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SEINÄJOKI UNIVERSITY OF APPLIED SCIENCES



# MOISTURE CONTENT OF NORWAY SPRUCE STUMP WOOD AFTER HARVESTING

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**School of Agriculture and Forestry**  
**The Sustainable Forest Energy Project**  
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The European Agricultural Fund  
for Rural Development:  
Europe investing in rural areas



# INTRODUCTION

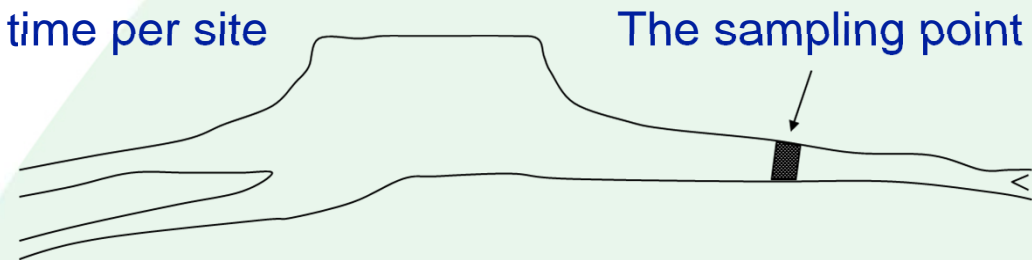
- Stump wood is an important source of bioenergy in Finland
- High energy content 130 - 250 MWh/ha
- Suitable fuel for large power plants
- Some positive effects on forest regeneration
- About half of the biomass of a living tree consists of water and from the point of view of energy production this water is unwelcome
- The aim of this study was clarify the moisture content of Norway spruce stump wood at the clear cutting areas immediately after stump harvesting and at the forest roadside storage sites after different drying times





# MATERIAL AND METHODS

- Samples from clear cutting areas and from forest roadside storages from four sites from Western Finland (2006 - 2009)
- ISO 589 “Hard coal – Determination of total moisture” (105 °C, 24 h)
- Eight samples per each collection time per site



Site	Latitude	Area, ha	Sampling time (calendar week number)				Samples
			2006	2007	2008	2009	
Jurva 1	62°37'N	9.7	27,33,43,50	17,46	24,34,42	4, -, -	80
Jurva 2	62°36'N	5.9	28,33,43,50	17,46	24,34,42	4,19,22	96
Jurva 3	62°37'N	3.9	29,33,43,50	17,46	24,34,42	4,19, -	87
Ähtäri	62°35'N	0.4	23,34,47,51	17,46	24,34,42	-, -, -	70
<b>Total</b>		<b>19.9</b>					<b>333</b>

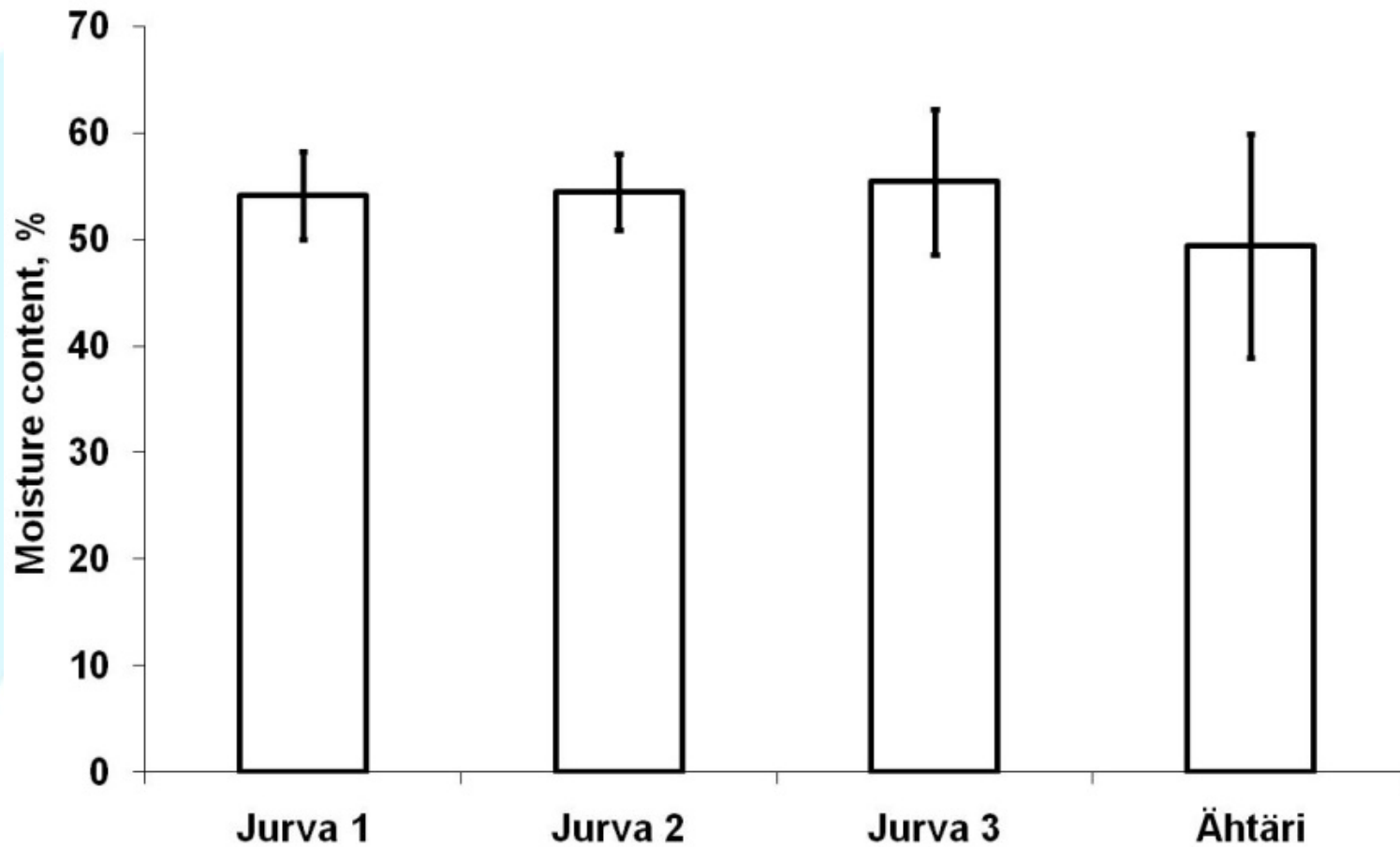


Piles in the clear cutting area, roadside storage and crushing of stumps

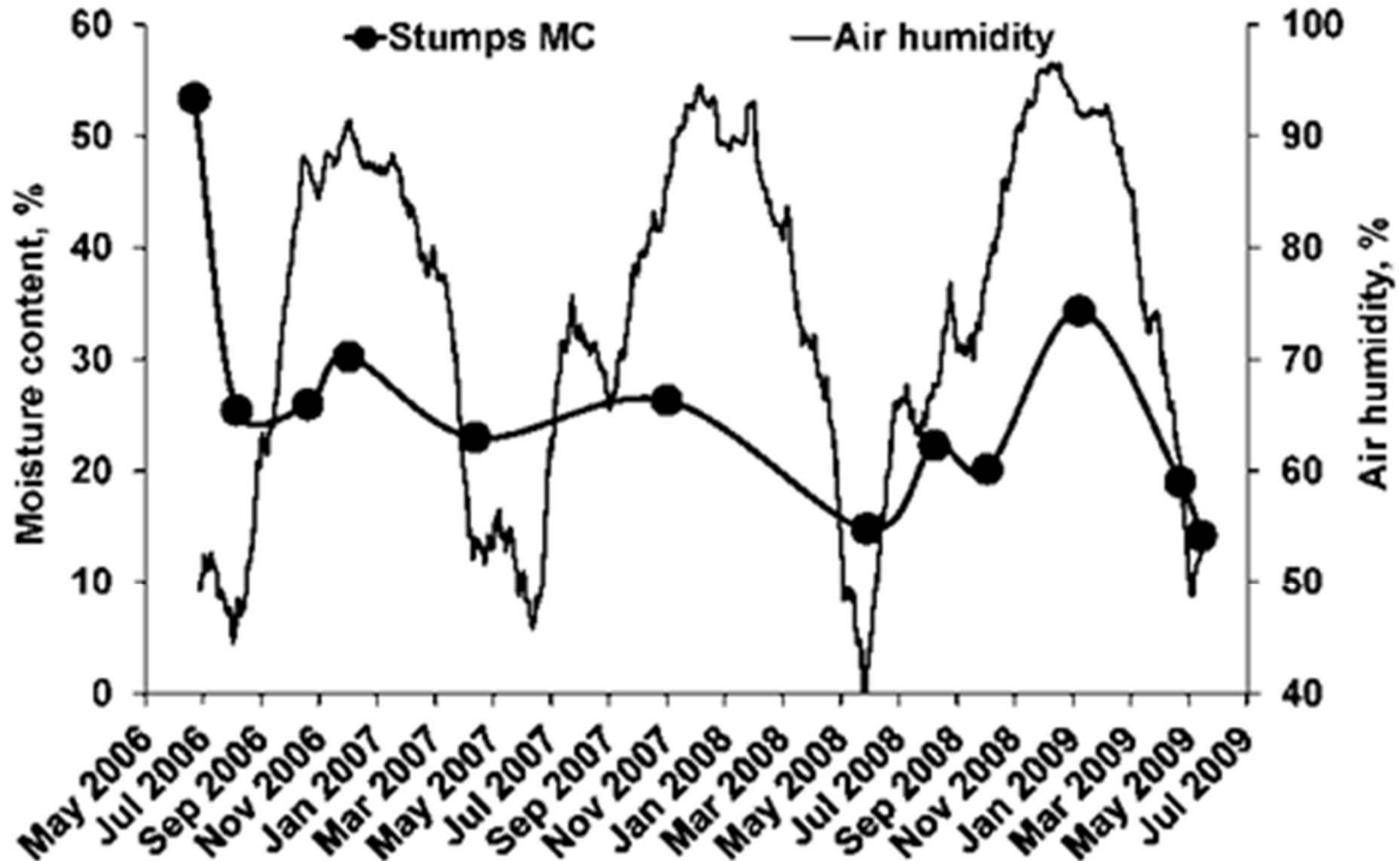




# RESULTS



Moisture content immediately after stump harvesting at the four sites.



Average moisture content of stump wood and air humidity as a function of time.



## Moisture Content Model ( $R^2=0.63$ )

$$MC = 0.0189 t_{wn} - 1.0694 AH_a - 0.0021 t_d^2 + 0.2499 T_a + 0.0375 t_d^2 - 0.7260 t_{wn} - 0.0340 t_d + 32.747$$

where:

MC = moisture content (wet basis)

$t_{wn}$  = calendar week number

$AH_a$  = air humidity (weekly average)

$T_a$  = temperature (weekly average)

$t_d$  = drying time in weeks



# DISCUSSION

- The most favourable time for stump harvesting is in the spring and early summer
- Immediately after stump harvesting the moisture content decreased fairly fast
- During the late autumn the moisture content increased, but not significantly
- Every spring and summer the MC was at a lower level compared to the previous year
- Many factors affect the moisture content of stump wood e.g. splitting method, structure of storage, shape of storage, weather and topography
- The stumps were combustible all year round except one month drying time immediately after harvesting

- The original research article is published in *Silva Fennica*: Vol. 44(3), 2010: 427-434.





# Thank you for your attention!

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