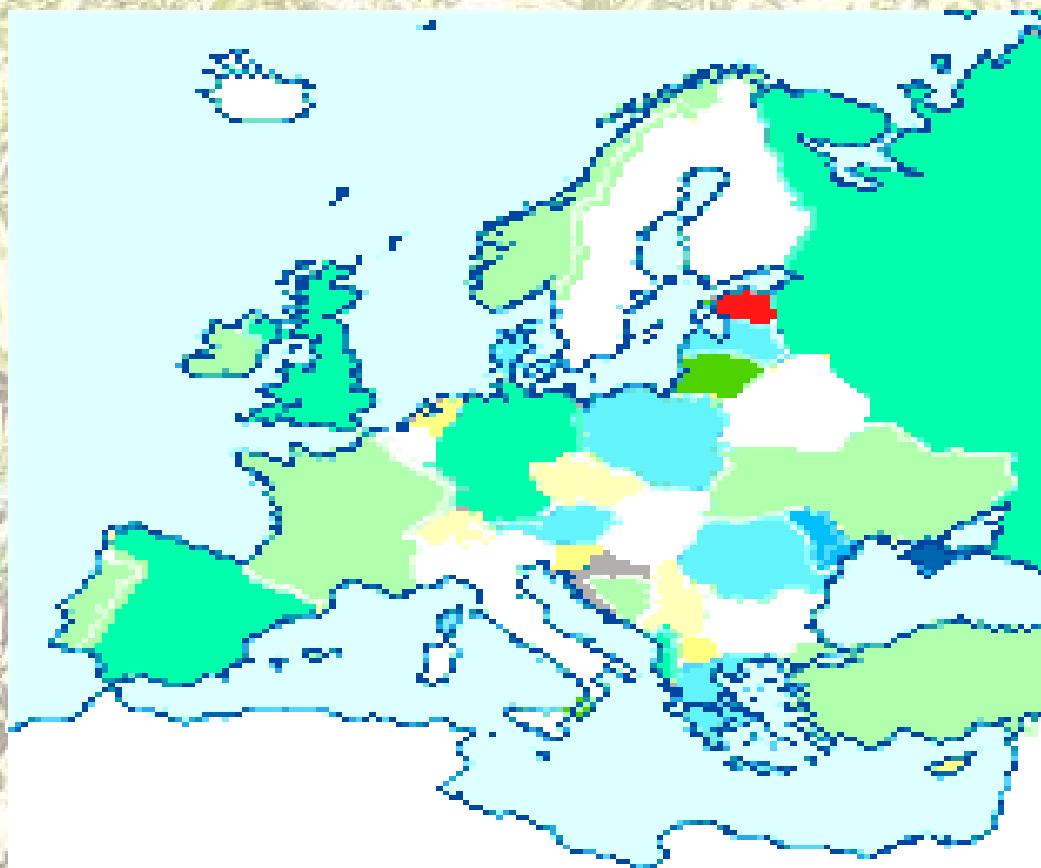


# Experiences of sustainable wastewater purification by *Salix* in Estonian small communities

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# Estonia



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## ***Temperature***

January :  $-7.0^{\circ}\text{C}$

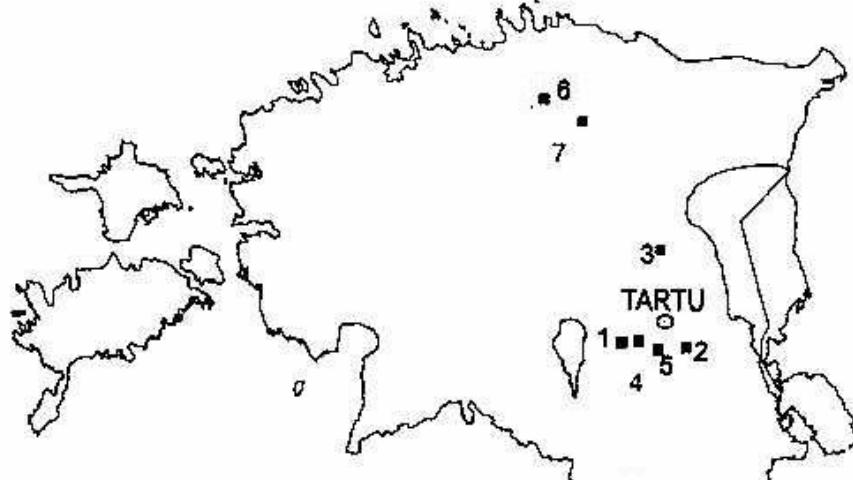
July :  $15.0^{\circ}\text{C}$

## ***Precipitation***

annual:  $670\text{ mm}$

during vegetation period:  
 $330\text{ mm}$

# *Salix* plantations in Estonia



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	0.4	1994, 1995	Municipal sludge utilisation
		0.4	2001	Clone selection
5	Aarike	0.18	1995	Wastewater purification
6	Vohnja	4.1	2003	Annual wastewater purification
	Kihlevere	1.45	2003	Freeflow wastewater purification & constructed wetland
7	Väike-Maarja	0.2	1993	Wastewater purification

# SRF plantation in Estonia - two goals

- Energy production



- Nutrient recycling

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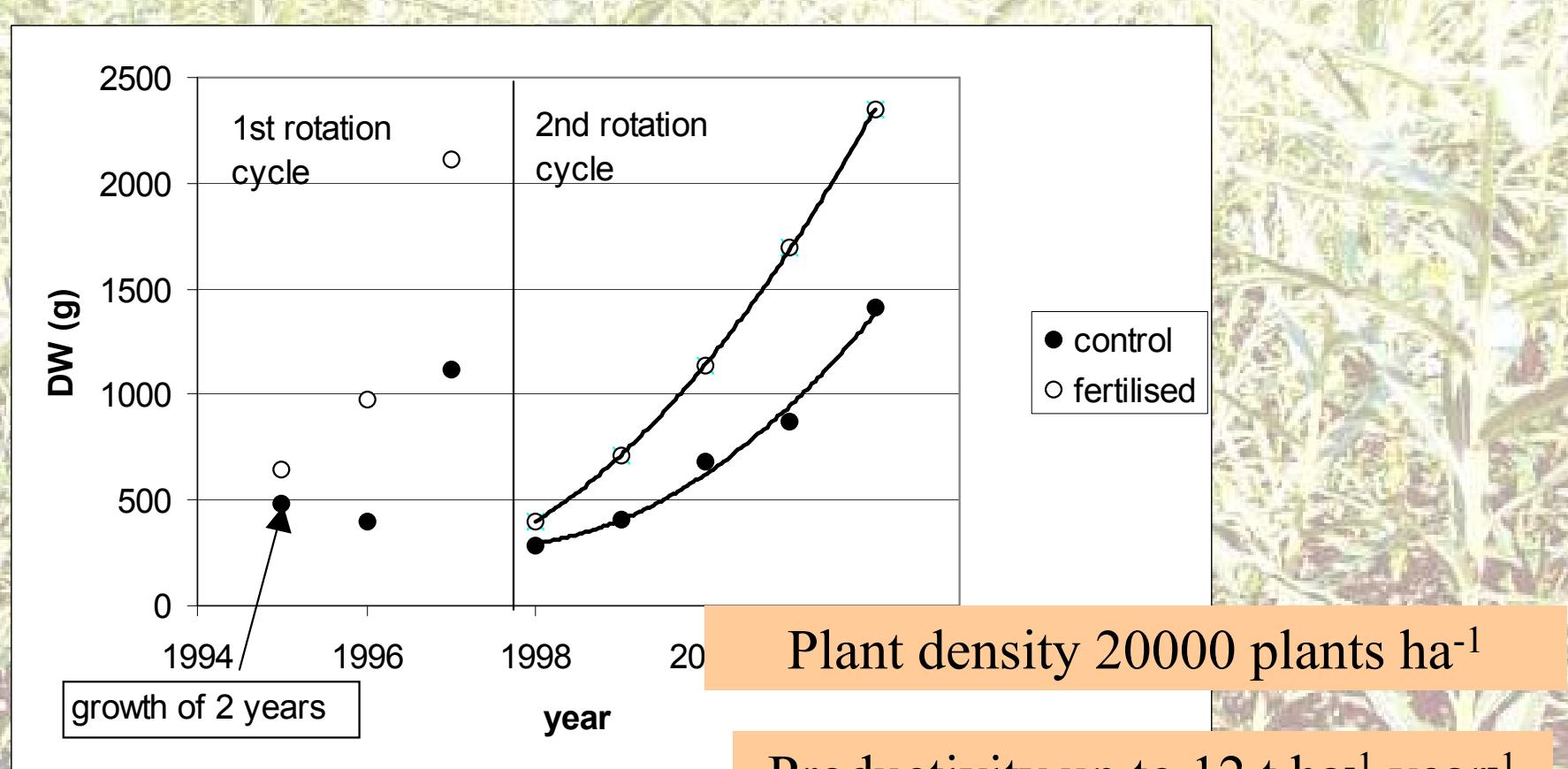
*Salix viminalis*



*Salix dasyclados*

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# Average annual production



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# Nõo plantation

Municipal sludge utilization studies



Area: 0.44 ha

Municipal sludge: 6.3 t (d.w.)  
applied in May, 2001

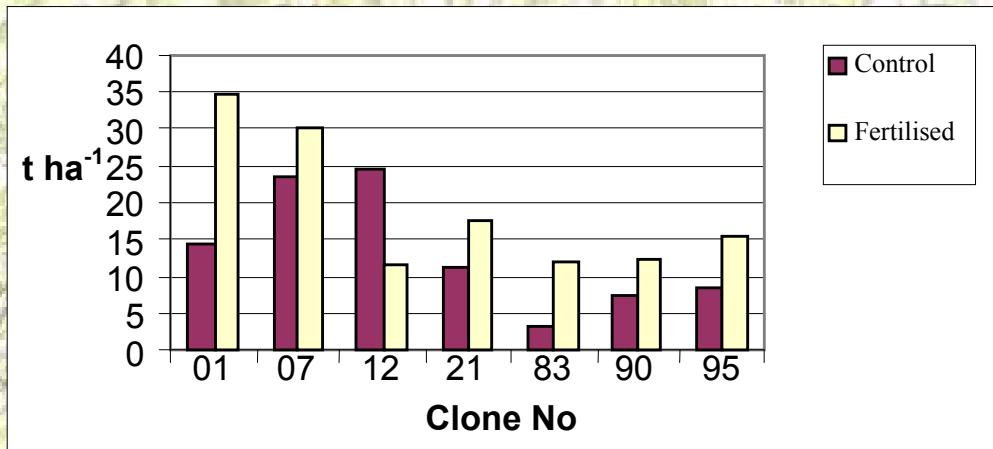
N - 304 t  $\text{ha}^{-1}$ ;

P - 217 t  $\text{ha}^{-1}$ ;

K - 46 t  $\text{ha}^{-1}$

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# Municipal sludge utilization

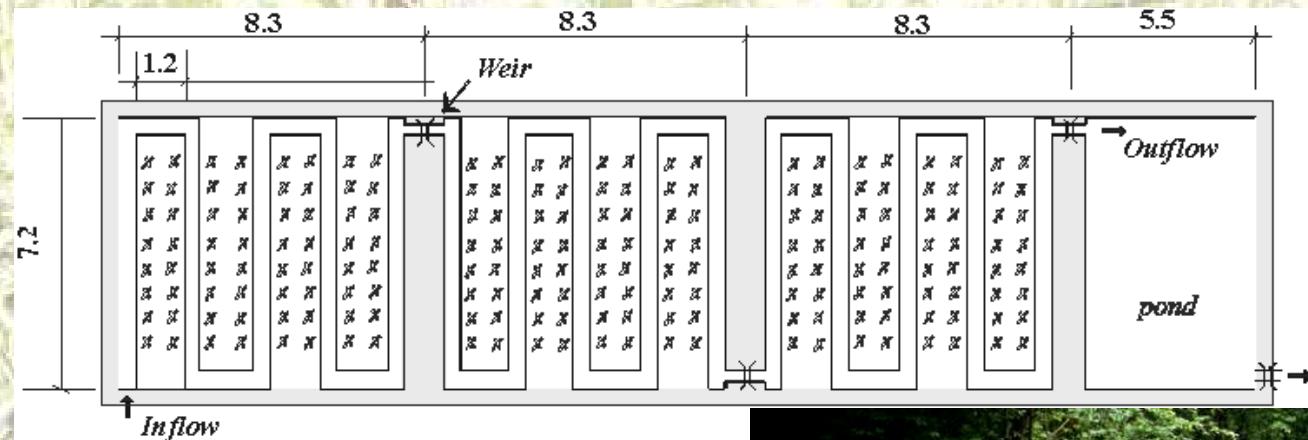


Year	Depth (cm)	Plot	BOD7 ( $\text{mg O l}^{-1}$ )	N ( $\text{mg l}^{-1}$ )	P ( $\text{mg l}^{-1}$ )
2001	10	control	<3,0	3,9	2,3
		fertilised	4,5	4,8	1,3
	40	control	<3,0	1,7	0,4
		fertilised			0,3
2002	10	control	<3,0	1,3	0,1
		fertilised	<3,0	2,8	2,1
	40	control	<3,0	2,7	0,4
		fertilised	<3,0	2,4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

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

# Aarike plantation

## Wastewater purification studies



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



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## Nutrient removal

No of plants	205
Average plant shoot growth g $y^{-1}$	750
Wood productivity (kg $y^{-1}$ )	154

	N	P
Purification efficiency (%)	32	14
Annual removal (kg)	35,0	2,1
Concentration in shoots (%)	0,74	0,07
Stored in shoots (kg $y^{-1}$ )	1,14	0,11
Removal in biomass (%)	3	5

# Kambja prototype

vegetation filter studies from  
2003



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# Kambja prototype

- Monthly analyses of total N, total P,  $\text{BOD}_7$ ,  $\text{NO}_3^{-2}$  and  $\text{NH}_4$

Mechanical treatment

Sedimentation pond

Biopond

WINTER

Additional biopond

Additional biopond

River

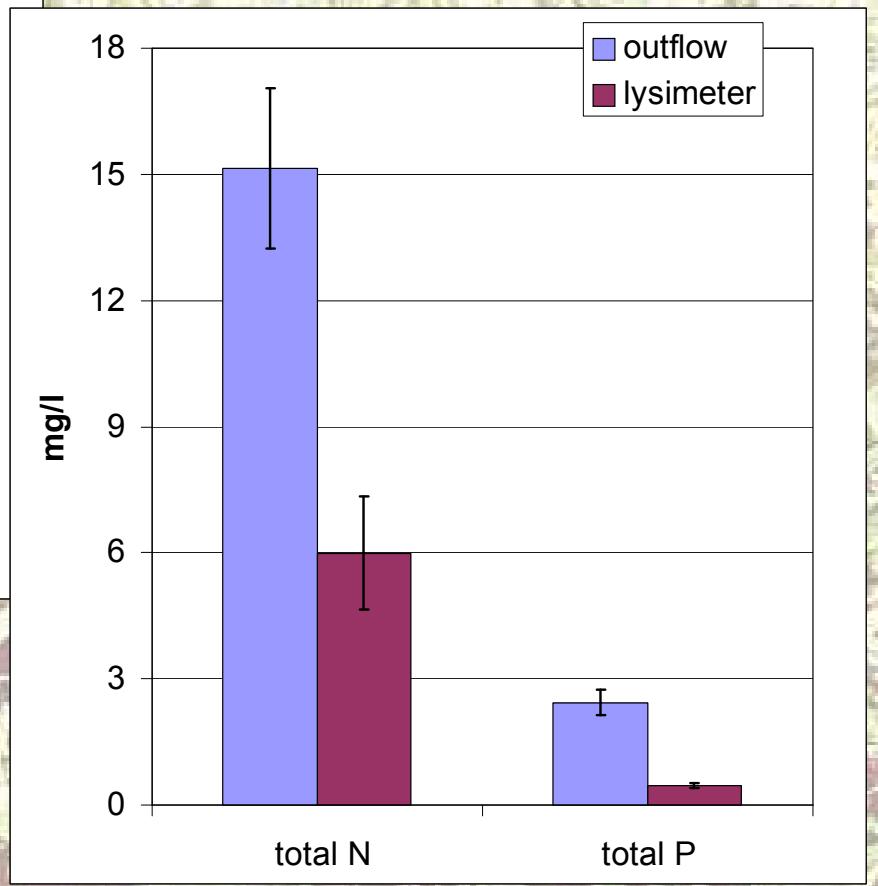
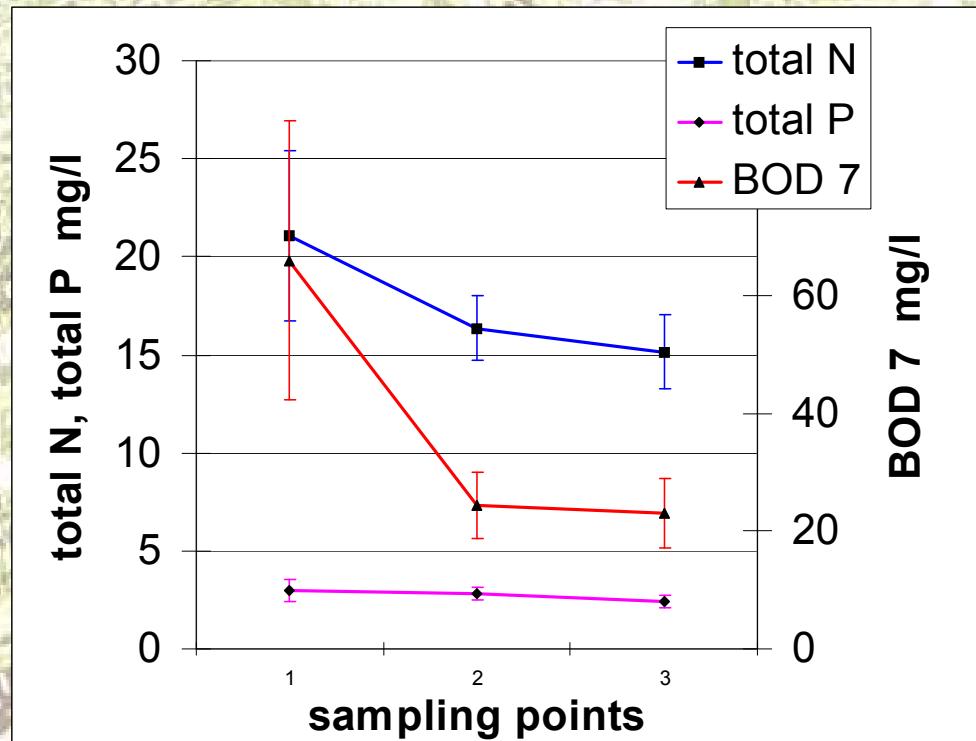
SUMMER

Vegetation filter with *Salix*,  
*Populus tremula f. gigas* and  
*Alnus*

- Water analyses from lysimeters
- Monitoring of plant growth

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# Kambja prototype



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# Conclusions

- *Salix* SRF plantations can be used in Estonian environmental conditions for both wastewater purification and sludge utilization
- Pollutants removal takes place both by plant uptake and by bacterial activity
- Sustainable wastewater purification with SRF has double benefit due to renewable biomass production

# Acknowledgements

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*Thank you for attention*

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