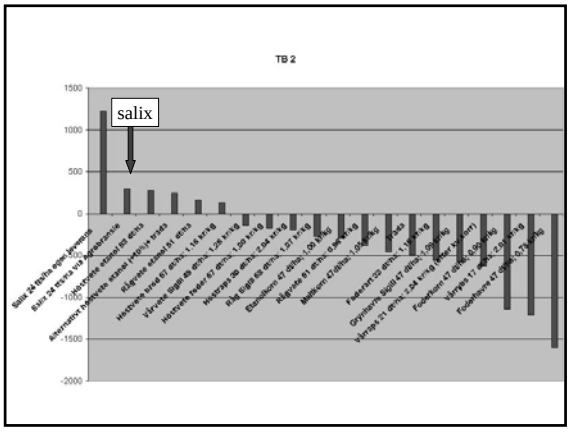
The municipality of Enköping is now our main customer

We are payed to store and spread sewage from private housholders

The farm in roughly figures

- Turn over: 200.000 Euro
  - Sewage incl spreading: 50 % - high net
  - EU-money: 20 % - extreemly high net
  - Salix 110 hectars: 10 % – high net
  - Grain 40 hectars: 10 % (2007 more) – low net
  - Pipe draining, meat-smoking etc: 10 %
- Result: 100.000 Euro





- The future can be a disappointment – because of the cold climate and dead Salix together with low prices…
- Or a surprise because of better varieties and higher prices...

Is SRF profitable?

- Earlier we got quite good yields but low prices. But we could at least keep all the EU-money – which we couldn´t with grain-production
- In the future we hope for good yields **and** good prices…
- **BUT what will happens with the grain-prices??? - and the energy-prices???**
- Whatever, I hope you as scientists keep to facts not being influenced by political waves! You have an important work to do. To produce facts and develope good materials and good methods.
- I cannot understand why people are so afraid of SRF? Compared with many other energy-sources it can easiely be replaced by food-production!

Thank you!

A creative designer's view: landscape perspective on SRF

Erik Skärbäck, Swedish University of Agricultural Sciences (SLU), Sweden

AESTHETIC CHARACTER

Structure : *upright growing* or *billowing.*


Texture :

compact/dense or *elegant/pervious*




Linear perspective:

even linear *or* *uneven linear*


equalising linear perspective in undulating terrain


Colour

Lustre:

Newly planted fields are experienced as shiny but change after 1-2 years to matt.

Colour scale:

The colours are greenish blue – turquoise in all stages of growth from newly planted to fellable.

Grey scale:

The grey scale is light-grey at all stages

Function:

Upkeep *interim stage* *fellable stage*


As an agricultural crop


may look unkempt and uncared

Field of stubs:

The felling stage during the winter

after as little as six months new shoots have begun to appear, which improve the impression.

Recommendations

To locate close to existing forests

To locate integrated with islands of other broadleaf trees

To harvest parts of the crop in different years

To establish a number of small crops close to each other to be harvested different years rather than one big crop

To plant different species in the same field, but in different sections e.g parallel streams

To leave buffer zones without any crop at the outer boarder of the field

Not to plant in areas with protection for nature preservation or cultural heritage

To harvest preferably on frozen ground

To site, design and maintain crops so they improve the variation in Landscape

Functions other than fuel and the landscape

SNOW PROTECTION

ANIMAL LIFE e.g. Roe-deers

Roe deer displayed the greatest increase

Fallow-deer (dovhjort) and red deer (kronhjort) have also increased.

Field hare and wild rabbits have increased.

Other species that have increased: Shrews (näbbmöss) and small weasels.

Earthworms decreased initially when the fields were first planted, but then began to record considerably higher quantities than before cultivation once the forests had been harvested.

11 bird species have increased in number during the course of the "Storförsök Syd" trials, and 15 species have decreased.

BIOLOGICAL FILTERS FOR N-REDUCTION

Energy forest is a fast-growing crop, the growth rate of which is significantly increased with the addition of nutrients and water.

Risks and possibilities of SRF from a nature conservation perspective

Sune Sohlberg, Swedish Environmental Protection Agency (SEPA), Sweden

Background

SEPA has followed up on SRF for energy purpose since the beginning of the seventies. Earlier the concept was called Mini-Rotation Forestry and aimed to produce fibres for pulp. During the seventies peat land was the big challenge for SRF. It was estimated that 1 800 000 hectares of peat land and 400 000 hectares of forest land were useful. This prognosis did not at all meet the expectations and not much was achieved. To my knowledge the use of agricultural land was not much discussed at that time.

The interest to introduce SRF has grown again as you know. In the Nordic-Baltic cooperation we nowadays work with bio energy issues. The same is also valid for the bilateral cooperation with Russian Federation, however mostly with forest energy from debris, branches etc. left after logging. From the energy production point of view this sources are very important as SRF (energy forest) does not yet produce enough energy to meet even the demand of a single energy plant.

In 2005 SEPA contracted the Swedish University of Agricultural Sciences (SLU) to investigate the possibilities and risks for biodiversity and cultural environment in SRF on arable lands. The preliminary report was presented and discussed at a SEPA seminar in January 2006. The report is now available on the SLU homepage but SEPA did not take the opportunity to publish it in SEPA's name. Instead SEPA decided to make a new comprehensive policy for the use of bio energy. This policy will be finalized by the end of 2007.

This Nordic-Baltic seminar creates an excellent opportunity to discuss SRF to highlight circumstances in SRF that effects or may effect biodiversity and the landscape. Cultural environment is also closely linked to a landscape perspective. How shall we use ecosystem services in a proper sustainable way?

Forestry

SRF normally differs from long rotation – the traditional production on forest land. However, short rotation is sometimes quite many years, 15 up to 30 years. When years are added the impact of SRF if applied on forest land will be similar to a longer rotation and the threats and risks may be the same as in traditional forestry.

- To high an extraction of debris, branches etc. will decrease the humus layer (Note; not on arable land)
- Difficulties to return ashes to the stands it came from
- Bad quality of ashes

Agriculture

Well, now I turn to more direct focus on SRF on agriculture land. SRF is similar to agriculture on arable land. Let's say three years intervals between crops in stead of one. This is a highly intensive management and it means that the environmental problems in agriculture very easily will be incorporated in SRF.

- High leakage of minerals, nitrogen, phosphorus etc depending on soils
- Fertilization and irrigation may accelerate the leakage
- Impact on biodiversity also in water ecosystems elsewhere

However if you compare with agriculture on arable land the problems are much the same. If you compare with arable land taken out of use it is of course worse. At present EU grants are given to land owners not to cultivate.

Biodiversity

I will give you my views of SRF on biodiversity divided in landscape, stand, species and genetic levels. Speaking of impact on biodiversity you have to bear in mind that the situation is very different between the countries represented at our meeting. My view refers to Sweden.

On a landscape level SRF can create more variation if the landscape is highly dominated by arable land used for agricultural crops or by well managed coniferous forests where you lack deciduous trees. If you plant shrubs etc around the SRF lots you can create linear corridors valuable for animals and plants and thus amplify the variation. In a very varied landscape with meadows and old agricultural methods applied you will loose biodiversity if SRF is introduced on these areas.

On stand level SRF compared with well managed land also can create more variation. The main reason is that the dense stands of Salix sp. etc provide protection and food to wildlife.

On species level especially species like butterflies, mammals and some birds benefit from SRF. Game increases as a result of SRF. If SRF lots are located close to open water it is even more favourable for the game (species that you hunt). On the other hand SRF should not be used close to waters because of the leakage if you fertilize or irrigate the land.

On genetic level the hybridisation has been discussed since the beginning of the use of Salix sp. etc. To my knowledge no such impact has been observed so far. Concerning SEPA views we recommend to use domestic species, want to ban GMO:s and still keep an eye on possible hybridisation.

A most critical risk with SRF is a bad management. If you start to harvest during breeding season SRF will work as a trap. As long as you continue to harvest in the winter this is fine. At the same time the risk to damage soils is much lower. SRF provides an opportunity to set an example for ordinary forestry not to harvest during breeding season.

Landscape

Under this heading I like to stress the need to safeguard high nature and cultural values. These values are expressed in physical plans of different kinds but also presented in focused conservation plans. Two examples are:

- Nature Conservation Plan for Wetlands
- Nature Conservation Plan for landscapes where old agricultural methods are in use/used. That is gracing land, meadows etc. with exclusive flora and also fauna. Some of them have never been fertilized.

In addition there are also other cultural environments that are very sensitive. However, I am not an expert in this field.

Having mentioned these restrictions, the landscape perspective also may include positive developments when applying combined land use. You can support biodiversity and you may use SRF as a new development in recreation. But SRF close to villages and cities will need certain consensus.
People's feelings may certainly restrict the use of SRF in cultural, open, agricultural landscapes also when biodiversity may benefit. The bio energy answer to this may be to use ordinary agricultural crops for energy purposes. SRF needs afterthought before acting. A landscape and ecosystem approach is needed.
In Sweden SRF is labelled agriculture and not forestry. It may be a confusion about whether this is regarded a forest or not. If you add years before harvesting the cultivated lots will certainly look like forest stands. In Sweden the Environmental Code states a legal biotope protection to islands of trees, stones, shrubs etc. in the open arable land. These biotopes are very valuable and must be kept in SRF. Our SEPA concern is that if the land use gradually changes to forestry alike stands these biotopes may loose their protection. Such biotopes are only protected on agricultural land.

Climate
The climate is a difficult issue but over all SRF may be neutral regarding carbon dioxide. SRF creates a cycle that binds and releases carbon dioxide in practise continuously.
There might be a sink at first use of arable land except for peat land. At first use the root-systems begin to develop before they reach a balance in relation to the rotation period. On peat land the peat itself starts to decompose and therefore releases carbon dioxide.

Environmental Quality Objectives
In my speech I did not comment on the linkages to Sweden's sixteen Environmental Quality Objectives. There are of course many obvious such links. Most related to the headline of my speech is the objective A Rich Diversity of Plant and Animal Life.

Legislation, interpretation, regulation: An agricultural administrator's view on SRF

Ingrid Svedinger, Swedish Ministry of Agriculture, Food and Fisheries, Sweden

Legislation, interpretation, regulation: An agricultural administrator's view on SRF

Ingrid Svedinger

Ministry of Agriculture

Council Regulation (EC) 1782/2003 establishing common rules for direct support schemes

Not on set- aside land

Crops for production of bio fuels or electric and thermal energy produced from biomass

The production shall be covered by a contract or an assurance if used on the holding. More detailed requirements

Aid 45 Euro per hectare per year

Eligible for single payment

Maximum area of 2 million ha in EU

Ministry of Agriculture

Council Regulation (EC) 1782/2003 establishing common rules for direct support schemes

On set-aside land

Enough entitlements for set-aside corresponding to the cultivated area

A contract isn't necessary

Fertilizers and plant protection products could be used

Harvest at least every twentieth year. More detailed requirements

Single payment

Ministry of Agriculture

Council Regulation (EC) 1782/2003 establishing common rules for direct support schemes

Member States may pay national aid up to 50 % of the costs associated with establishing permanent crops intended for bio-mass production

Ministry of Agriculture

Council Regulation 1698/2005 on support for Rural Development

- Investment support for plant and plantation of energy crops
- Max limit support 40-60% depending on if the area is non LFA or LFA, young farmers
- Swedish Rural Development Programme 2007-2013

Ministry of Agriculture

Swedish Rural Development Programme

Investment support for plants and plantation of energy crops

Minimum 1,0 hectare of Salix or 0,1 hectare of Hybrid aspen and Poplar

Acceptance by the County Administrative Board needed, avoiding unacceptable negative effects on the physical appearance of the country-side, on cultural heritage or biodiversity

40 % plus 10 % national aid, maximum 5 000 SEK (555 Euro) per hectare

Possible to combine with support under 1782/2003

Ministry of Agriculture

Council Regulation 1698/2005 on support for Rural Development

First afforestation of agricultural land

Establishment costs only related to fast-growing species for short-term cultivation

Max limit support 70-80 % (depending on non LFA or LFA area)

No possibility to combine with support under 1782/2003

Ministry of Agriculture

Council Regulation 1698/2005 on support for Rural Development

Training and information activities

Processing activities to expand the use and the energy value of the harvest

Encourage co-operation between producers and processing industry

Ministry of Agriculture

Generating surplus from SRF: An entrepreneurs perspective

Eddie Johansson, Ena Energi AB, Enköping, Sweden

Generating surplus from SRF
An entrepreneur perspective

Eddie Johansson
ENA Energi AB
Enköping
Sweden
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ENA Energi AB

- ✓ Facts and key numbers
- ✓ Ongoing projects:
  - Salix
  - Fuel dryer
  - Applying for authorization to build a Waste incineration Plant
- ✓ Future

CHP Plant

400 GWh Bio fuel

100 GWh Electricity

250 GWh Heat

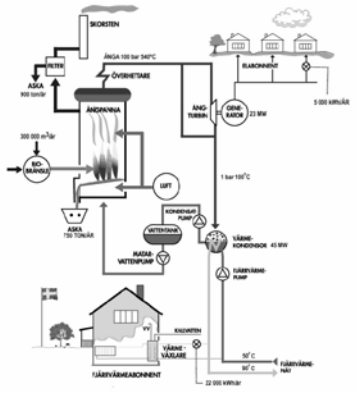
1 GWh = 3,6 TJ = 85,98 toe

Bio fuel

➢Residues from logging and forestry industries:

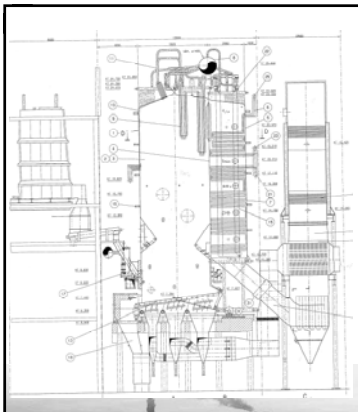
- Branches and tops (50 %)
- Bark (20 %)
- Sawdust (15 %)

➢Energy crop, Salix (15 %)



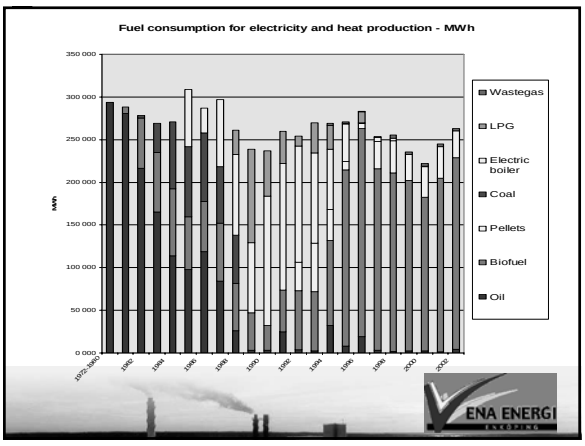
Main Boiler

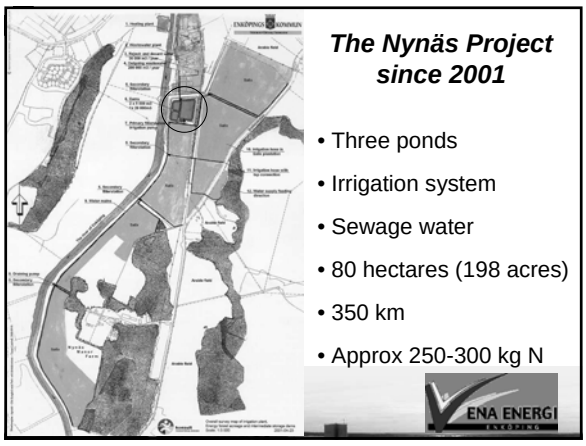
- ✓ 55 MW Heat (Including Flue Gas Condenser)
- ✓ 23 MW Electricity
- ✓ Bottom-ash 900 ton/year
- ✓ Fly-ash 1000 ton/year

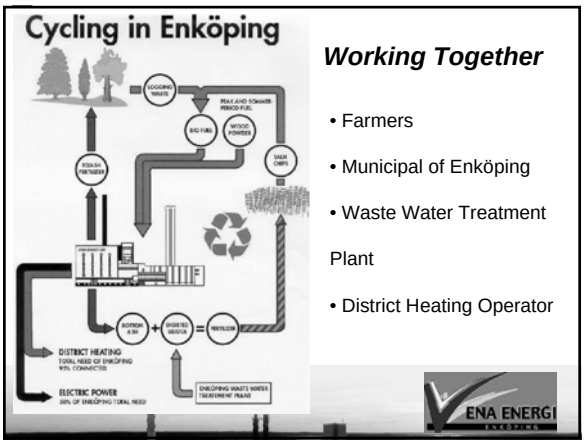


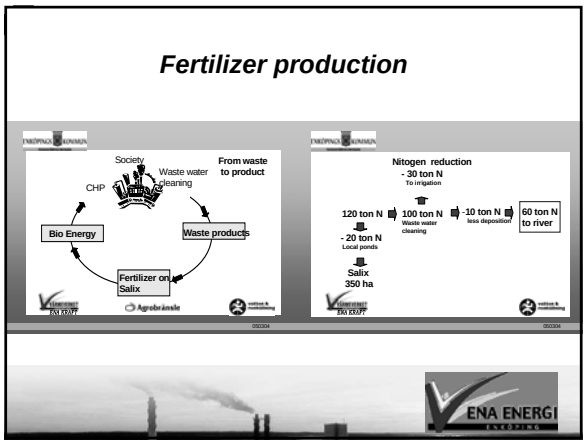
Biomass Boiler

- ✓Grate fired boiler
- ✓ Vibrating grate
- ✓ Bottom and fly ash
- ✓Sort heavy metals









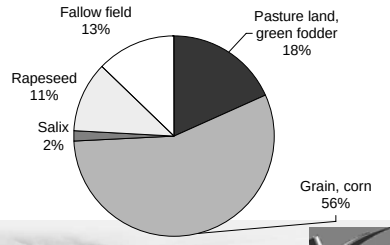
Bio energy - Resources and Consumption in Enköping

✓ ENA Energy need	350 GWh/year
✓ Yearly natural growth in	100 GWh/year
✓ Today 1200 ha Salix	35 GWh/year
If 10% of farming land (5200 ha)	140 GWh/year

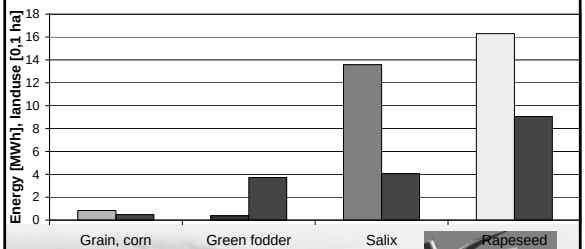
Enköping Municipality

• Area 1184 km2	118 400 ha (293 000 acre)
• Farming land 46%	54 500 ha
• Forests 37,5%	44 400 ha
• Others 16%	19 000 ha
• Rivers 0,5%	

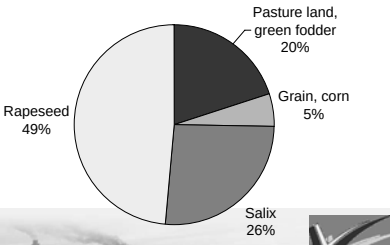
Today use of farmland in Enköping



Farmland use per person



Market optimized use of farmland in Enköping



Full speed ahead!

- New actors necessary, low interest from farmers
- Knowledge and experience exist
- Creating a lot of local employments
- Who is holding the brake?

Restart Salix Project 2004

- ✓ 50 GWh new Salix before 2008 within Enköping municipality
- ✓ Production cost lower than 8 €/MWh
- ✓ Rent appr. 2200 ha farming land
- ✓ Use existing expertise from Universities, Agroenergi, Landscape architects, Hunters ass. to create a winning concept

Socio-economic benefits of using bio energy

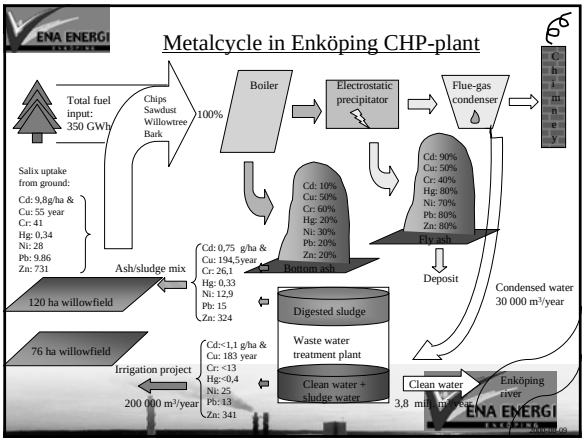
- ✓ Farmers get long term contracts for energy supply
- ✓ Recycling waste products as fertilizer
- ✓ Reduce nitrogen leakage
- ✓ Bio filter
- ✓ Local energy

Aska/slamspridning

Foto:Rolf Slagbrand

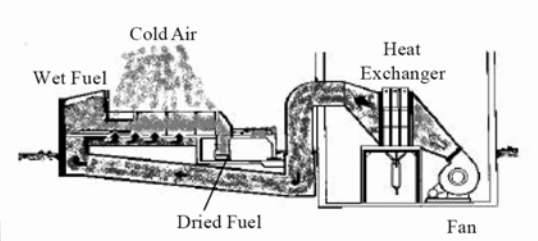
- 2-2500 ton slam/aska/år.
- Gränsvärden för tungmetaller uppfylls.

Metalcycle in Enköping CHP-plant

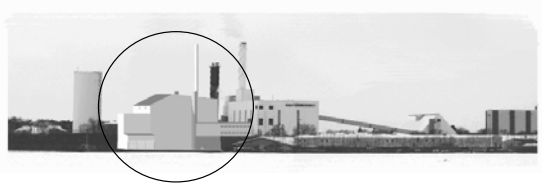


Drying the Fuel

- From 50 % to 30 % moisture content
- 7-8 MW Heat

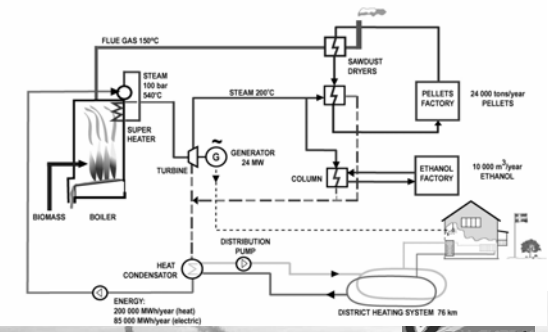


Building a Waste Incineration Plant



- Applying for authorization at the County Administrative Board
- New boiler recycling waste to energy
- Bio fuel over heater

In the Future – Bio Energy Combine



Thank You!

www.enae.se

eddie.johansson@enae.se

Environmental and Landscape Aspects of Short Rotation Forestry in Finland

Tanja Kähkönen & Aki Villa, University of Joensuu, Finland

Abstract

This paper will summarise the main results from the Finnish survey in a Nordic research project "Short rotation forestry on agricultural land and its possibilities for sustainable energy production in a Nordic perspective". The survey was conducted in autumn 2006 as an internet survey. In total 246 recipients were invited to participate the survey. In total 39 individual respondents participated the survey response rate thus being 16 %. The survey results indicate that both positive and negative attitudes towards short rotation forestry are present in different organisations. The species that divides opinions the most is Salix. Scenic disadvantages were the most important environmental disadvantage related to environment. Whereas effects of short rotation forestry for agriculture were often considered negative, the effects for rural development were, on the other hand, often considered positive. The effects for energy production were also considered normally positive. Whereas the survey results indicate that there is a great deal of attitudes and perceptions towards short rotation forestry, they also show that only very few individual people have more practical knowledge on the issue.

Key words: bioenergy, energy crops, Salix

Introduction

In Finland more than one fifth of the energy used is based on biomass. Wood is the major bioenergy source, for example in the form of logging residues, black liquor, and by products from the sawmilling industry that are used for energy production. Support schemes exist, for instance, for the production of wood chips. The major energy crop grown on agricultural land is reed canary grass (MMM 2007). The cultivation area of Salix is limited to a few hectares cultivated by individual growers. Some experimental areas also exist established by individual research organisations. The support schemes favour the cultivation of other energy crops than Salix. Research on Salix cultivation has been conducted for example by the Faculty of Forest Sciences at the University of Joensuu. In addition to this, for instance the Finnish Forest Research Institute has done research on growing aspen with short rotation and its possibilities for producing wood for the industry.

Methods

The survey was conducted in autumn 2006. An invitation letter to participate the survey by filling in an internet-based questionnaire was sent by e-mail to 246 recipients in total. A program facilitating internet surveys called E-lomake was used. The majority of the questions was presented as multiple choices for the respondents. However, there was also "another" option in each of the questions to allow the respondents to give more comments. The recipients and their organisations were identified by their previous known interest to short rotation forestry, environmental issues, forestry, agriculture, or scenic issues. The questionnaire was sent to a person having a leading position in the organisation. If this was not possible, it was sent to a person responsible for the subject areas related to this survey. The identified organisations included various non-governmental organisations, national and regional authorities, counselling organisations, educational organisations, research institutes, and enterprises.

To remind the recipients to participate the survey, a follow-up e-mail was sent to the recipients ten days after the original invitation. Finally in total 39 respondents participated the survey response

rate being 16 %. The respondents as well as the formed subgroups were very heterogeneous and, thus, there were poor possibilities to, for instance, calculate significance levels for estimating statistical differences between groups. The mean for answers in each question was calculated if possible.

Results

The term energy forest had the most positive reputation among the respondents out of four terms presented for their judgement (energy forest, short rotation forestry, energy willow, willow on field). The term willow on field had the worst reputation and was often associated with a lazy farmer.

The weaknesses of short rotation forestry cultivation on agricultural land were often associated with a lack of active developers, or some practical issues such as clogging of drainage and lack of economic support. Increasing energy self-sufficiency was evaluated to be the most important strength in this type of cultivation.

The most important threats that the respondents associated with cultivation was the 'necessity of large subsidies' needed for the production (table 1). Clogging of drainage was second in importance, and cultivation of competing field energy plants was evaluated as the third one in importance. In comments given in writing, effects to landscape and other uses of the same land area were most often elaborated as possible threats.

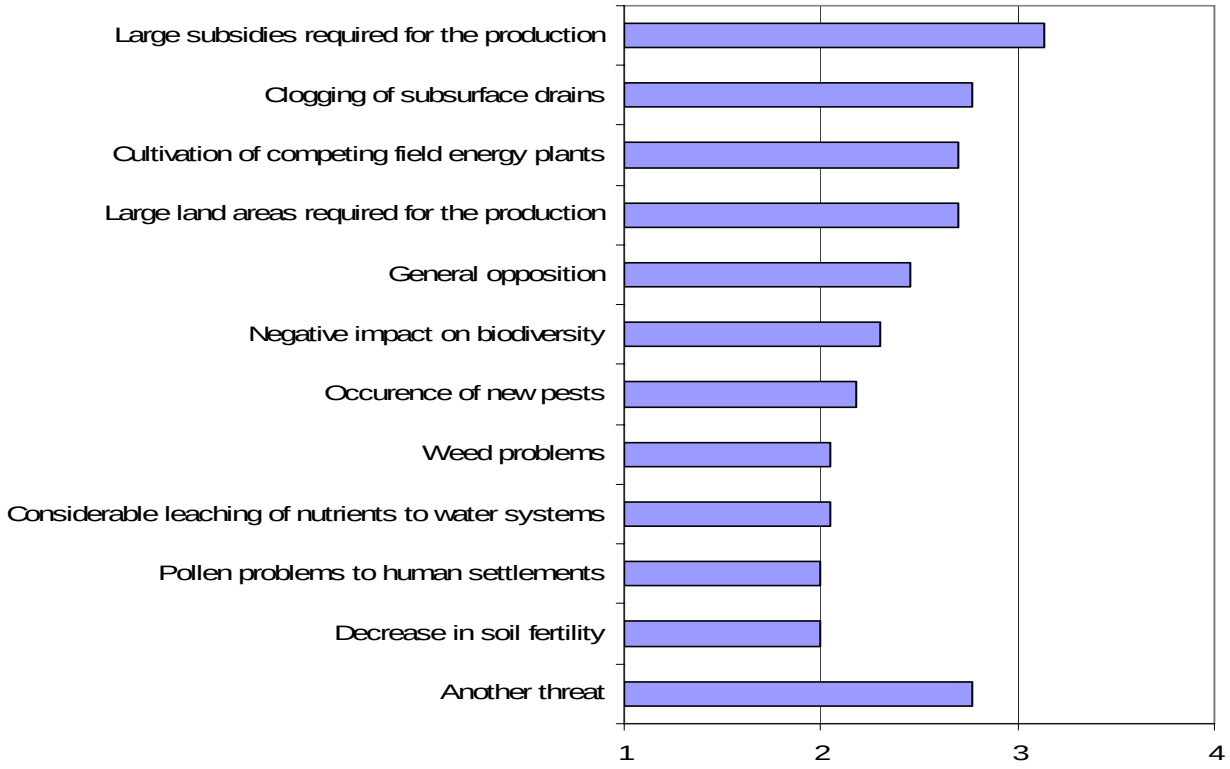


Table 1. Threats in short rotation forestry on agricultural land (n=13-23). (1=not importance at all, 2=little importance, 3=important, 4=very important threat). n presents the number of respondents evaluating the importance level of given statement in the question.

The generation of jobs in rural areas was considered the most important possibility, followed by the treatment of waste water in rural areas by absorbing it by willow plantations (table 2). Possibility for multiple use of Salix was the other positive aspect most often mentioned.

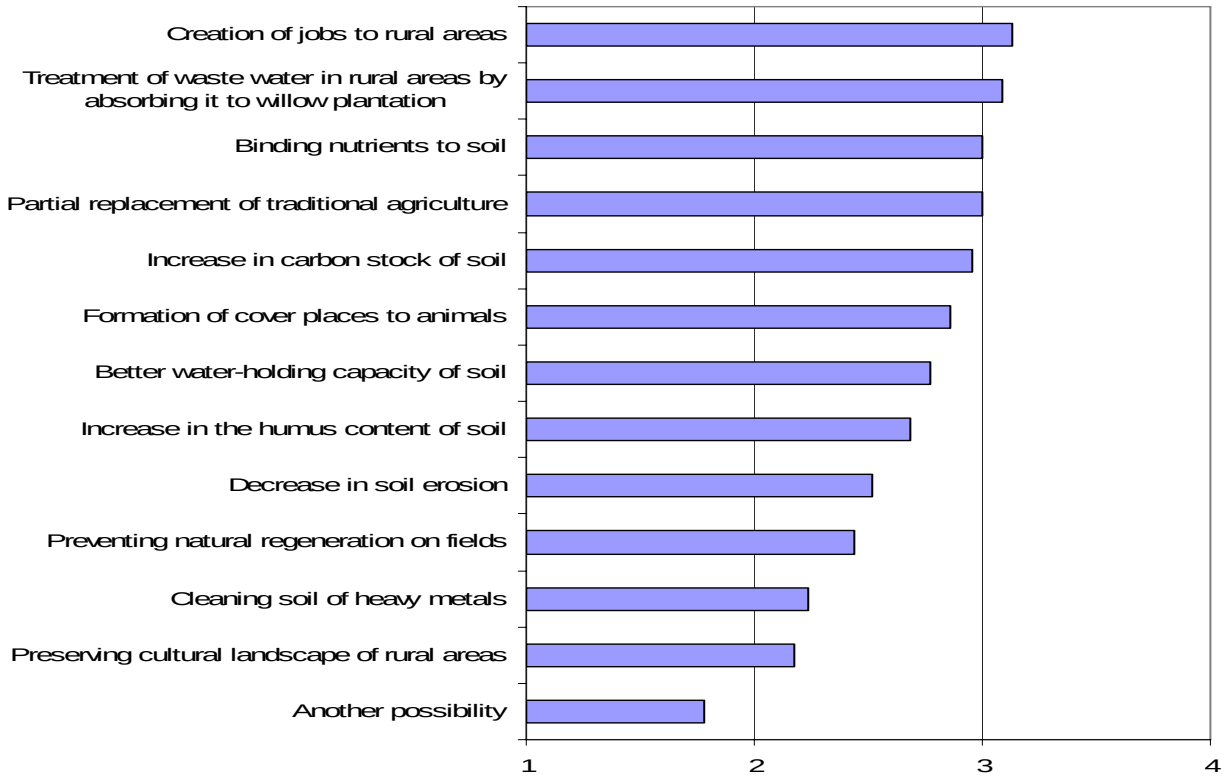


Table 2. Possibilities in short rotation forestry on agricultural land (n=9-23). (1=not importance at all, 2=little importance, 3=important, 4=very important possibility). n presents the number of respondents evaluating the importance level of given statement in the question.

The agricultural land removed from use was evaluated to be the most suitable location for short rotation forestry plantations. Remote rural areas were preferred against rural areas located near towns.

Scenic disadvantages were considered the most important environmental threat. The most important environmental benefit was evaluated to be the sustainable production of renewable energy. It is notable that environmental benefits were normally ranked higher by the respondents than the environmental disadvantages. In order to improve environmental benefits, respondents ranked possibilities for the local use of wood as the most important means. Placement in the infiltration areas of domestic waste waters was ranked as the second in importance as a means to improve environmental benefits.

Discussion

The survey results indicate that both positive and negative attitudes towards short rotation forestry are present in different organisations. The species that divides opinions most is Salix. Scenic disadvantages were the most important environmental disadvantage related to environment. Whereas effects of short rotation forestry for agriculture were often considered negative, the effects for rural development were, on the other hand, often considered positive. The effects for energy production were also considered normally positive.

Whereas the study results indicate that there is a great deal of attitudes and perceptions towards short rotation forestry, they also show that only very few individual people have more practical

knowledge on the issue. What are the different reasons behind all of these different attitudes and perceptions was left unclear by this survey and the methods used in it.

The limitations of the survey results relate to the appropriateness of the questionnaire for different respondents. The survey was sent to different types of respondents which might not have had any practical experiences with Salix. The results are indicative and can form a basis for further discussion.

Conclusions

The risks in short rotation forestry appear to be greatly related to people's attitudes and perceptions. There appears to be an inevitable need for involving all the relevant stakeholder groups in developing successful short rotation forestry that would be accepted by the general public. According to the survey results, landscape issues would need more attention. More research would be needed in order to find underlying reasons behind different attitudes and perceptions. When financial and productional issues are solved, this data would allow the further development of short rotation forestry.

Acknowledgements

We want to thank professor Paavo Pelkonen and researcher Eero Forss for their support. The financial support provided by the Nordic Association of Ministers through the Nordic research project "Short rotation forestry on agricultural land and its possibilities for sustainable energy production in a Nordic perspective" is gratefully acknowledged.

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Country report: Denmark

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Introduction

Denmark is a fairly small country with a rather intensive agricultural production. The total land area is 4.3 mill. ha, of which 2.7 mill. ha, approx 62 %, is agricultural land (2006). Forest comprises approx 10 % of the land area; buildings, roads etc. 15 % and nature areas and other approx 13 %.

Danish agriculture has a large livestock production in both the milk and pig sectors, a little less than 0.5 mill. ha in grown with grass and other green fodder crops while 1.5 mill. ha are grown with cereals, off which about 80 % is used for feed purposes.

Use of renewable energy

In the last 10 year period renewables make up an increasing share of the total energy supply in DK and is now (2006) about15 % of the total energy supply.

The Danish energy strategy is mainly based on solid biofuels for heat and power generation and wind power.

As can be seen from table 1 straw and wood comprises about 45 % of the renevable energy supply.

Table 1. Use of renewable energy in Denmark

	1995	2000	2001	2002	2003	2004	2005	2006
	Per cent							
Renewable share	7.4	10.5	11.1	12.0	12.9	14.6	15.5	14.9
	PJ*							
Here of:								
Wind	4.2	15.3	15.5	17.6	20.0	23.7	23.8	22.0
Straw	13.1	12.2	13.7	15.7	16.9	17.9	18.5	18.6
Wood	21.6	25.1	26.2	25.7	30.6	32.3	34.4	33.7
Biogas	1.8	2.9	3.0	3.4	3.6	3.7	3.8	3.9
Waste (bio deg.)	17.5	23.6	25.0	26.3	28.4	28.7	28.7	30.9
Heat pumps etc.	3.6	4.2	5.4	6.0	6.5	7.5	8.1	9.2
Total	61.8	83.3	88.8	94.7	106.0	113.8	117.3	118.3

The increase in the use of straw and partly in the use wood is based on a political agreement from 1993 stating that from year 2000 1.4 mill. t of biomass should be used for fuel in the power generating sector (1.2 mill. tonnes of straw + 0.2 mill. t of wood chips). The plan has however been delayed but is now more or less fulfilled and there has been some adjustments towards less use of straw (1.0 mill. tons of straw) and an increased use of wood chips (0.4 mill. t).
There is still an estimated 1 mill. t of straw potentially available for energy purposes while the wood resources are fully utilised and about 14 PJ of wood based biofuel is imported.

Due to the unutilised straw resources there is only a minor production of dedicated energy crops for solid biofuels on agricultural land, the most recent estimate is about 3.000 ha of salix.

The DK survey
The survey is based on following questionnaire:

1. Is the term “energy forest” (willow, poplar or similar fast growing trees) held in good, neutral or bad repute for you / your organization?

2. Which (positive) possibilities do you / does your organization associate with the culture of fast-growing trees on agricultural land?

3. Which problems could you / your organization foresee in relation to the culture of fast-growing trees on agricultural land?

4. Where should plantations of fast-growing trees be located (landscape and agricultural context) and where should they be avoided? Please motivate your answer!

5. How should plantations of fast-growing trees be formed (e.g., shape, size of plantation, mixture of species/varieties)? Please motivate your answer!

6. Which, if any, specific management actions (apart from purely yield-related) should be considered to enhance the environmental benefits of plantations of fast-growing trees? Please motivate your answer!

7. Compared to other energy crops which disadvantages and benefits do you / does your organization associate with energy forest compared to other energy crops?

8. Which legal and economic issues do you / does your organization consider as the most important barrier for energy forest on agricultural land?

Out of 26 persons/institutions/companies approached 20, responded to the questionnaire. The respondents can be grouped into:

A. Public authorities (3)

B. Researchers (7)

C. Farmers association and advisory service (5)

D. Traders and heat and electricity producers (3)

E. Suppliers of planting material, planting, harvesting and general management services. (2)

All respondents were contacted by phone or e-mail and both telephone interviews and answers by e-mail has been used to collect the answers.

Main findings from the survey
- All respondents were positive towards the term energy forest, however the public authorities were “wait and see” positive.

- All respondents saw energy forest as a new opportunity for expanding bioenergy production in a sustainable way and create new activities and income possibilities in rural areas.

- Energy forest opens up for landscape diversification and can improve conditions for wildlife and enhance hunting.

- Energy forest expand the supply of wood based biofuel and ensures long term supply.

- Energy forest can in some areas be in conflict with other nature conservation plans.

- The high starting costs and the long rotation period can decrease flexibility for farmers.

- Energy forest is visually dominating and the location and form of plantations should be carefully considered and planned.

- It is important that energy forest plantations have a certain minimum size to ensure efficient harvest. Sub plantations within the plantation and borderlines could ensure diversity.

- More plantations located within a reasonable area could facilitate efficient use of machinery and give possibilities for shared management.

- The nutrient uptake capacity of energy forest is an advantage and should be utilised.

- There are some institutional barriers related to energy forest.

Summary
Energy forest is in general held in good standing and is seen as an opportunity to expand biofuel supply in a sustainable way.

The location of energy forest should be carefully planned and the landscape dominating effects should be considered, but can also be positively utilised.

The long rotation period and high starting costs together with the need of special equipment is considered as a problem for many farmers.

Country report: Norway

Trine A. Sogn, The Norwegian University of Life Sciences, Norway

Although fire wood always has been used for heat production, Norway must be regarded as a Developing country with respect to the use and development of bioenergy. Rich in oil (Figure 1) and waterfall resources influences excellent access to cheap energy in Norway. Also a new energy success has happened the last years; the environmental friendly solar panels. The cheap energy has been and still is a preference for Norwegian industry. Energy has become more expensive, but is still cheap relative to other European countries. The easy access to and the low prises on energy have influenced that research and development of alternative energy sources have been given low priority. However, there is an international pressure on Norway, in order to stimulate use of renewable energy sources. It is bad reputation for a country which enjoys being associated with beautiful clean, environment, fresh air, that most of the energy consume is based on no-renewable energy sources, and additionally has a high net emission of carbon dioxide.

Figure 1. Oil extraction in the North Sea.

Bioenergy – production of heat and electricity based on wood, has in Norway mainly been associated with forests – increased withdrawal of biomass from the forest. Due to low timer prizes the standing biomass in forest are increasing. Actually, forest owners hope the need for wood connected to bioenergy industry, will induce higher prices. It is generally no confidence in that bioenergy ever may constitute a major part of the heat and electricity production in Norway. – But if it should be the general opinion is that the raw material should be based on the standing forest and tops and branches.

Also, the topography, the difficult accessibility (Figure 2), has been an argument towards emphasizing bioenergy in Norway.

Norway has also a strong agricultural tradition. The agriculture in Norway is expensive and actually only minor part of it is capable of living without major governmental money transfers as subsides and support schemes. Anyway, most Norwegians think that agriculture is important in order to maintain settlement in the rural districts and for the cultivated landscape. The culture is closely related to the rural areas with small farms with the white living houses and the red work buildings. Additionally, cultivated landscape signifies for most Norwegians open landscape.

However, Norwegian agriculture is also subjected to significant alterations. Particularly, areas for grassing animals are reduced. The number of summer pastures has declined dramatically. Also in the more urban agricultural areas, earlier meadow areas are clogged because livestock are concentrated in more rural areas, while the more urban agricultural areas are used for grain production. There are now significant concern about

clogging of earlier meadows and abandoned farmland. Farmers are now offered possibilities to rent grassing animals, in order to maintain the open cultivated landscape.

With this background some examples of the answers given to the questionnaire in Norway will be presented.

1) Is the term "energy forest" held in good, neutral or bad repute for you / your organization?
- *"Energy forest" is not an established term in Norway.*
The term was explained, but only very few saw any potential for that form of energy biomass in Norway. Those who were positive (good, or at least regarded as interesting, repute) were researchers within forestry.

An example of one answer, being representative for the majority:
-It is not a topic of interest. We have plentiful with bioenergy sources connected to forests and scrubs, which at present are considered as a clogging problem.

Among researchers and advisers in agriculture, nobody was positive.

2) Which (positive) possibilities do you / does your organization associate with the culture of fast-growing trees on agricultural land?
- I see no possibilities. The agricultural areas should be used for production of food and fodder. Agricultural areas should not be used for energy forest production with concern of the culture landscape. Possibly, can energy plants as oil seeds or perennial grasses be grown. They do not change the agricultural culture landscape and the areas can easily be transformed back to food and fodder plant production.
- We are opposing against trees on agricultural home fields. There is a lot of unexploited biomass within the forests, as well as parts of the pastures are increasingly clogged, so development of the logistic for felling (small dimensions) and transport should be stressed.

However, some of the forest researchers had some more positive answers:
- If energy forests could be produced at abandoned farmland, it could have been interesting. However, these areas are steep, and difficult accessible. Thus profitable energy forest production may be difficult.
- It might be a new trade for farmers in the future. With the present low energy prices and the high grain prises, it is not of current interest to utilize agricultural land for energy forest production. - But this can of course change.
- Energy forest may contribute positively to the environment. It might function as a buffer zone towards unwanted leaching of nutrients to water ways. Possibly, it might contribute positively to the CO_2-budget. Additionally it might be fertilised with sewage sludge, thereby contributing to recirculation of nutrients.

3) Which problems can arise with the culture of fast-growing trees on agricultural land?
Her it was a long list:
- Energy forest plantations on agricultural land will destroy the overall impression of the cultivated landscape and then reduce its value connected to nature and cultural based industrial- and commercial development. Most probably people will not see energy forest as an element which fit in the cultivated landscape! Additionally the roots may destroy the drainage system, and thus it will be very expensive to back transfer the areas used for energy forest production back to agricultural food and fodder plant production.
- It may impoverish the soil, because of nutrient leakage.
-Due to low price energy price and low demand for bioenergy, energy production in Norway will be very problematic.

4) Where should plantations of fast-growing trees be located (landscape context) and where should they be avoided? Please motivate your answer!
- *From a cultivated landscape point of view, energy forest production cannot be accepted in the Norwegian (Nordic) landscape!*
*-Norway and the Nordic region should not have energy forest production on agricultural land!**
- *Possible energy plants as oil raps and perennial grasses may be produced, plants which do not tie up the areas such long periods as fast-growing tree species do.*

The forest researcher had however a more constructive answer:
- *Energy forest should be produced on areas where such production could be cost-effective, i.e. close to processing industry and population centres, primarily in central agricultural areas in south eastern Norway, some parts of mid-Norway, and at the south west coast (Jæren).*

5) How should plantations of fast-growing trees be formed (e.g., shape, size of plantation, mixture of species/varieties)? Please motivate your answer!
** was repeated*

The more constructive answers were however:
- *If energy forests should be established, those fields should not be too big and continuous. Fast growing trees might be more acceptable as zones in boundaries of fields, as buffer zones to water ways, or as corridors for stock of game and increased biodiversity. For the biodiversity it would also be better with mixtures of different tree species.*
- *Should not be too high. Mixtures of tree species would be preferable.*

6) Which, if any, specific management actions (apart from purely yield-related) should be considered to enhance the environmental benefits of plantations of fast-growing trees? Please motivate your answer!
** was repeated*
However, some were kind of positive;
- *It might have a positive effect on leaching and erosion.*

Figure 2. Also, the topography, the difficult accessibility, has been an argument towards emphasizing bioenergy in Norway.

Initially it was claimed that Norway had to be regarded as a Development country with respect to bioenergy. However, there are unique political directions now that renewable energy sources have to be investigated and exploited. Among the renewable sources are bioenergy. Since e.g. the neighbour in east, Sweden, has carried out extensive research and development of bioenergy for 20 years already, it is very important that Norway uses the knowledge gained. However, as explained, there are some differences between Norway and Sweden. There are big differences between topography of e.g. Scania (Skåne) and the steep dales in Norway (Figure 2). Thus, local adjustments are indeed needed.

Country report: Latvia

Andis Lazdiņš & Dagnija Lazdiņa, LSFRI Silava, Latvia

Utilization of solid biofuel in Latvia

From the statistical point of view Latvia is the biggest consumer of solid biofuel in Europe. The most of energy wood utilizes municipal boiler houses (about 1500, 10-0.5 MW). No reliable data are available about industry, but, for instance, the pellet production has a capacity of 500,000 tons of pellets yearly, which implies great consumption of biofuels both as raw material for the industry and as fuel. The consumption of solid biofuel was 1.2 million t (50% moisture) in 2005, including district heating (1.0 million t) and different technological processes (0.2 million t). In 2006 the consumption of solid biofuel was 1.2 million t, including district heating (0.9 million t) and technological processes (0.3 million t). No data are available about private consumers.

Solid biofuel export from Latvia

Trade statistics shows that the export of solid biofuel is much higher than the local consumption. In 2005 wood biofuel export was 2.3 million t corresponding to 95 million EUR, including 0.3 million t of wood logs (34 EUR/t), 1.5 million t of wood chips (35 EUR/t) and 0.5 million t of sawdust and pellets (64 EUR/t). In 2006 the biofuel export from Latvia increased by 30 % and reached 3.3 million t or 110 million EUR, including 0.3 million t of wood logs (46 EUR/t), 2.5 million t of wood chips (21 EUR/t), 0.5 million t of sawdust and pellets (87 EUR/t). No detailed information is available on the export of pellets and briquettes.

Solid biofuel resources in Latvia

In spite of a large amount of energy wood, which is already utilized in Latvia or exported, a great potential in solid biofuel resources is not used at all. Local biofuel resources consist of:

- forest harvesting residues (5.6 million m^3);
  - slash in clear-cuts – 2.5 million m^3 or ~ 5.0 million MWh,
  - stumps in clear-cuts – 1 million m^3 or ~ 2.0 million MWh,
  - commercial thinning 0.9 million m^3 or ~ 1.8 million MWh,
- wood industry – 1.2 million m^3 or ~ 2.4 million MWh (local origin wood);
- recycled wood – 0.1 million m^3 or ~ 0.2 million MWh;
- willow plantations – 0.3 million m^3 or ~ 0.5 million MWh;
- Total ~ 7.2 million m^3 or ~ 14 million MWh, or about 220 million EUR.

Additional resources in the short and long term may come from naturally reforested former agricultural land (320,000 ha). These land areas are interesting for the plantation of energy forests.

Potential of energy crops

The potential of energy crops is evaluated from the amount of fertilizer available in the country. Wastewater sludge production in Latvia is about 25-28,000 t of dry mass yearly. Theoretically, the necessary area of energy crops to utilize all these materials is 14,000 ha in a 4-years rotation. The total increment of wood in these plantations wood be up to 120,000 t dry mass yearly, but the total growing stock at harvesting age would be up to 120,000 t dry mass or 270,000 m^3.

It is noted in some public announcements of the Ministry of Agriculture that at least partial support for energy crops, including establishment subsidy, will be introduced starting from 2008.

Latvian energy planning

Future biofuel consumption in Latvia strongly depends on the National energy policy plans: the Energy program 2006-2016 and the Renewable fuel development program 2006-1010. These documents prescribe support to build a new coal power plant, combined heat and power production, a new nuclear power plant in Lithuania, the development of hydro power, wind, small hydro, solar etc., including financial aids to biomass co generation (79 million EUR) and district heating (91 million EUR).

Results of questionnaires

Questionnaires were sent by e-mail to 987 organizations, including 520 municipalities, 282 environmental non-governmental organizations, 65 private forestry related companies and 120 state organizations. A wide range of recipients was chosen to distribute information about energy forests and to start a discussion about the potentials of solid biofuel production in the future. The questionnaire contained a brief description of different energy crops and links to internet resources about this issue in the local language.

The questionnaire was answered by only 74 organizations, including 59 municipalities and 17 state organizations. No response was received from environmental non-governmental organizations and private companies.

The general appreciation of energy forests and energy crops as such was mostly neutral or positive. Energy forests usually were mentioned as a potential way to utilize finally somehow set aside agricultural lands. No special limitations to establish or manage energy forests were mentioned. A commonly mentioned problem was the lack of information – people do not clearly understand the meaning of the term “energy forests”. Many responses from municipalities contained information requests about energy forests. The pattern of (lacking) answers indicates a general lack of interest especially from non-governmental organizations, which could strongly affect the processes needed to develop the idea of energy forests in Latvia.

Reputation of the term “short rotation energy wood plantations”

The most common response from municipalities was: “The repute is neutral”, because of lack of information as well as lack of energy forests in Latvia. Several municipalities, especially those which are utilizing wood in district heating systems, answered that they have a positive attitude to this term and would be interested in the establishment of energy wood plantations in their own lands.

State organizations indicated a more positive than neutral or negative appreciation.

Positive possibilities of energy forest cultivation

Municipalities noted that energy forests on agricultural land could increase the share of local renewable fuel in the national energy balance and offer an opportunity for the economically feasible utilization of set aside agricultural lands, especially those which have a complex relief structure. Some municipalities see no positive opportunities with energy forests at the moment, in part because of the currently unfavourable state agricultural policy.

State organizations noted that fuel wood in Latvia is widely utilized in the heating sector, especially in small scale and private heating systems, and only wood primary and secondary processing residues are utilized. The local fuel wood market is changing during the last years and wood processing residues start to dissipate from the market as they are used in pellet

production. There are two realistic alternatives to supply lacking fuel wood to the district heating sector in the future: to start intensively utilize forest harvesting residues and to plant short rotation energy forests. So, energy forests will have a great potential in future, but not nowadays.

Potential problems

Municipalities usually answered that there are no problems or that the available information is insufficient to evaluate potential problems. More detailed responses contained warnings that too heavy pressure and support for energy forest will interfere with fuel wood production from forest harvesting residues, which should be done first, because forest residuals are ready to use and waiting in the forest. Some municipalities mentioned that the transformation of agricultural lands into forests will reduce the area available for food production, which can raise problems in future; other warned that, if this industry will be unprofitable, agricultural lands will overgrow with bushes and low quality forest.

State organizations represented by the Ministry of agriculture, Department of forest resources, described potential problems more detailed. The most important problem could be the choice of wrong tree species for certain areas and low quality forest stands or no stands at all as a result. Another potential problem could be the ignorance of interests of agriculture in the case of intense support to energy forests.

Location of energy forests

Municipalities noted that suitable places for energy forests are fields where they will not hide favourable landscapes, parks and highways. The most commonly mentioned location for energy forests was set aside and disturbed lands. Fertilized plantations should be located so that wind does not bring smell during spreading of fertilizer to the villages or cities.

State organizations noted the low quality agricultural lands. Forestry related people mentioned that local tree species and well managed forest stands cannot make landscape ugly, especially because of the objective reason that set aside lands are naturally overgrowing with bushes and low quality trees, making landscape really depressive.

Form and shape of energy forests

Municipalities usually mentioned that information is insufficient to make decisions bout the best form or shape of energy forest plantations. Plantations should look good by default as any well maintained place, established according legal borders and with respect to land owner initiatives. Plantations should not impact negatively value of other lands. Form and size are not important issues in comparison to the increasing availability of biofuel resources. Regular fields are preferable to reduce management costs. Additional research is necessary in this field.

State organizations mentioned that there is no need for particular shaping of plantations. Decisions regarding planting area and species depend on the economy. It is important to evaluate all aspects (investments, other costs, potential income, available technical solutions) before a final decision about the establishment of plantations can be done.

Other management options

Municipalities had very few comments in this section. Energy forests and willow plantations can be planted in clear-cuts nearby villages and cities. Game management and establishment of habitats for different animal and bird species should be taken into account during the plantation planning stage.

State organizations, represented by the Ministry of agriculture, also had only few comments here. Energy forests and short rotation willow plantations are targeted to produce biofuel and

this should be the main indicator in the decision making process. Potential effects on the environment, such as soil and groundwater pollution risks, should be taken in account.

Other suggestions

Other comments were generalized, because there were no significant differences in relation to the group of respondents. Most of municipalities mentioned that more information about energy forests and willow plantations as well as about available support schemes is necessary. Another very common comment was that the establishment of energy forests should be subsidized to be competitive with conventional agriculture or land set-aside support schemes.

Biofuel market aspects were important, often mentioned issues. It is necessary to support the utilization of biofuel locally, not to export it, for instance, to Sweden. If set-aside agricultural lands can be used to grow valuable energy wood, it should be supported at all levels, including the EC and national support schemes.

Country report: Estonia

Anneli Adler, Swedish University of Agricultural Sciences (SLU), Sweden

Primary energy production in Estonia is mostly based on oil shale employing 10,000 people in this relatively small country. In 2005, 91% of electricity was produced from oil shale, 0.75% from hydro- and wind-power and only 0.32% from other renewable sources [1]. Energy production from oil shale pollutes the environment with huge amounts of ashes and CO_2, and has very low efficiency of saving energy (ca. 30%). In 2005, 20% of heat was produced from renewable energy sources, mainly wood fuel. During the last decade 752 heating plants have been reconstructed to use chopped wood as main energy source. However, the shortage of wood fuel and the high prices have forced these reconstructed heating plants to increase the energy production from natural gas during the last years [1, 2]. Wood fuel resources from traditional forestry are estimated to decrease by the factor of two by 2030 [3]. These facts and the renewable energy politics in EU have led the Estonian governmental organisations to search for alternative sources of energy production.

In January 2007, the Estonian Government forced the "Development plan to promote the use of biomass and bioenergy 2007-2013" [4]. This plan aims to create suitable conditions for the development of domestic biofuel and bioenergy production, reduce Estonia's dependence on imported resources and fossil fuels, reduce pressure on the natural environment, make efficient and sustainable use of land resources, promote full employment in rural areas and support the development of the bioenergy market. Special attention will be paid on the maintenance of the diversity of landscapes and ecosystems when developing the domestic bioenergy infrastructure [5].

The renewable energy potential of Estonia lies primarily in the co-generation of heat and electricity based on biofuel, and in wind energy [6, 7]. Estonia aims to increase the share of renewable energy in the transport sector by up to 5.75% by 2011 and the production of electricity by up to 5.1% by 2010; in addition, an increase in the efficiency of energy production is envisaged.

The potential to produce biomass for energy from short rotation forestry is high in Estonia [8, 9]. The country has 1.2 millions ha of agricultural land. In 2006, ca 275,000 ha has been abandoned since the beginning of the 1990s. However, how much of the abandoned land could be used for energy crop production, is unknown. The interest to grow energy crops is slowly increasing among the farmers. One of the main problems concerning biofuel production in Estonia is a lack of knowledge among growers about the effectiveness and profitability of producing and using biofuel. Comparative life cycle analysis of energy crop production, economy and energy efficiency are not available. The market for energy crops is not yet developed [4]. The link between producers (growers) and consumers (heat and power plants) is poorly established and growers have insufficient experience of growing short rotation crops on agricultural land. The advisors in the agricultural sector cannot give any suggestions concerning the management of short rotation forestry. If the production of woody energy crops is not profitable this potentially available land will not be used for this purpose.

The amount of energy per ha that is possible to produce is dependent on the type of crop (cereals, perennial fast-growing herbaceous trees or energy grasses) and the combustion technology. Effective technologies need higher investments; therefore long-term plans for energy production should be considered. Joint projects between different research groups within Estonia as well as more intensive international cooperation would enhance the implementation of new technologies in the renewable energy sector [4]. The Estonian Rural Development plan 2007-2013 supports the investments aimed at the production of biomass and biofuels in agricultural holdings [10].

Experimental short rotation willow plantations, established between 1993 and 2003, cover ca 24 ha of agricultural land and 92 % of them function as vegetation filters – these are fertilised and irrigated with wastewater [11]. The production potential of short rotation willow plantations is ca 10 t ha^{-1} y^{-1} [9,12]. In 2005 ca 130 ha of commercial willow plantations were established [13].

Since March 2007 around EEK 700/ha in subsidies for the establishment of energy crops are available for farmers. Unfortunately, only 1 ha of *Salix* was planted with the subsidy for the establishment of energy crops in 2007 (Einar Kikkas, Estonian Ministry of Agriculture, personal communication). Until now the plant material used to establish willow plantations have originated from Sweden, but breeding of local clones suitable for Estonian climate is going to be started [14].

In 2005 ca 700 ha of hybrid aspen plantations were grown in Estonia. The establishment of hybrid aspen plantations started in 1999 in cooperation with Finnish enterprises [15]. Since 2004 the establishment of hybrid aspen (as an introduced species) is officially allowed, but subsidies for the establishment of hybrid aspen plantations are not currently available.

Grey alder is another potential species to grow as energy crop on agricultural land in Estonia [14, 16]. The effects of grey alder on soil nitrogen retention, fertility, nitrogen leaching and denitrification as well as nitrogen use efficiency in grey alder plantations will be studied [14].

The effect of short rotation crops on the diversity of landscape and different organisms has not been studied yet in Estonia.

Acknowledgements

The consultation with Andres Koppel concerning current situation in short rotation forestry is greatly acknowledged.

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Country report: Lithuania

Algis Avizienis, UAB "Jusu sodui", Lithuania

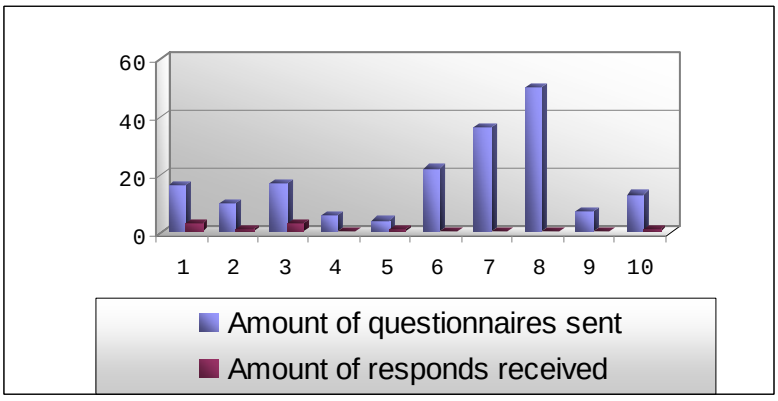
The cultivation of fast-growing trees for energy production is at an embryonic stage in Lithuania, with very little active government involvement or coordination in evidence. The 10 respondents to the questionnaire, who included government officials, researchers and representatives of civic organizations, favorably assessed the overall impact of energy forests on the environment. There seems to be a consensus that plantations of energy crops should be located on marginal agricultural land presently unused or abandoned. High-yielding arable land should be reserved for food production. Roughly one-sixth of the 3 million ha of arable land in Lithuania is presently unused, and in many cases overgrown with weeds or even wild trees and bushes. This unsatisfactory situation, in which rural depopulation and underemployment also play a part, has cast the question of biomass cultivation primarily in an economic light. The importance of promoting the planting of energy forests is perceived in its potential to utilize abandoned land, provide employment to rural populations and increase the supply of local fuel. Environmental officials seem to be concerned that poor maintenance of energy crop plantations could result in a proliferation of abandoned energy forests, which would allegedly blight the Lithuanian countryside. A number of researchers hold the view that energy forests should not be located near rivers, lakes, beaches, recreational areas or archeological sites. Some respondents favor large plantations for their economic benefits, while others prefer smaller cultivated areas on aesthetic grounds.

Natural forests should not be sacrificed for biomass cultivation. Conversely, it is understood that, in the near future, energy forests could reduce pressure on natural forests, which are subject to intensifying exploitation for biomass production. The use of biomass for heating, already fairly significant, will increase markedly by 2012, and begin to exceed the productive capacity of natural forests. Energy crops, such as fast-growing willow, are expected to fill gaps in available supply. Growers of biomass crops receive no support for the care and maintenance of their plantations (only compensation for establishment costs), while planters of natural forests do. In addition, landowners receive EU support payments for maintaining symbolic pastureland, which often involves merely mowing the area concerned once or twice. Many landowners are content with this support, and are not interested in the considerable time, investment and work required to establish an energy forest, which will provide a return only after 4 years. The question of the relative advantage of EU assistance is crucial here.

Analysis on potential development of Short Rotation Forestry with emphasis on the society attitude under Polish conditions

Anna Wróbel, Warsaw Agricultural University & Institute for Fuels and Renewable Energy, Poland

The presentation includes the methods and results from the research run in Poland that was aimed at assessing the general attitude among Polish representatives of different groups towards the potential development of short rotation forestry plantations in Poland.
The arable area of Poland exceeds 60% of the country area and presents great potential for agricultural ventures. However, about one tenth of this area is covered by fallow land. Despite relatively large arable land in Poland, comparing to other European countries, energy plantations cover only seven thousands hectares.
The research was based on assessing the general attitude of representatives from different groups which was investigated by means of special questionnaires. Two types of questionnaires have been used in this research. Both forms referred to elements of SWOT analysis (strengths, weaknesses, opportunities and threats) of the short rotation forestry plantations implementation and included questions concerning personal opinion about energy plantations and estimated knowledge about maintaining these plantations.
The difference between two used questionnaires was the method of spreading them. Twenty five forms have been used for personal pooling among farmers while almost one hundred eighty questionnaires have been sent via internet.
The target groups included representatives from different production-supply-conversion chain levels, which were: farmers and land owners, producers of briquettes and pellets, representatives of transport branch, researchers and academic teachers, policy makers, decision makers on the local level and companies from consulting branch, companies producing special equipment for biomass production and conversion and others. The statistics of sent and received questionnaires is seen below.



1- Non-governmental organizations,
2- Energy plants,
3- Professors, academic teachers,
4- Municipalities,
5- Energy companies,
6- Farmers, producers of plant material,
7- Suppliers and producers of pellets,
8- Companies producing stoves and other equipment for processing biomass,
9- Consulting branch,
10- Others.

The representatives of different groups connected with the topic mentioned both positive and negative aspects of introducing short rotation forestry plantations. Our responders were also asked what possibilities they suggest for increasing the benefits from plantations of energy species. The ideas mentioned the most often were: the involvement of local community, proper information spreading, multiply species use and multiply land use. The elements of SWOT analysis mentioned by our responders are shown below.

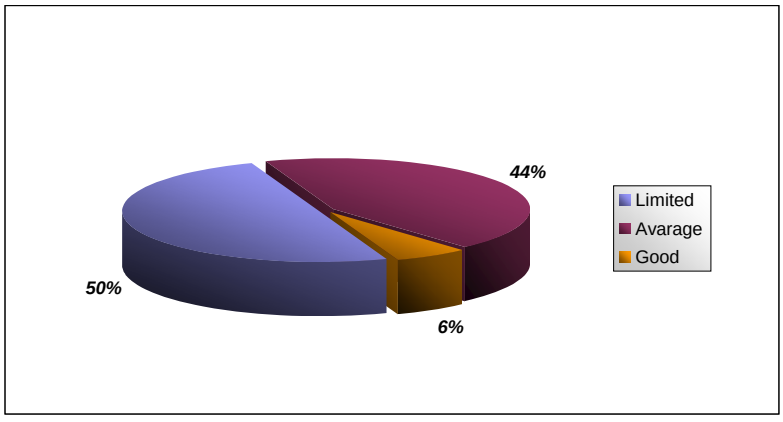
Strengts and Opportunities

- Energy independence connected with the introduction of new source of energy
- Use of worse land-classes areas
- CO_2 absorption increase
- Extra income in the future
- Relatively low chemical inputs, in consequence, low costs of managing
- Diversification of activities which causes less risk of failure

Weeknesses and Threats

- Decrease of biodiversity caused by introduction of monoculture
- High equipment and labour costs
- Possible negative changes in soil water regime
- Profitability risk
- Weak price negotiation position
- Price competitiveness
- Market related issues
- Lack of information and knowledge

Concerning the type of biomass the majority of pooled farmers would like to grow willow while less than 40 % could provide their straw as a biomass material would like to grow rape or are willing to start grasses plantations. The study included inquiries connected with the level of knowledge about energy species and their management. Only six percent of pooled farmers have estimated their knowledge as good. According to the rest of pooled, their level of knowledge is limited and average. The estimation of knowledge among farmers is shown on the chart below.



The time and method of spreading questionnaires could have had a serious influence on the amount of responds received. Despite the fact that all the necessary information (ex. target of the project, contact person, name of supervising organization) has been included, the responders might have felt suspicious towards the project they have not heard about. From all the questionnaires sent via internet only ten answers were gained and analyzed. Twenty one questionnaires have been gained using the method of personal pooling, which is undoubtedly better result.

On the base of the results some conclusions have been formed. From the financial point of view the access to preferential credits, subsidies and direct payments must be provided, as

well as the plantations profitability. The spreading of knowledge and experience must be improved. Information chains and sharing experience shall be ensured by researchers in cooperation with policy makers, and performed on both national and international level; also aimed at different groups connected with the topic separately. Policy makers in the country should support bioenergy branch by forming and introducing different bills and laws providing facilitation for the establishment of new energy plantations. Finally the research branch which is responsible for both environmental and technical progress could help to make biomass ventures successful.

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Sustainable management of SRF plantations: Do we need recommendations and guidelines?

Nils-Erik Nordh, Swedish University of Agricultural Sciences (SLU), Sweden & Stig Larsson, Lantmännen Agroenergi AB, Sweden

Short rotation forestry (SRF) with salix refers to a perennial agricultural production system with an expected life span of 20 – 30 years. During that period the plantation will be harvested repeatedly every 3rd or 4th year. Like other agricultural crops, salix needs adequate management in order to reach a high and sustainable biomass yield. The recommended and necessary management measurements have been presented in several "Manuals for growers", the most recent by Gustafsson *et al* (2007), which describes all practical aspects of salix cultivation such as choice of suitable site and site preparation, choice of plant material (varieties), planting and weeding during the critical establishment phase, fertilisation, harvesting and finally removal of old plantations.
In comparison to many other dedicated bioenergy crops, salix is the cultivation system that causes the most obvious changes for the farmer since it is perennial, harvested only every 3rd or 4th year and reduces the farmers´ own labour input (Rosenqvist 2007). Also in the landscape salix may have a large impact due to its height (6 to 9 m at harvest) and perennial nature. Therefore, the landscape perspective has also to be considered when establishing a salix plantation and the following paragraph can be found on the website of the *Swedish Board of Agriculture* (http://www.sjv.se/):

"You shall adapt the plantation to the landscape scenery. Flora, fauna or valuable natural environments may not be negatively affected by the SRF plantation. You shall also consider nature conservation and cultural environment interests. The county administrative board will therefore evaluate your application in the context of the regulations in the environmental law and the law on cultural heritage." (free translation from Swedish)

However, the required adaptations and considerations are here formulated very generally and not specified in terms of any concrete actions or considerations that could be taken by the farmer. How should the plantation be 'adapted to the landscape scenery'? Which actions can be taken to avoid that 'flora, fauna or valuable natural environments may not be negatively affected by the SRF plantation'? These and other, similar questions remain often unanswered and put the farmer in a situation where he hardly gets information on how to meet the requirements. Therefore, it would be very desirable if recommendations or guidelines for the sustainable biomass production in SRF plantations on agricultural land would be available to farmers and public authorities dealing with regulation aspects of SRF plantations. Aronsson *et al.* (2007) suggested the following recommendations for the sustainable management of SRF plantations in Sweden:

- *Plant close to domestic deciduous forest or establish "islands" of native deciduous trees adjacent to the SRF plantation*
- *Harvest only parts of the plantation each year*
- *Plant different species or varieties (preferably of different sex) in the same stand, but in different sections (e.g. parallel strips), each section with a single species/variety*
- *Perform weeding only when establishing the plantations*
- *Adapt the fertilisation to the growth*
- *Leave unplanted border zones*

These recommendations could act as a starting point for the discussion on how to maximize the positive environmental effects of SRF plantations. Recommendations or guidelines for the sustainable management of SRF plantations could be developed and included in revised versions of grower manuals and/or supplied to farmers by advisory officers.

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Sustainable agriculture and SRF: Symbiosis or oxymoron?

Gun Rudquist, Swedish Society for Nature Conservation (SNF),Sweden

Sustainable agriculture and SRF

Swedish Society for Nature Conservation

Non governmental environmental organisation

Democratic, non political

Founded 1909

170 000 members

24 regional branches, 275 local branches

Head office Stockholm and Göteborg, staff of 55

Financed mainly through member fees and donations

Yearly turnover 13 Million euros

Naturskyddsföreningen Kansliet 2007-03-08 1

Sustainable agriculture and SRF

SSNC spreads knowledge, map environmental threats, create solutions, and

influence politicians and public authorities, at both national and international levels.

Consumer power via member activities and our own Eco-label, "Bra Miljöval"(Good Environmental Choice).

Main areas of involvement - climate, the oceans, forests, environmental toxins, and agriculture.

Naturskyddsföreningen Kansliet 2007-03-08 2

Sustainable agriculture and SRF

Starting point – reduce overall energy consumption

Great potential for efficiency increase

Changes in behaviour needed

Bio-energy – part of the solution

Focus should be on biomass rather than biofuels

Naturskyddsföreningen Kansliet 2007-03-08 3

Sustainable agriculture and SRF

SSNC and agriculture

Clean, good and fair food

Bio-energy and other raw materials

Preserve and enhance biodiversity and other public goods

Active farming all over the country – backbone of rural development

Naturskyddsföreningen Kansliet 2007-03-08 4

Sustainable agriculture and SRF

Negative effects of agriculture

- Eutrophication
- Residues of pesticides
- Biodiversity loss
- Erosion
- Water shortage
- Climate impact

Naturskyddsföreningen Kansliet 2007-03-08 5

Sustainable agriculture and SRF

Overall environmental demand on bio-energy production must be the same the same as on any other agricultural production.

No cultivation in nature and culture conservation areas

Risk – intensification in the name of climate change

Naturskyddsföreningen Kansliet 2007-03-08 6

Sustainable agriculture and SRF

Bio-energy crops

At present – economically viable?

1. Ethanol from grains – questionable energy and CO2 profit

- **Risks: monoculture (pesticide use, organic matter, biodiversity, etc)**

Sustainable agriculture and SRF

2. Salix

Greater potential than grains

Could be used to create variation in monotonous landscapes

Reduce pollution in soils

Not enough knowledge on biodiversity effects today

Effects on ecosystem services rarely discussed

SSNC study undertaken

Sustainable agriculture and SRF

An import part of the discussion on bio-energy is what the arable land primarily should be used for. Food and feed?

One must consider the alternative use of arable land and impacts in Sweden as well as abroad of focusing on bio-energy.

Sustainable agriculture and SRF

Implications of growing demand for bio-energy from the south

Positive: creating jobs, income for farmers and export revenues for countries. Foreign investment flows, transfer of technologies, support for research and development.

Sustainable agriculture and SRF

Negative:

- **Forest conversion and biodiversity loss**
- **Land use and land rights**
- **Working conditions**
- **Use of agrochemicals**
- **Water and soil**
- **GMO**

Sustainable agriculture and SRF

Future strategies

- **Sustainability criteria – ecological, economical and social**
- **Include origin of biomass, land use, production system and environmental managment**
- **Certification – participation of local groups; tracebility, transparancy, etc**

Report from the field trip performed on day 2 of the workshop

Nils-Erik Nordh, Swedish University of Agricultural Sciences (SLU), Sweden

The field trip on Tuesday September 11 started with a bus trip to Enköping, a town located about 45 km southwest of Uppsala. The first goal on the trip was the Lundby farm, 10 km outside Enköping, and we were welcomed by Johan Lind, who was our host during the visit. Lundby farm is run by Johan Lind and his brother Lars Helgstrand (see separate Summary in this report), and the farm comprises 150 ha agricultural land and 110 ha forest land. Salix is grown on 110 ha of the farm land while 40 ha are used for cereal crops. Lundby farm is participating in a project on recycling for a sustainable society run by the Enköping municipality. Within this project, Lundby farm has built two large ponds for waste water storage and get paid by the municipality for taking care of septic tank waste water which is collected from nearby farms and houses. The waste water is stored for one year in the ponds and thereafter it is spread on newly harvested willow plantations through an irrigation system. This operation reduces the “waste” load for the waste water treatment plant in Enköping and at the same time the salix plantations benefit from the irrigation and the mineral nutrients that the waste water contains. The Lundby farm owns and runs a transportable tractor-powered irrigation system that also is used on other farms with waste water storage ponds. The waste water operations are an important and economically very profitable part of the financial turnover of the Lundby farm.

First stop at the waste water storage ponds of the Lundby farm, where the participants were supplied not only with practical information on the management of SRF plantations treated with municipal waste water as a nutrient source, but also with “nutrition” from the improvised coffee table.

After looking at the ponds, the bus took the participants through the major part of the salix SRF plantations belonging to the farm, up to an elevated point in the landscape with a good overview of the salix plantations and the adjacent cereal fields. The scenery stimulated lively “in situ” discussions among the participants on the impact of SRF on landscape, biodiversity and recreation. Johan Lind reported that when establishing the salix plantation, areas close to the main drainage tubes were left unplanted in order to, if possible, prevent root penetration into the tubes. These unplanted areas have become popular paths for horse-riding and walking. The landscape expertise among the participants (E. Skärbäck) was very pleased about the arrangement of the willow plantations in the landscape context, although no landscape expertise had been consulted prior to plantation establishment.

Johan Lind (to the left) explained the farming concept to the participants and a lively discussion on plantation, management and landscape issues in relation to willow SRF plantations was initiated "in situ".

After pre-booked lunch at a simple restaurant in Enköping, the next stop was Ena Energi AB, the district heating plant (DHP) of the Enköping municipality. The managing director Eddie Johansson welcomed us and presented the company Ena Energi AB, which operates a combined heat and power station (CHP) supplying all heat and tap water (220,000 MWh/year) and the major part of the electricity (100,000 MWh/year) to Enköping, a town with 22,000 inhabitants. Ena Energi AB uses only biofuels, of which c. 15% comes from salix plantations and the rest consists mainly of waste material from the forest industry. Eddie Johansson described the shift from fossil fuels to biofuels that took place from the early 1980´s to the late 1990´s. He also reported about the company's efforts to cooperate with local farmers that could grow salix and supply biofuel to Ena Energi AB. The visit at Ena Energi AB ended with a guided walking tour around the DHP, starting where the biofuels enter the DHP by lorry, through the fuel quality check, onwards to the site where the fuel is unloaded and transported by conveyer belts into the boiler, passing the boiler. The tour ended in the control room, where the boiler and heat supply is monitored. The final stop of the trip was at a 75-ha salix plantation located just 1 km from Ena Energi AB and even closer to the Enköping municipal waste water treatment plant. At this site Dr. Jannis Dimitriou, a researcher at the Department of Crop Production Ecology, SLU, was our guide. Here, the salix plantation is used to utilize decanted water from the dewatering of sewage sludge from the waste water treatment plant (waste water "recycling" concept). The waste water is stored in large ponds and irrigated through drip pipes into the salix plantation during the period from May to September. The irrigation is some 300 mm per year containing about 250 kg nitrogen and 7 kg phosphorus per ha. The municipality has covered all the costs for the ponds and the irrigation system, while a local farmer established and runs the salix plantations and also has the responsibility for the maintenance of the irrigation pipes. The biomass from the plantation is used in the DHP and the ash from the boiler is recycled back to the salix plantation.

Jannis Dimitriou (to the left) contributed with professional expertise on the "recycling" concept applied at the Ena Kraft combined heat and power plant, especially the possibilities and problems of waste water storage and application to the nearby salix "jungle", where some of the participants almost lost orientation.

Many of the participants had never seen commercial SRF plantations and/or waste-water treatment systems integrated in salix production systems before and all participants regarded this day as were rewarding and welcomed this "outdoor" activity as a nice break inbetween the indoor workshop sessions.

Discussions during the workshop – notes and conclusions

Nils-Erik Nordh, Lovisa Blomqvist & Martin Weih, Swedish University of Agricultural Sciences (SLU), Sweden

The discussions during the workshop concerned a number of topics within the field of short rotation forestry (SRF) plantations grown on agricultural land and mainly focussed on issues related to the cultivation of SRF with salix. Among the issues discussed were public acceptance, landscape aspects, environmental consequences, biodiversity, dissemination of knowledge and information (e.g., handbooks, guidelines, courses), economics, management, and implementation of SRF.

Major observations and conclusions during the discussions

It became very clear during the discussions that the participants from the different Nordic and Baltic countries had very different views on the potential and possibilities of SRF plantations in their respective countries, which strongly influenced their view on the importance of environmental and landscape aspects. Countries with hardly any examples of SRF plantations on their own land did not really see the necessity to discuss landscape and environmental issues in detail, because other factors (e.g. management, economy) currently are much more important. The discussion of landscape and environmental aspects was therefore dominated by contributions from participants from countries with a longer history of SRF plantations and/or countries with generally high public awareness of environmental issues (e.g., participants from Sweden, Denmark, Germany).

An interesting observation during the discussions was also that participants representing presumably conflicting interests (e.g., Swed. Environ. Prot. Agency and the salix company Lantmännen Agroenergi AB) were very well able to communicate critical issues in a constructive way, but that there is usually a great lack of opportunities to discuss the critical issues among representatives from conflicting interests. Therefore, the current workshop, offering a platform for this sort of discussion among controversial groups of interests, was most welcomed by the participants and a desperate need for further initiatives of this kind was identified.

One of the most important issues during the discussion was the obvious fact that there are gaps of knowledge and a lot of misunderstandings among many groups of stakeholders dealing with SRF, not only in the countries where SRF is less common, but also in Sweden, where salix has been a commercial crop for more than 15 years. The lack of knowledge is sometimes on a very fundamental level, i.e., whether salix is an agriculture crop or forestry. Therefore there is an urgent need for education and dissemination of information among key persons and decision-makers not the least at the level of County Administrative Boards; training and information dissemination could be achieved by means of workshops or training days that probably should be obligatory for representatives of County Administration Boards of regions with a potential for the future establishment of SRF plantations..

There was also identified an urgent need for the development and implementation of recommendations and/or guidelines for the sustainable establishment and localisation of SRF in order to achieve as many positive effects as possible on environment, landscape and biodiversity. This work could be initiated by the Swedish Environmental Protection Agency and performed in close cooperation with researchers and regional authorities (County Administrative Boards) and organizations.

Further issues discussed:

Landscape aspects

- **SRF can be favourable for landscape.** (E. Skärbäck, landscape architect, Sweden)
- Look at SRF as a **dynamic landscape element** and see what you can do. There is a great variety of appearances over time, from planting to felling and from winter through summer and autumn aspects, which renders SRF an agricultural crop with unique possibilities to create variation in landscape (Skärbäck)
- Salix could also be used for **landscape shaping** in a creative way.
- **People don't like when landscapes changes**, but living landscape is always exposed to changes, not just when the change is due to SRF.
- Salix plantations have to be seen in a **global perspective** – the need for biomass for energy – in relation to eventual negative local effects (scenery) (A. Lundborg, Energy Agency, Sweden)
- County Administrative Boards in Sweden see less conflicts today compared to the period during the 1990-ties when the crop was introduced commercially in Sweden; the objections today are mainly **archaeological concerns**

Cultivation aspects

- **Salix plantations are not difficult to remove.** This has been experienced by the farmer Lars Helgstrand.
- **Salix plantations can repay the investment after just one harvest!** Everything you get after that (during about 20 years) is just profit. (Stig Larsson, Lantmännen)
- **Cooperation can be profitable.** In Enköping the municipality saves money when the sewage is used as fertilizer on the Salix fields instead of treated in the waste water treatment plant. Salix grows very well with the sewage input, which gives the farmers good incomes. It is chipped and used in the Ena Energi AB heating plant nearby, giving cheap and clean energy and electricity in the area!
- The decrease of labour input by the farmer when growing salix instead of grain is commonly seen as a problem, but also offers an opportunity for land owners living in cities or with other employment as well.

Environment and biodiversity aspects

- **Uptake of heavy metals** with salix is a possibility that may be of increased importance in the future if polluted soils can be "decontaminated".
- **Decrease in nutrient leakage**, compared to grain crops, can be achieved with salix, as less fertilizing is needed and the roots are present year around. There is also a possibility to fertilize with waste water and sludge.
- **Chemical herbicides in salix plantations are only used when establishing and removing the plants.** Compared to annual crops, this implies a substantial reduction in the use of herbicides.
- **Better hunting conditions** than with grain crops, due to shelter and grazing possibilities. Moose, roe deer, hare etc have been seen to increase in number around salix plantations.

- Salix can **prevent flooding** by help taking up water when there is a lot of rain and drainage from cities.
- **Salix can work as a windbreak** in open landscapes and also prevent erosion.
- **Salix can provide a stable income** for the farmer as the price on wood chips is likely to be more stable over time than the fluctuating grain prices (Stig Larsson, Agroenergi)
- **Impacts of SRF plantations on biodiversity depend on the starting point**: In e.g. Poland much farm land is managed using traditional farming practice, i.e., with a great variety of different crops and small field sizes. This type of farming land might be characterized by high biodiversity and the large-scale introduction of salix SRF plantations would probably have a greatly negative impact on biodiversity.

Interesting ideas and facts

- **A payment for improving the conditions for aspects like biodiversity, landscape, uptake of cadmium etc.** For example a "buffer" of deciduous forest could be planted around the crop or "roads" could be kept open through and around the plantation or used for some type of agroforestry. This ought to be applicable for all crops, not just salix. This is an idea that came up from discussions about the different precautionary measures that should be taken when cultivating salix, which is unfair if the same rules are not used for other crops.
- **Organize the demand.** Interested consumers of biomass from salix located close to the growers are a great advantage. Contracts are important for the farmer to secure his income.
- **Organize the farmers.** If several farmers co-ordinate the harvests it can improve the economy for the farmer.
- **Map suitable areas for salix cultivation**. **I**t would be good if Nordic Environmental Protection Agencies could supply farmers with maps of land suitable for salix cultivation. This is not allowed now. Today studies show that the market is far more important than the soil when farmers decide whether to cultivate salix. This is not optimal.
- The County Administrative Board could maybe **assess the need for salix plantations for certain purposes** (like nutrient uptake near wetlands or as buffer zones between agricultural land and lakes and rivers) and contact farmers to encourage them to plant salix for these purposes and at the same time produce biomass for energy.
- Advisors (Lantmännen Agroenergi, Hushållningssällskapet etc) should be aware of **both the positive and the negative** sides of SRF.
- A **careful approach** should be taken when introducing energy crops to an area, even if SRF can be good for the climate (replacing fossil fuels). (SNF)
- There are **different conditions** for growing energy crops in different countries, for example in Latvia the economy is the only concern – not the landscape. In developing southern countries the farmer has little power to affect the development.
- Commonly biodiversity is defined as "protection of natural biotopes"; however just as well there is the **possibility to create new biotopes**! New criteria are needed improvement of biodiversity.
- Lantmännen Agroenergi is changing the payment schemes so that the farmers cultivating salix closer to the heating plants will be given a higher prize for the harvest. The purpose is to decrease the transport distances.

- In order to plant salix, the farmers request 2000 SEK/ha higher profit compared to other conventional crops. This is to compensate for the "increased risk" that the farmer experiences when starting growing salix. This includes reduced flexibility compared to annual crops, little use of conventional farming machinery and equipment, uncertainties of future political decisions
- It is very difficult to convince farmers to grow salix since it is a 20 - to 30 -year commitment
- There is a big demand for wood chips in Sweden. To supply just 10% of the fuel for the new biofuel boiler now being built in Stockholm 5000 ha salix is needed.
- In central Sweden salix is economically better than grain. In southern Sweden, payment is better for grain and sugar beets in comparison and the wood chips are harder to sell.)

Comments on the presented draft manual for willow SRC growers[1]

The manual was in general regarded as good, but some improvements were suggested:

- A farmer should be co-writer of the manual to make it more trustworthy to farmers.
- We discuss SRF in a different way than other agricultural crops, how do we expect farmers to regard SRF as any other crop?
- Complementary information needed on the webpage: As the published manual is rather basic, detailed information about SRF cultivation is needed on an advertised webpage. Examples of economic calculations for growing salix, under different conditions, are important. More details on how to get started is needed, e.g. information about suitable salix varieties in different areas. Environmental and landscape aspects are very poorly considered in the manual and the manual should be supplemented by additional recommendations or guidelines regarding these aspects.

[1] A draft of the following publication was made available to the participants of the workshop: Gustafsson, J., Larsson, S., Nordh, N.-E. (2007). Manual for SRC willow growers. Lantmännen Agroenergi AB/Salix, Örebro, Sweden. 18 p.

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