Twelve years of short rotation forest studies in Estonia

Andres Koppel, Katrin Heinsoo,
Estonian Agricultural University

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1. The “environment” for SRF in Estonia

Most arguments for SRF have become more evident during past 10+ years

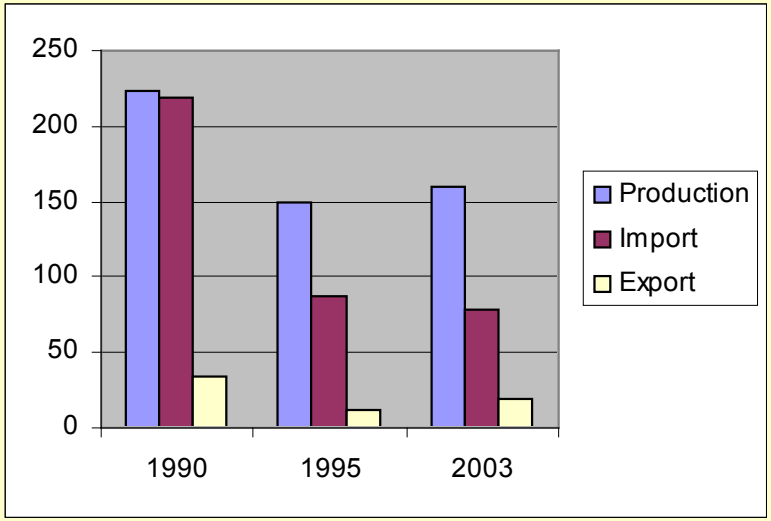
- Energy: fossil fuels - price up, Kyoto protocol, traditional resources close to exhaustion
- Land resources: area of abandoned arable land doubled since 1995
- Rural employment still a problem

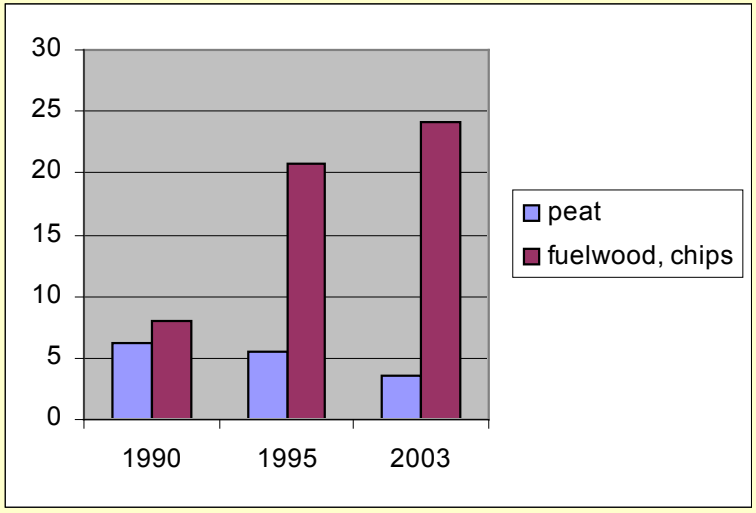
1.1. The environment for SRF in Estonia. Energy
Structure of energy production, import and export in Estonia (TJ)

	1990	1995	2003
Production	**224**	**149**	**160**
oil shale	210	122	132
peat	6,2	5,5	3,5
firewood, chips	7,96	20,7	24,2
Import	**219**	**88**	**79,1**
coal	9,4	2,7	1,6
oil shale	22	12,5	8,9
gas	52,1	24,6	27,8
fuel oil	73,4	18,5	3,6
diesel oil, gasoline	54	13,5	36,2
Export	**33,9**	**11,6**	**19,9**
oil shale	2,1	1,1	0,9
peat	0,3	0,5	2,4
oil-shale oil	0,8	5,8	6,4
electricity	30,5	3,6	7,1
firewood	0	0,5	2,9

Source: Statistical Office of Estonia

1.1. The environment for SRF in Estonia. Energy Structure of energy production, import and export in Estonia (TJ)

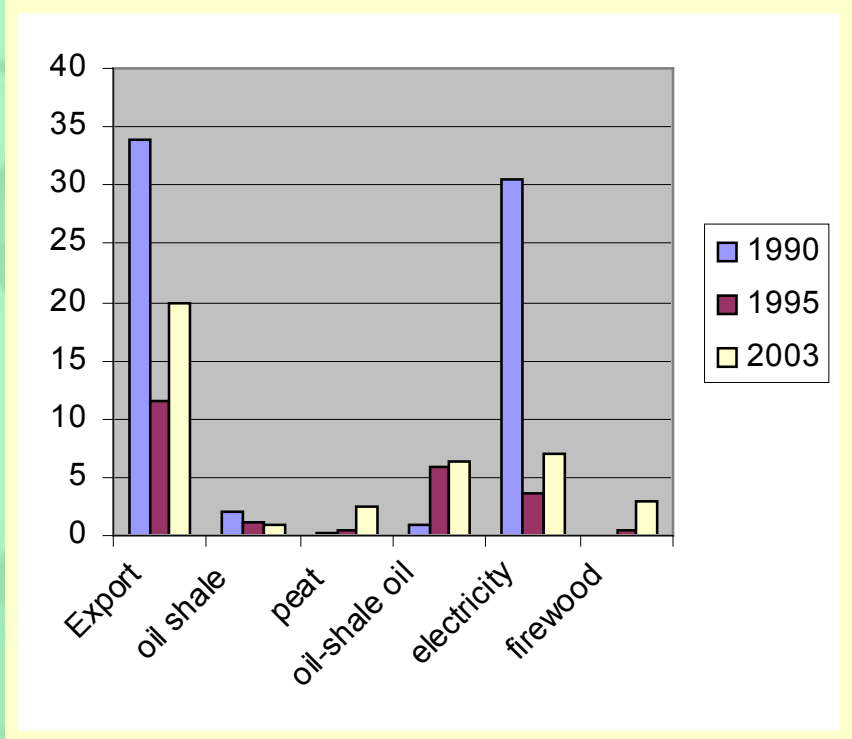




- Energy production dropped rapidly and stabilised
- Import declined and is still declining
- Export is slowly growing

4. Production of renewables (firewood) increased 3 times

1.1. The environment for SRF in Estonia. Energy Structure of energy export in Estonia (TJ)



5. Firewood export is growing fast, most of peat exported
6. Gas import growing
7. Petrol and diesel oil import growing

1.1. The environment for SRF in Estonia. Energy Structure of energy production, import and export in Estonia

Conclusions from the statistical data:

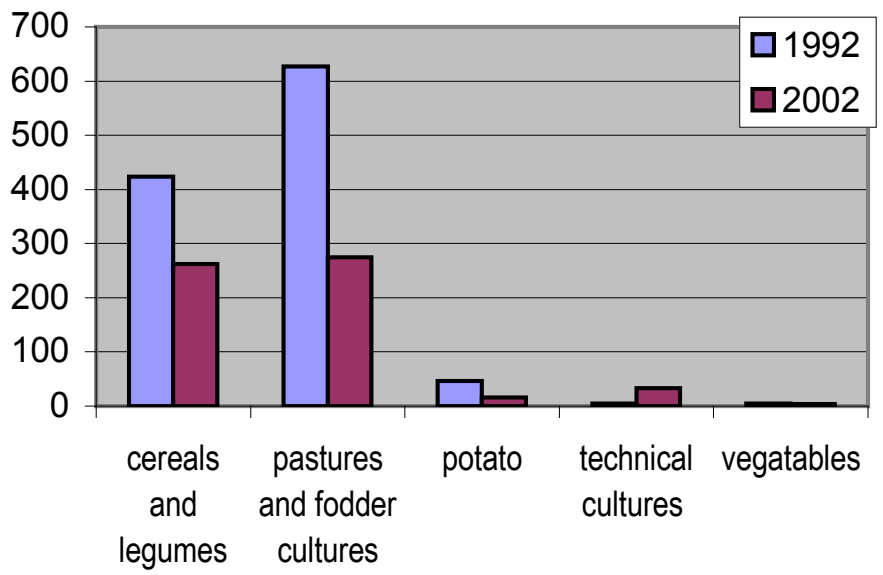
- Domestic traditional renewable sources of energy almost exhausted
- Prices of firewood and woodchips rising fast

•1. The environment for SRF in Estonia. Energy Structure of energy production, import and export in Estonia

Results of the current situation:

- Possibility that recently reconstructed wood-fired- boilers will be converted to gas
- Heat producers revitalised the renewable energy project

1.2. The environment for SRF in Estonia. Land Structure of agricultural land use in Estonia (th ha)



- Rapid decline in arable land use
  - Cereals: -161
  - Pastures: -353

- One exception: rapeseed
33 → 46 → 64 th ha
2002 → 2003 → 2004

- Totally >440 th ha abandoned (approx 40% of arable land).
NB! In 1995 the figure was 180 th ha

1.2 The environment for SRF in Estonia. Land

442 th ha abandoned

(Source: Estonian Ministry of Agriculture)

How to exploit this resource?

1. Let the nature rule!
   Approx 10-15% of abandoned areas - natural forestation
2. Afforestation programmes
   Approx 700 ha of hybrid poplar
3. Energy crops

- Rapeseed (rapidly expanding – 2004 approx 64 th ha)
- Short rotation forests (no commercial plantations exist)
- Other energy cultures - ? Only discussions

1.3. The environment for SRF in Estonia. Strategy documents

Estonian long-term energy development plan 2015

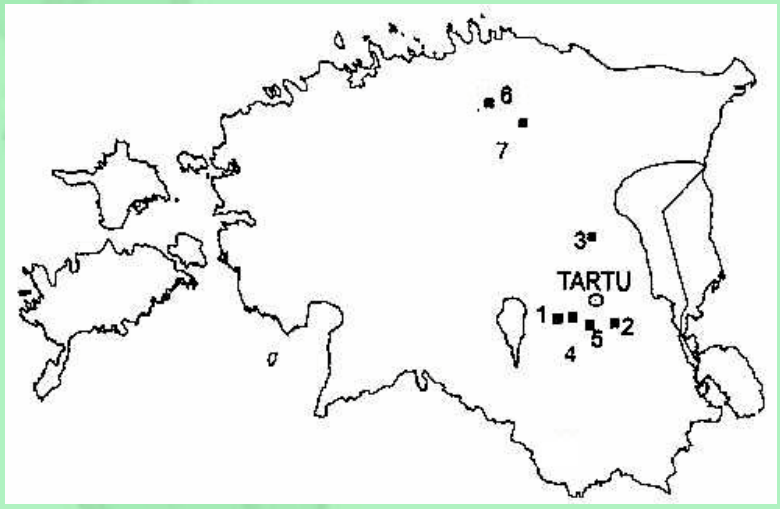
(adopted in Parliament 15.12.2004)

- Stabilisation of energy consumption on the level of 2003
- The share of renewable electricity should grow to 5.1% by 2010 (wind, co-generation)
- Emphasis on renewable liquid biofuels, especially biodiesel
- Solid biofuels? - Sceptical attitude
  - Stated, that the export is growing and therefore the resources of domestic biofuel are exhausted
  - **For further development of biomass plantations economic calculations are needed**

1.4. The environment for SRF in Estonia. Attitude

- 10 -15 years ago :
  - Public opinion - we have natural shrublands, no need to introduce artificial ones
  - Forest researchers: we have enough resources from conventional forests. Willow is not a tree. Willow productivity is too low. Harvesting is a problem
- Today:
  - Public opinion: innovative ideas are welcome. Everything is possible and acceptable if it works
  - Forest researchers: willow is acceptable, there are other fast-growing species too- hybrid polplar, grey alder etc.
  - Politicians: sharp rise of interest
  - Entrepreneurs: does it pay off?
  - Farmers: ready to accept. Where to get the planting material?

2.1. Past. SRF test plantations in Estonia



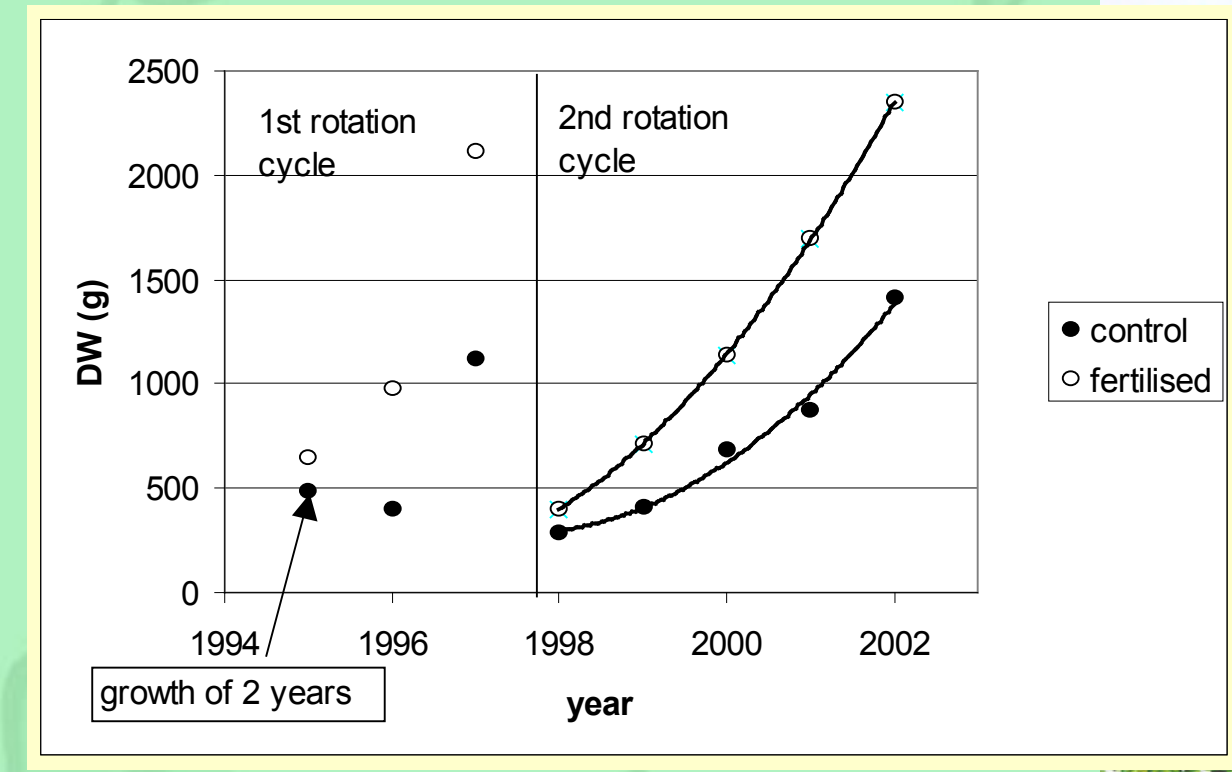
1993: 5 plantations—1,6 ha

2004: 8 plantations– 24,5 ha

NB! Only 1 plantation established in 1993 failed totally (Valga)

No	Location	Area (ha)	Established in	Studies
1	Tõravere	0.2	1993	Light use efficiency
2	Kambja	0.3	1993	Productivity
		16	2003	Seasonal wastewater purification
3	Saare	0.6	1993	Productivity, fertilisation effect
4	Nõo	1.3	1994, 1995	Municipal sludge utilisation
		0.4	2001	Clone tests
5	Aarike	0.02!!	1995	Wastewater purification
6	Vohnja	4.1	2003	Wastewater purification
	Kihlevere	1.45	2003	Freeflow wastewater purification & constructed wetland
7	Väike-Maarja	0.2	1993	Wastewater purification. Practical use

2.2. Past. Productivity studies: Saare plantation



2.2. Past. Productivity studies: Saare plantation

		Annual production (t ha^{-1})	
		Average of 7 clones	Best clone
1st rotation period	Control	5,2	8,7
	Fertilised	11,0	14,7
2nd rotation period	Control	5,0	6,5
	Fertilised	7,4	10,9

2.2. Past. Productivity studies: Saare plantation

Results:

1. Fertilisation doubles growth (mechanism - allocation pattern changes)
2. Stability over 3 rotation periods
3. Clone differences. Clone susceptibility to pests differs on different sites

Conclusion: more emphasis needed to pests and disease studies

2.3. Past. Waste utilisation.
a. Municipal sludge disposal

Area: 0.44 ha of Nõo plantation

Municipal sludge: 6.3 t (d.w.)

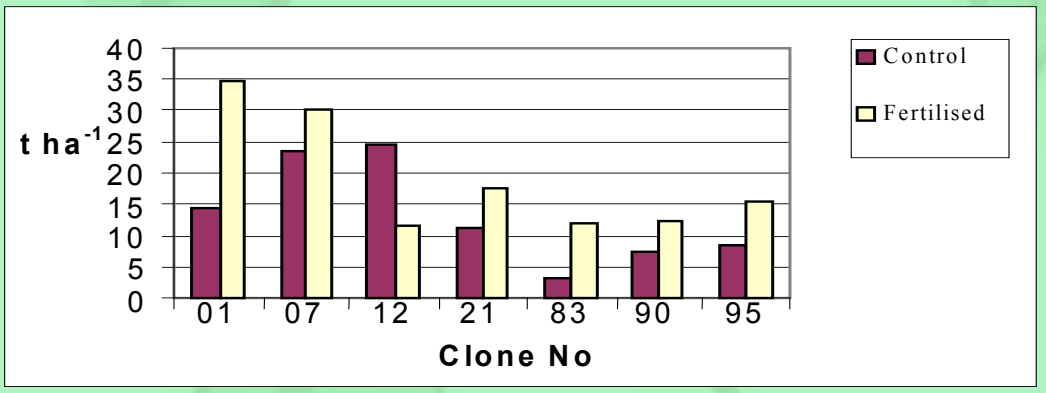
applied in May, 2001

N - 304 kg ha^{-1};

P - 217 kg ha^{-1};

K - 46 kg ha^{-1}

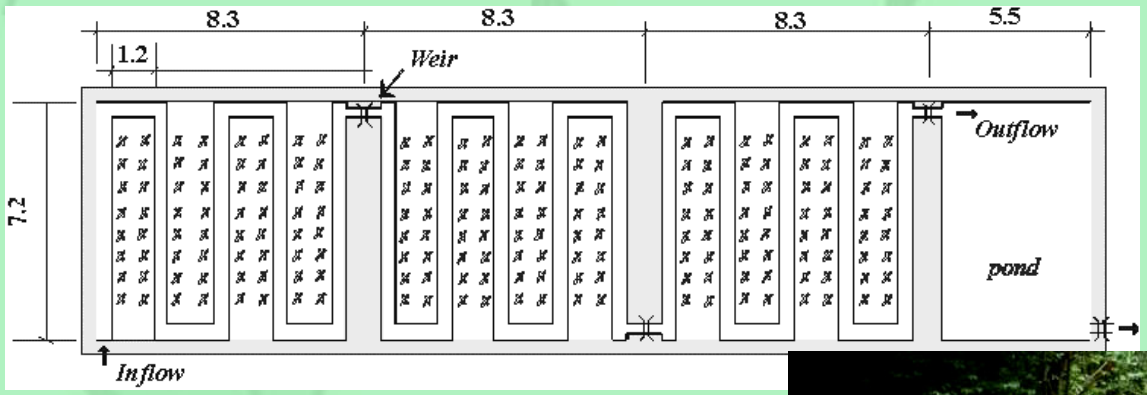
2.3. Past. Waste utilisation.
a. Municipal sludge disposal



Year	Depth (cm)	Plot	BOD7 (mgO l^{-1})	N (mg l^{-1})	P (mg l^{-1})
2001	10	control	<3,0	3,9	2,3
		fertilised	4,5	4,8	1,3
	40	control	<3,0	1,7	0,4
		fertilised			0,3
2002	10	control	<3,0	1,3	0,1
		fertilised	<3,0	2,8	2,1
	40	control	<3,0	2,7	0,4
		fertilised	<3,0	2,4	0,5

- Municipal sludge almost doubled shoot productivity
- Sludge application did not cause nutrient leakage to groundwater

2.3. Past. Waste utilisation. b. Wastewater purification



Period	BOD7	total-N	Total-P
1995	60	23	14
1996	72	29	19
1997	60	35	20
1998	60	41	18
1999	88	28	9
Average for the period	75	32	14

3. From past to present. Ongoing projects

- LIFE ENVIRONMENT demonstration project (2002-2005); 3 Estonian partners (EAU + 2 municipalities)
- EC 6FP CRAFT cooperation research project WACOSYS (2004-2006); Partners from 5 countries
- EC 6FW CRAFT cooperation research project BIOPROS (2005-2007); Partners from 9 countries
- Estonian MoAgr, MoEnv – “Estonian bioenergy programme feasibility study ”

LIFE Environment project – Sustainable wastewater purification in Estonian small municipalities

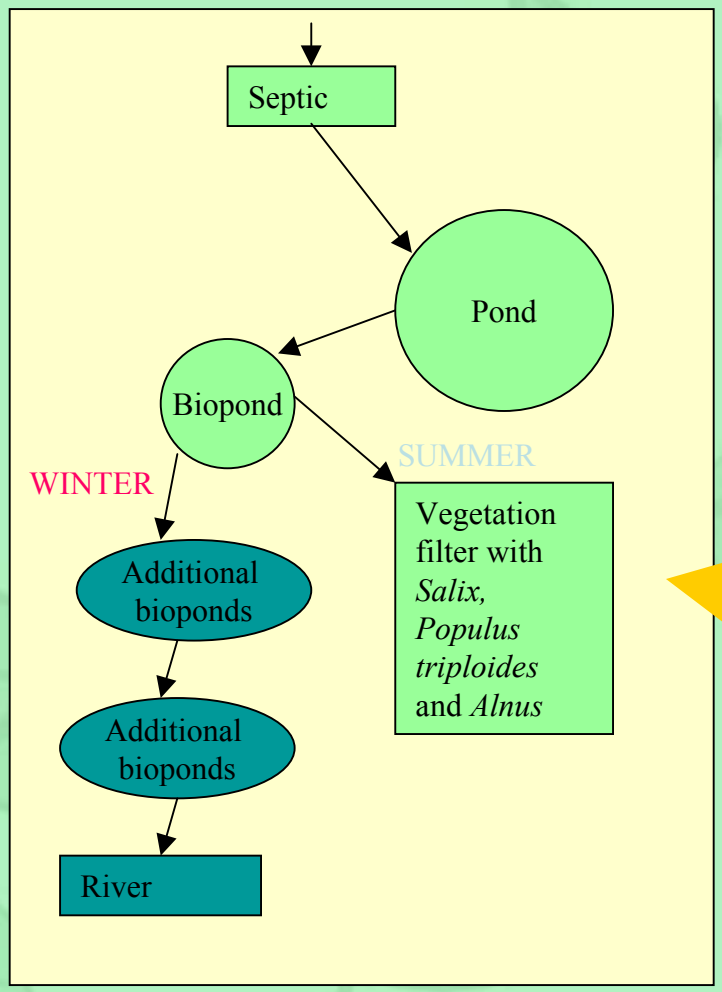
Aims

- Establish 3 different prototypes of wastewater purification systems in 3 rural settlements in Estonia
- To present the innovative sustainable wastewater purification system as one solution for local environmental/energy supply problems in Estonia

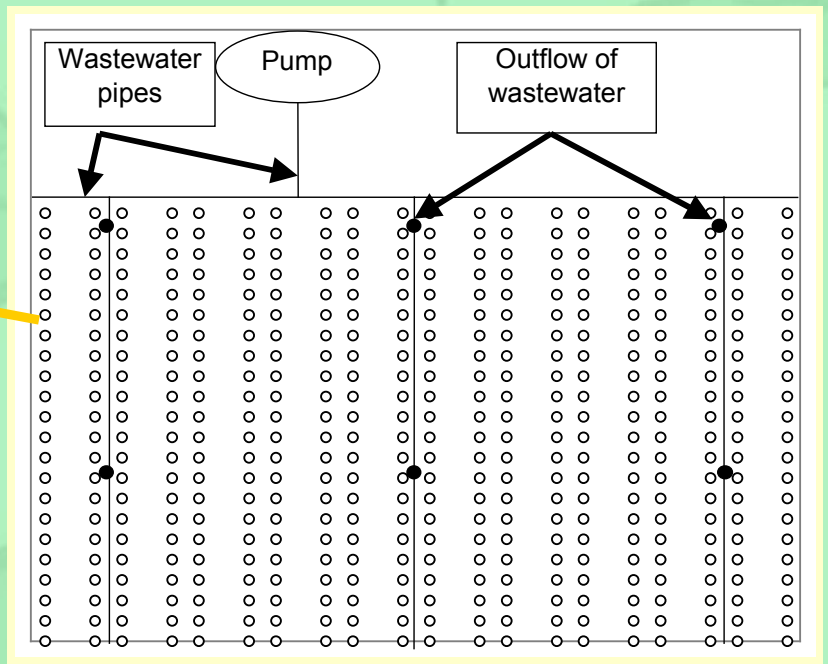
Some expected results

- Practical : Nutrient discharge to water bodies is lower than allowed threshold
- Improved knowledge: on vegetation filters, ecophysiology of different plant species and purification efficiency
- Dissemination

3. LIFE - Kambja prototype



- Ca 1000 PE
- 9.1 ha *Salix* (+5.0 ha control)
- 1.6 ha *Alnus* + *Populus*



3. From past to present
Wastewater purification & energy production Kambja prototype

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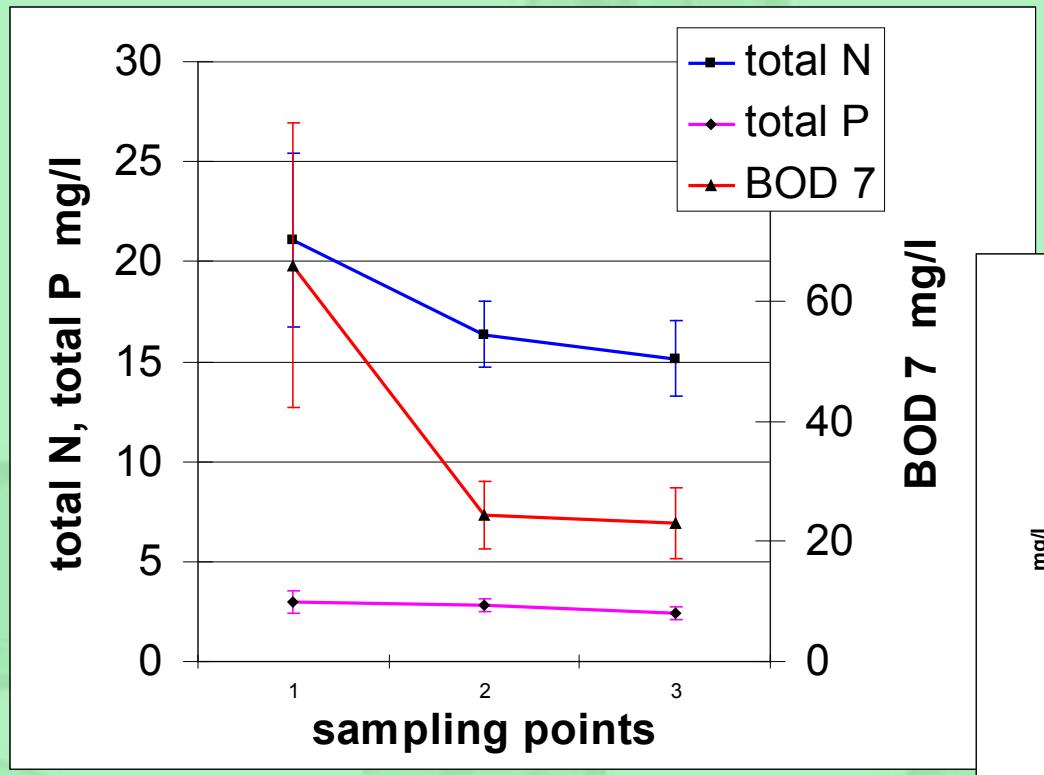
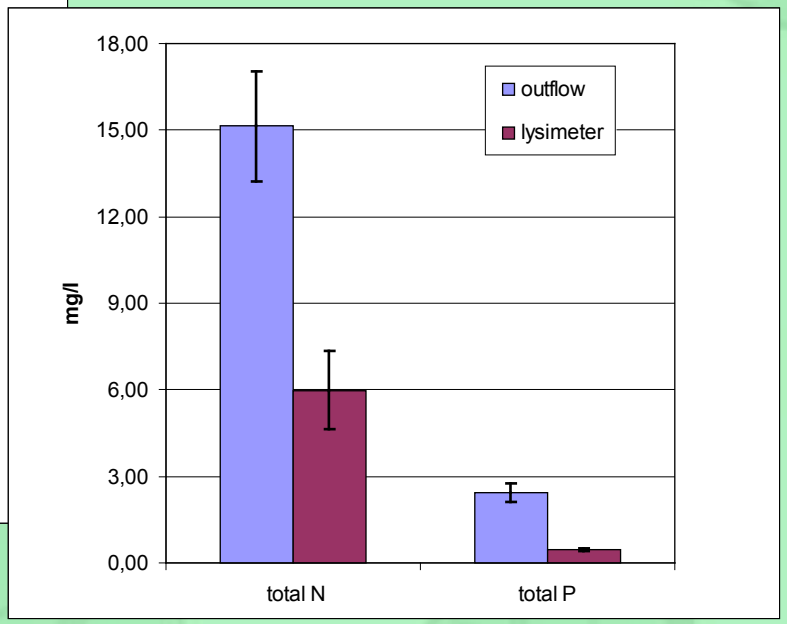
Wastewater purification & energy production Kambja prototype

- First results





WACOSYS - Monitoring and Control System for Wastewater irrigated Energy plantations

Aims

- Develop, test and optimise monitoring and control system for irrigation and fertilisation of SRP plantations with wastewater
- Guarantee efficient, low cost and sustainable production of combustible biomass products (pellets)
- Reduce wastewater treatment costs for small communities

Some expected results

- Local renewable CO_2 neutral energy sources created
- Surface and groundwater pollution avoided
- Water resources saved by reusing wastewater and closing the nutrient loop at local level
- Economy of rural areas strengthened
- New markets for renewable energy consumption

BIOPROS - Solutions for the safe application of wastewater and sludge for high efficient biomass production in Short-Rotation-Plantations

Aims

- Gain knowledge about the economic, ecological and technical feasibility of SRPs for different local conditions and market requirements
- Transfer it to their SME members (farmers, biomass processors, engineers, decisions makers)

Some expected results

- SRP biomass production throughout Europe and abroad will increase
- Better knowledge about a wide range of SRP aspects will be reached including SRPs' best practice and costs as well as related legislation and standards

Feasibility study of Estonian bioenergy programme 2005

KESKKONNAINVESTEERINGUTE K E S K U S

Aims & expected results

- Analysis of legislative background (Estonian, EU, incl. support schemes, environmental constraints)
- Results of the applied research: productivity, possible cultures
- Analysis of technologies (incl. production, combustion)
- Economical feasibility calculation
- Suggestion of methods for land resource evaluation
- Suggestion of the organisational structure for the commercial production chain

4. Future: Perspectives

- Estonian bioenergy programme?
- More co-operation in Estonian research community?
- Structural unit for renewables in EAU?

Thank you!

Estonian Agricultural University: www.eau.ee

More information on SRF studies in Estonia : www.zbi.ee/life/

Andres Koppel: andres.koppel@eau.ee

Katrin Heinsoo: katrin.heinsoo@eau.ee