



EFORWOOD

Sustainability Impact Assessment
of the Forestry - Wood Chain



Project no. 518128

EFORWOOD

Tools for Sustainability Impact Assessment

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Thematic Priority: 6.3 Global Change and Ecosystems

D3.2.3 SI-data for harvesting operations based on 3.2.1 and 3.2.2

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PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Abstract

This deliverable concerns the documentation of how data and SI indicators are collected and formed for three test chains, namely Nordic Pine chain, Spruce chain and the Eucalyptus chain.

The logging systems in each chain was defined according to the principle of being a dominant system or a modern system that soon will be dominant. Cost and production estimates are presented in this document and are formalized according to cost calculation models.

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Introduction

This deliverable concerns the documenting of how data and SI indicators are collected and formed for three test chains, namely Nordic Pine chain (Skogforsk), Spruce chain (FVA, Baden-Württemberg) and the Eucalyptus chain (Afocel). This report is based on work organised according to PD3.2.1 Harvesting set of criteria and indicators and their measurement concerning input (energy, labour, and machinery and output (different wood and fibre products) and PD3.2.2 Description of the harvesting systems and method applied in the test chain with the necessary machines, labour and other resources.

These stages were reached through the interactions of partners 1 Skogforsk (Working Party-leader), 5 ALUFR, 7 STFI, 14 FR, 19 Afocel and 27 FVA. Meetings took place in Edinburg 8-11 May 2006, Uppsala June 8th 2006 and Freiburg September 6-8th 2006.

Methods applied

The logging systems in each chain was defined according to the principle of being a dominant system (Nordic Pine Chain and Spruce Chain) or a modern system that soon will be dominant (Eucalyptus chain). These choices have the merits it is easier to acquire reliable data for operations. The choice also relies on the assumption that other systems that exist, but not being dominant or modern, are there because they are not too different in performance. Other wise they should have disappeared. The calculations of performance data are done according to each institutes own routines.

Holzernte programme Version 7.0. Holzernte Kalkulationsprogramme für Holzernte und Holzvermarktung, FVA machine costs were calculated by an excel-based cost calculation model of a forest entrepreneur association.

- PROCOU, pour calculer le coût de différentes operations d'exploitation forestière
- Version 02/12/96, ARMEF (Afocel)
- Cost calculations. xlc , Skogforsk.

Holzernte is an ambitious product that apart from giving cost and performance data to forest operations also is a decision support system for harvesting and marketing in general as it also provides input or input interfaces about forest stands and some end products. "Procou" and "Cost calculations" are also excel-based computer routines for calculations of costs and performance. The latter can only handle harvesting and forwarding, Proucou has also other operations.

Each reporting institute calculate cost and performance according to there own routines as above. It was however agreed how input data should be treated.

Table 1.

Recommendations how input data should be treated.

Entity	content
Investment, €	<i>Actual investment on each market-</i>
Depreciation, years -	<i>1 year for motormanual equipment, 4 years for harvester, 7 years for forwarders</i>
Interest rate %	<i>- 4% based on Euromarket 6 months bonds 2001 - 2006 + 1,9 %</i>
End value, € -	<i>Actual value on each market</i>
Administrative costs	<i>allocated per PMH</i>
Social costs and taxes	<i>for labour</i>
Taxes machine	
Machine Hours -	<i>productive machine hours, PMH (related to work period according to each cost model) allocated per PMH</i>
Moving costs	<i>excl. taxes and social costs</i>
Labour cost/PMH	<i>costs for infrastructure roads and terminals allocated per PMH</i>
Infrastructure costs,	
Fuel use kg/pmh	<i>actual</i>
Use of lubricants kg/pmh	<i>actual</i>
Use of chemicals kg/pmh	<i>actual</i>
Fuel cost incl. taxes €/kg	<i>actual</i>
Lubrication cost incl. taxes €/kg	<i>actual</i>
Cost for chemicals incl. taxes €/kg	<i>actual</i>
Cost for maintenance (repair), €/PMH	<i>actual</i>
Cost for tyres, €/PMH	<i>actual</i>

Characteristics of harvesting operations

The main parts of harvesting operations are felling (cutting) and ground transport of roundwood (forwarding). Here harvesting operations also contain pre commercial harvesting, which in Nordic Pine Chain and Spruce Chain are early spacing in the young stand that is done with no purpose to bring in profits, rather to ameliorate the further production of the stand. Hence its attributes are not allocated to harvested cubic meters but treated hectares. In the Eucalyptus chain pre commercial thing is done directly in conjunction to harvesting and are attributed to those harvested cubic metres. Since the report PD 3.2.2 some traits in the Eucalyptus chain is changed. Apart from that the Characteristics for harvesting operations is as they were depicted in Deliverable PD3.2.2 and results from data collection are demonstrated in Table 2–4.

Table 2.

Characteristics for Nordic Pine Chain.

Pine chain	Operation	Equipment	Type of fuel etc. used	Personnel	Product
Pre commercial thinnings					
Cutting in young pine stands	Moving between sites, Removing of small trees	Any vehicle Power saw	Petrol or Diesel EU class(1–3)	One operator	At site treated ha/m
Harvesting chains					
Mechanized chain					
Final harvesting					
Mechanized cutting, large harvester	Moving between sites, Felling Debranching and Cross cutting Sorting to quality	Harvester /trailer, large harvester	Diesel EU class (1–3), lubes	One operator	At site, Logs at base road according to assortment size and quality
Forwarding, large forwarder	Moving between sites, Forwarding on base road	Large harvester, large forwarder	Diesel EU class (1–3), lubes	One operator	At site, Logs piled at roadside according to assortment size and quality
Thinning					
Mechanized cutting, large harvester	Moving between sites, Felling Debranching and Cross cutting Sorting to quality	Forwarder /trailer	Diesel EU class (1–3), lubes	One operator	At site, Logs at base road according to assortment size and quality

Table 3.
Characteristics for Spruce Chain.

Spruce chain	Operation	Equipment	Type of fuel etc. used	Personnel	Product
Pre commercial thinnings					
Cutting in young spruce stands	Moving between sites, Removing of small trees	Any vehicle Power saw	Petrol or Diesel EU class(1–3)	One operator	At site treated ha/m
Harvesting chains					
Motor manual chain					
Motor manual felling	Moving between sites, Felling of trees Debranching Cross cutting	Any vehicle Power saw	Petrol (1–2) or Diesel EU class (1–3)	One operator*	At site Whole trees Whole stem to pole length at top D>8 cm
Forwarding & cross cutting	Moving between sites, Skidding on base road Cross cutting Sorting to quality	Skidder/trailer Double winch wheel skidder Power saw Skidder	Petrol or Diesel EU class (1–3), lubes	One operator	At site, pole length trees, changed location pole length tree, top>12 cm, max 20 m length; side product: short logs (pulp & paper; panels; bioenergy) Sorted logs at roadside according to size and quality
Mechanized Cutting					
Mechanized cutting Medium harvester	Moving between sites, Felling Debranching Sorting to quality	Forwarder/trailer Medium harvester	Diesel EU class (1–3), lubes	One operator	At site, Felled tree Whole stem Logs
Forwarding Medium Forwarder	Moving between sites, Forwarding on base road	Forwarder/trailer Medium forwarder	Diesel EU class (1–3), lubes	One operator	At site, Logs piled at roadside according to assortment size and quality

Table 4.
Characteristics for Eucalyptus chain.

Eucalyptus chain	Operation	Equipment	Type of fuel etc. used	Personnel	Product
Harvesting chains					
Mechanized chains					
First harvesting					
Mechanized cutting, medium harvester	Moving between sites, Felling Debranching, debarking and Cross cutting Sorting to quality	Harvester /trailer, medium harvester	Diesel EU class (1–3), lubes	One operator	At site, Debarked logs at base road according to assortment size and quality
Forwarding, medium forwarder	Moving between sites, Forwarding on base road	Medium forwarder	Diesel EU class (1–3), lubes	One operator	At site, Logs piled at roadside according to assortment size and quality
Second or third harvest					
Motor manual felling	Moving between sites, Felling half of the trees, difficult for the harvester	Any vehicle Power saw	Petrol (1–2) or Diesel EU class(1–3)	One operator	At site Whole trees
Mechanized cutting, medium harvester	Moving between sites, Felling the other part of the trees Debranching, debarking and Cross cutting Sorting to quality	Harvester /trailer, medium harvester	Diesel EU class (1–3), lubes	One operator	At site, Debarked logs at base road according to assortment size and quality
Forwarding, medium forwarder	Moving between sites, Forwarding on base road	Medium forwarder	Diesel EU class (1–3), lubes	One operator	At site, Logs piled at roadside according to assortment size and quality

Cost and performance data from forest operations

Results concerning calculated costs and performances are demonstrated in Tables 5–7.

Table 5.

Cost and performance in Nordic Pine Chain (na = not available; nr= not relevant).

	Pre commercial thinning	Final felling, large harvester	Final felling, large forwarder	Thinning, large harvester	Thinning, medium forwarder
Resources kg /PMH fuel	1,82	11,8	10,7	11,8	8,2
Resources kg /PMH lubricants	0,07	0,7	0,4	0,7	0,3
Resources kg /PMH misc. chemicals	0	na	na	na	Na
Roads m/ha forest area	9,23	9,23	9,23	9,23	9,23
Cost €/PMH Infrastructure, roads & terminals	na	na	na	na	na
Cost €/PMH moving	na	1,0	0,8	2,0	1,8
Cost €/PMH administration	na	na	na	na	na
Cost €/PMH personnel	27,2	26,0	23,1	26,4	23,4
Cost €/PMH machine	1	43,0	20,8	43,3	15,5
Cost €/PMH sum of fuel, lubricants and chemicals	2,6	18,5	16,0	18,5	12,1
Total Cost €/PMH	30,8	88,5	60,7	90,2	52,7
Cost €/m³ sub	nr	2,40	3,97	5,40	3,77
Cost €/ha (7,04 PMH/ha)	217	nr	nr	nr	nr
m³sub/PMH	nr	37	15,3	16,7	14,0
Time (PMH)/m³	nr	0,027	0,065	0,060	0,071

Table 6.

Cost and performance in Spruce Chain (na=not available; nr =not relevant).

	Pre commercial thinning	Motor manual felling	Motor manual forwarding and crosscutting	Mechanized cutting, medium harvester	Mechanized forwarding, medium forwarder
Resources kg /PMH fuel	0,975	0,975	5,88	10,92	8,4
Resources kg /PMH lubricants	0,45	0,45	0,45	0,54	0,45
Resources kg /PMH misc. chemicals	na	na	na	na	na
Roads m/ha forest area	52	52	52	52	52
Cost €/PMH Infrastructure, roads & terminals	na	na	na	na	na
Cost €/PMH moving between sites	na	na	na	na	na
Cost €/PMH administration	2	2	1,2	6	2
Cost €/PMH personnel	26	26	26	29	26
Cost €/PMH machine	2,23	2,23	33	84	31
Cost €/PMH sum of fuel, lubricants and chemicals	2,76	2,76	8,07	15,9	14,2
Total Cost €/PMH	33,0	8,0	68,27	134,9	73,2
Cost €/m³ sub	nr	1,44	6,83	6,75	4,90
Cost €/ha (1 PMH/ha)	33,0				
m³sub/PMH		37	15,3	16,7	14,0
Time PMH/m³ sub	1	0,18	0,1	0,05	0,067

Table 7.
Cost and performance in Eucalyptus Chain (na= not available; nr not relevant).

	First harvesting			Second or third harvest	
	Mechanized cutting medium harvester	Forwarding, medium forwarder	Motor manual felling	Mechanized cutting medium harvester	Forwarding Medium forwarder
Resources kg /PMH fuel	na	na	na	na	na
Resources kg /PMH lubricants	na	na	na	na	na
Resources kg /PMH misc. chemicals	na	na	na	na	na
Roads m/ha forest area	na	na	na	na	na
Cost €/PMH Infrastructure, roads & terminals	na	na	na	na	na
Cost €/PMH moving between sites	12,2	12,2	4,5	12,2	12,2
Cost €/PMH administration	3,5	3,7	4,7	3,5	3,7
Cost €/PMH personnel	17,7	18,4	22,5	17,7	18,4
Cost €/PMH machine	35,3	18,4	2,9	35,3	18,4
Cost €/PMH sum of fuel, lubricants and chemicals	6,65	3,38	1,80	6,65	3,38
Total Cost €/PMH	75,4	56,5	36,4	75,4	56,5
Cost €/m³ sub	5,05	3,78	0,24	6,25	5,65
Cost €/ha (1,33PMH/ha with 200 m³sub/ha)	nr	nr	27,3	nr	nr
m³sub/PMH	14,9	14,9	150,3	12,0	10,0
Time (PMH)/m³ sub	0,067	0,010	0,07	0,083	0,010

ToSIA indicators for test chains

The WP 3.2 has completed indicators for which data were available. The Indicators were based on Sets of Indicators 1 to 3 as given in Deliverable PD3.2.1, During the course of time further work on indicators brought and will bring forward more refined set of indicators (sets 4 and 5 are still under development) Figure 9.

The actual set of indicators are presented in table 8 below.


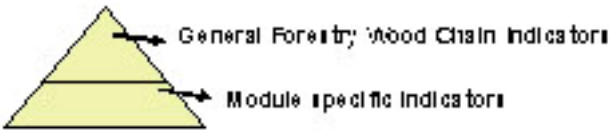

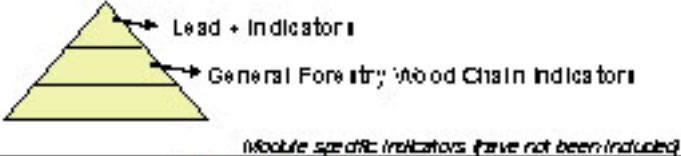

Table 8.

Gross set of indicators for this deliverable.

LI 2a Production cost of process inputs from the FWC
LI 2b Other production costs
LI 10a Employment male
LI 10b Employment female
LI 10c Employment rural
LI 10d Employment urban
LI 11a Wages and salaries male
LI 11b Wages and salaries female
LI 15a Energy generation (from process inputs)
LI 15b Energy generation (from other wood biomass)
LI 15c Energy use (renewable)
LI 15d Energy use (non-renewable)
LI 15e Energy use/ share self-sufficiency
LI 16b Carbon sequestration in woody living biomass (above and belowground)
LI 16c Carbon sequestration in woody dead biomass (standing and lying)
LI 16d Carbon sequestration in forest soils
LI 16e Carbon sequestration in harvested wood products
LI 16a Total greenhouse gas emissions per process
LI 4a Resources and material use (wood material)
LI 4b Resources and material use (non-wood material)
LI 4c Resources and material use (recovered raw material)
LI 12a Occupational accidents (non-fatal)
LI 12b Occupational accidents (fatal)
LI 12c Occupational diseases
LI 13a Education time per person-year working time in the process
LI 13b Education expenditure per person-year working time in the process
LI 17a Transport distance road transport
LI 17b Transport distance rail transport
LI 17c Transport distance water transport (inland waterways and sea)
LI 17d Transport distance air transport
LI 17e Freight volume road transport
LI 17f Freight volume rail transport
LI 17g Freight volume water transport (inland waterways and sea)
LI 17h Freight volume air transport
LI 18a Water use in total
LI 18b Water pollution with organic substances
LI 18c Water pollution with nutrients
LI 18d Water pollution with hazardous substances

Table 9.

Progress of sets of indicators for sets 1 to 4 further to come. Figure after Ewald Rametsteiner (proposal).

	<p>Draft Set 1 (Feb 2006)</p>
	<p>Draft Set 2 (March 2006)</p>
	<p>Draft 'Lead + Indicator' Set (May 2006)</p>
	<p>Draft Set 3 (July 2006)</p>
	<p>Draft Set 4 (October 2006)</p>

References

General forestry

Cost calculations. xls, Skogforsk.

Holzernte programme Version 7.0. Holzernte Kalkulationsprogramme für Holzernte und Holzvermarktung, FVA.

PROCOU, pour calculer le coût de différentes operations d'exploitation forestière

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PD3.2.1 Harvesting set of criteria and indicators and their measurement concerning input (energy, labour, and machinery and output (different wood and fibre products).

PD3.2.2 Description of the harvesting systems and method applied in the test chain with the necessary machines, labour and other resources.