Cost reduction and efficiency improvement of Short Rotation Coppice (CREFF)

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Cost reduction and efficiency improvement of Short Rotation Coppice (CREFF)

on small field sizes and under unfavorable site conditions by focusing on high product quality and a product-oriented cooperative value chain

ERA-NET kick-off meeting
Potsdam, Germany, September 9, 2008

Present geopolitical and environmental world context:

- Rarefaction of fossil fuels
- Needs to reduce CO_2 emissions

➔ **Promotion of renewable energy**
➔ **Biomass**
➔ **Short Rotation Coppice (SRC)**


Up to recently, slow development in Europe due to non competitive profits as compared to non-energetic cultures

- Expensive plant material
- Plant breeding and optimization of species-site matching needed
- High harvest and transport costs

➔ **Necessity to reduce production and supply costs**


- At present, research results available for:
  - medium to good sites
  - for large field sizes
- Such conditions rarely found in many regions of Central Europe:
  - **Good sites** rare and expensive and used for demanding annual crops
    ➔ SRC on less favorable sites in terms of soil quality and forms (small stripes along creeks or forests)
  - Average **sizes of fields and farms** much smaller than in UK and south-Sweden
    ➔ SRC in small field sizes, at scattered locations and on unfavorable sites


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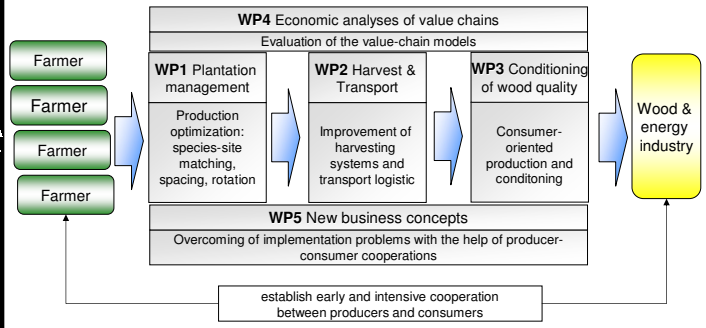
➔ To promote the use of biomass from SRC, **optimized SRC value chains for unfavorable conditions have to be found**

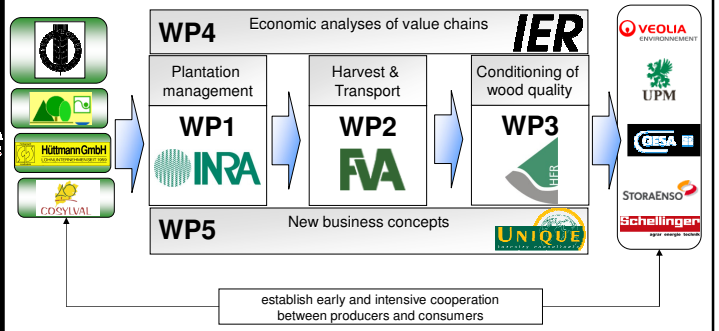
Approach:

- Initialization of intensive and early co-operation between producers and consumers
- Concentration of the SRC-production inside these co-operations to the requirements of industrial consumers
- Based on the known value chain structures, streamlining of all major processes like the production, harvest and logistics, and conditioning of SRC-products
- Design of improved local SRC value chains with help of real pilot co-operations of producer and consumer
- Evaluation of economic and socio-economic aspects of improved local SRC value chain scenarios

Approach:



A complementary consortium:

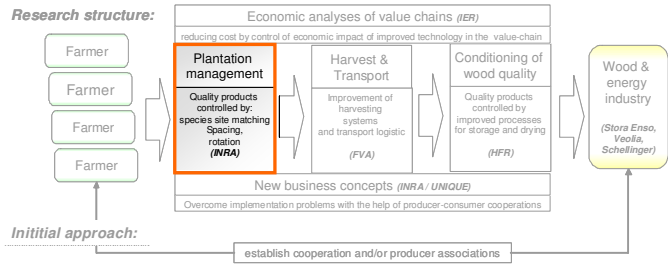


General results:

➔ Development of strategies allowing a major cost reduction and a higher efficiency even for areas in Central Europe characterized by less favorable conditions for SRC-production

➔ Implementation of the results in the course of the project through the establishment of pilot cooperatives of SRC-producers and industrial consumers (show-cases for new efficient strategies fostering a wider implementation of SRC)

WP1: Cost optimization through site adapted plantation management



1. State of the art

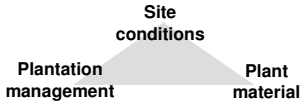
SRC, a particular forest ecosystem

- **Little biomass accumulation**
- **Regular young wood exportations, without residuals, implying a rapid soil depletion**

➔ **Necessity to optimize and to sustain biomass production while preserving soil richness**

2. Problem

SRC, a particular forest ecosystem

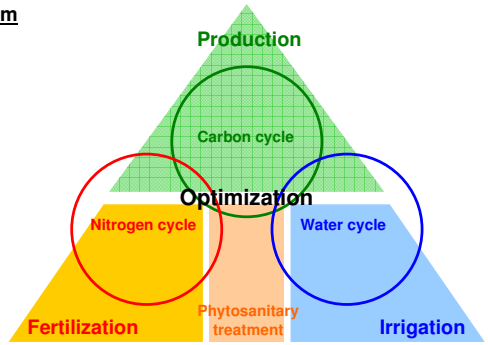


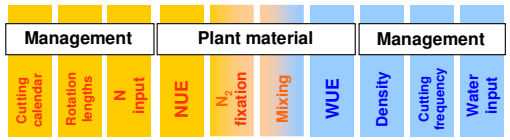
Adequate / optimized matching

➔ **Reduction of input needs**

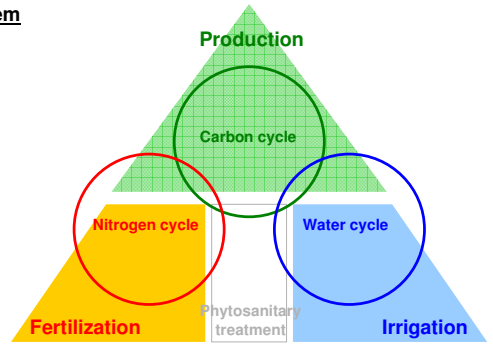
➔ **Reduction of associated costs**

2. Problem

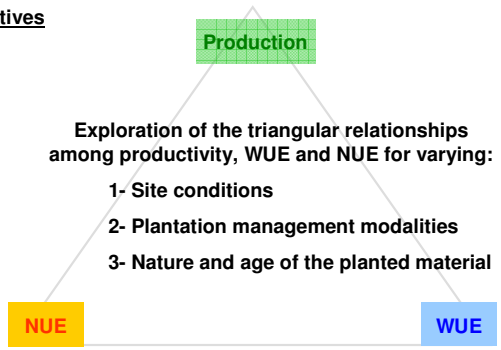




2. Problem



3. Objectives



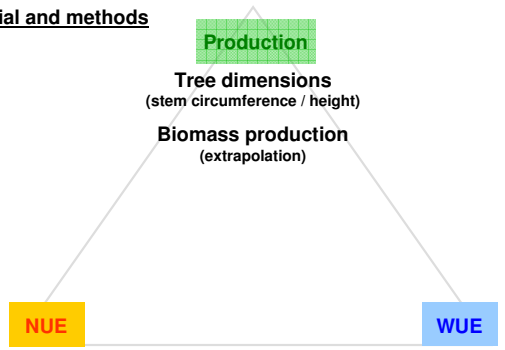
Exploration of the triangular relationships among productivity, WUE and NUE for varying:

1- Site conditions

2- Plantation management modalities

3- Nature and age of the planted material

4. Material and methods



= Nutrient-use efficiency
= Biomass production
/ Nutrient content

➔ Estimation of the wood/leaf contents in N, P, K, Ca, Mg by elemental analysis

= Water-use efficiency
= Biomass production
/ Water consumption

➔ Estimation via the wood/leaf content in carbon 13 by mass spectrometry

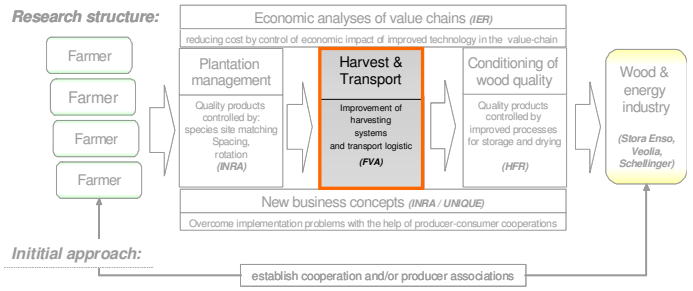
4. Material and methods

- **Potential sites:**
  - **Germany**
  - **France**
  - **Austria**

- **Potential species:**
  - **Poplar** - ***Populus***
  - **Willow** - ***Salix***
  - **Black locust** - ***Robinia***
  - **(Alder** - ***Alnus*****)**

➔ **Inventory and selection**

WP2: Improvement of harvesting systems and transport logistic related to specific site conditions



1. Problem

SRC is often uneconomical!

→ Costs have to be reduced!

→ Harvesting & Transport can cause < 90% of total SRC costs

- especially on small field sizes, steep and wet areas
- full-mechanised harvesting is often not possible or uneconomical
- semi-mechanised or feller-buncher harvesting are often not cost-efficient enough so far and need to be improved
- scattered SRCs of a small field size need to be included in an effective logistic system to reach an economical SRC management

2. State of the art

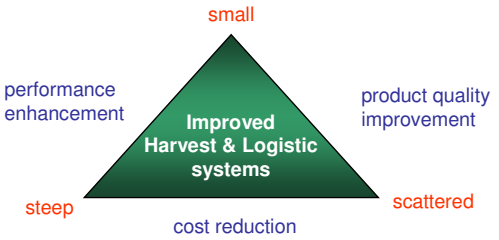
- No large scale experience for harvesting systems so far
- Especially with harvesting and logistics of SRC products on small size fields and with longer rotation periods (> 5 years)
- Tests up to now mainly for forage harvesters; only few for semi-mechanised and motor-manual methods (Burger and Scholz 2004, Textor and Wilwerding 2003)
- Little experience with logistics for combined harvesting of several small scale plots.

Burger, F.; Scholz, V. (2004): Stand der Technik bei der Ernte von Energiewäldern. Holz-Zentralblatt 130 (46), 610-611.

Textor, B.; Wilwerding, A. (2003): Cultivation, allocation and energetic use of woody biomass. (Anbau, Bereitstellung und energetische Nutzung holzartiger Biomasse. Praxisversuch "Energieproduktion und Verwertung"). Versuchsbericht der FVA 2003/3.

3. Objectives

"Development of improved and economically viable SRC harvesting and logistic systems which are adapted to the particular site conditions" (focus on small field sizes and unfavorable site conditions)



4.1 Material and methods (1)

The three commonly used **harvesting systems** (forage harvester, feller-buncher, motor-manual) will be analyzed under different **site conditions** (steep, wet, small field size, etc.) on 50 SRC-plantations in Germany, Austria and France

Their **capacity** and **production cost** will be analyzed using **time-studies**;
the **quality** of the wood chips will be compared and analyzed in the **laboratory**.



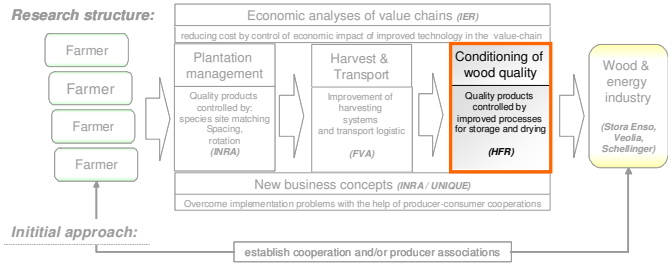
4.2 Material and methods (2)

Different **means of transport** of the SRC wood to its processing place will be analyzed under different **circumstances** (distance, reloading points, field storage, etc.)

New efficient logistic models will be developed using the results of all WP and with a focus on widely scattered small size SRCs.



WP3: Value added conditioning of SRC raw material



1. Problem

raw material from SRC often shows different properties in comparison to traditional wooden material, for instance:

- higher percentage of bark
- higher content of minerals

Aspects:

- very cost sensitive material
- quality parameters for different applications (e.g. pellet, pulp) are characterised and defined insufficient
- technical instructions are not existing (SRC material)
- losses of quality while raw material storing
- standardized conditioning methods must be developed for …
  storage / dimensioning / drying … of wood chips

2. State of the art

- insufficient information on quality issues regarding utilisation in the energy sector or as fibrous raw material
- quality aspects are often excluded in the price formation process
- still unsatisfactory conditions for the storage of wood chips from SRC
- previous simulations could not simulate all the relevant conditions of storage
- inhomogeneous raw material because of the small SRCs

(LECHNER et al. 2004; CREMER et al. 2007; BÜCHELE 2007; MAHR 2001; SCHILL 2001; PELZ 2004; PELZ et al. 2006; KIRSCHBAUM 1998; SCHOLZ et al. 2006)

3. Objectives

- identify and characterise conditioning technologies and processes, which increase the product quality in terms of different utilisation paths (energy-, pulp- and wood-industry)

Decision Support System
Technical Instructions
} for conditioning raw material

- simulation of storage:

→ different raw material qualities and storage possibilities under different material and climate conditions

4.1 Material and methods

- tagging and systematise properties and quality parameters characterising important end product requirements

- workshops
- research background

- developing a set of standardized evaluation methods for key parameters
- design of a device to simulate the behaviour of wood chips under different conditioning scenarios

- laboratory
- workshops
- research background

4.2 Material and methods

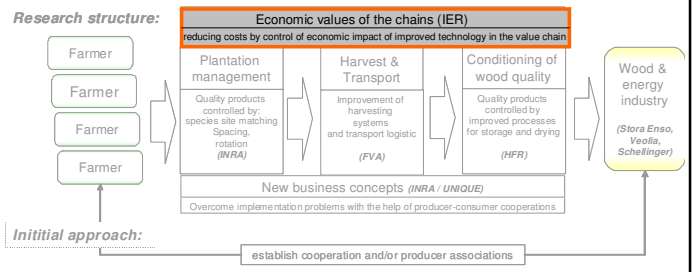
- identifying and developing best practise methods of storage, dimensioning and drying wood chips
- detection of technical and economical constraints for productive and efficient technologies

- industrial experience
- research background
- inquiries

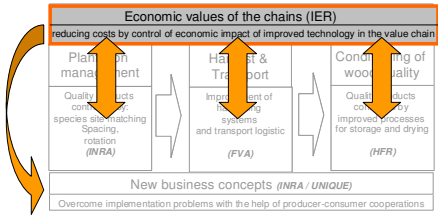
- describing productivity and cost efficiency of different technologies
- compilation of a decision support model for storing and conditioning measures
- design of technical instructions (Quality Management System) with cost efficient assessment methods

- pilot studies at installations of the industrial partners

WP4: Economic and socio-economic evaluation of SRC-value chain



Strong relations amongst the WP4 and the WP1 – 3 and 5



1. Problem

- For an optimization of the supply chain for wood from SRC the different parts of the chain (production, provision and conditioning) have to be connected
- The costs of wood supply chains based on sites with non favorable site conditions (slope, quality, water and nutrition supply) is not well known

2. State of the art

- A few studies and examinations about cost of parts or the process chain like the production (planting, management) or the provision (harvesting) exist
- No overall and comprehensive information about product oriented wood supply **chains** for CHP
- The aspect of product orientation as well as the aspect of non favorable field location and sizes cannot be found in the chain analysis

3. Objectives

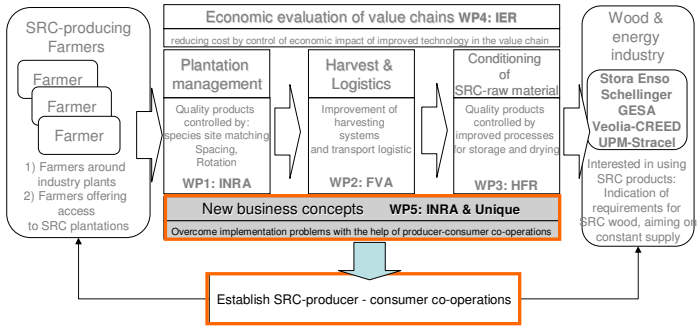
- the determination and the assessment of the costs of different options of wood production in short rotation coppice (SRC) and the development of market and prices of energy wood
- the analysis of the effects of area characteristics (location, area size a. o.) and other factors (work intensity, amount of pestizides, transport distance) on the feasibility of SRC
- the assessment of additional economic (added values through by-products) and socio-economic benefits (employment effects) of the most important value chains and frame conditions
- the estimation of mid-term developments and the cost optimization potentials connected to these developments
- definition of optimized production and provision chains with respect to costs and ecological aspects (GHG-emissions)

4. Material and methods

Based on input from the WP1 – 3 about process chain related cost categories like machine hours and material flows (fertilizer, pesticides etc.)

- Definition and characterization of typical products (bundles or chips, high or low moisture content, etc.) and systems
- Cost balance of the different production and provision systems
- Emission balances and related environmental costs
- Balance of employment effects and other macroeconomic aspects (added values)
- Definition of optimum production and provision systems with respect to the costs and ecological aspects

WP5: New business concepts for successful implementation of a consumer-oriented wood-fuel value chain from SRC



1. Problem

- In many areas of central and western Europe the SRC-production is still in its infancy and a very "exotic" topic for farmers – explicitly in our main study area (South-West Germany and North-East of France).
- Biomass from SRC often seems not known or not accepted by wood fuel consumers or the wood industry.
- Even in the past two years with rising prices for wood and growing demand for wood, there are obvious many **constraints and problems for farmers to invest in SRC**.

2. State of the art

- Lack of "implementation oriented" research along the supply- and value-chain with a focus on the implementation problems.
- Lack of research with a "case-study approach":
  - Meaning working with main stakeholders = SRC producer-consumer groups
  - trying to work-out optimal business concepts in close cooperation.
- Results from field-research are rare (i.e. Dendrom, Agrowood*) and missing for the specific conditions in our study-area (South-West Germany & North-east France).

* Lit.:
Kröber et al.(2008): DENDROM, Beiträge zur 3. Fachtagung.
Skodawessely; Pretzsch (2008): DENDROM, Beiträge zur 3. Fachtagung.
Gerold et al.(2006): Anbau und Nutzung von Bäumen auf landwirtschaftlichen Flächen. Tagungsband.

3. Objectives

- (1) Identify reasons, why farmers do not invest in SRC production. Hypothesis is:
  - The low level of implementation of SRC production is caused by
    - lack of knowledge amongst farmers, politicians, and other stakeholders,
    - lack of knowledge about SRC products (wood-chips / industrial wood) at industrial consumers,
    - undeveloped markets and unclear quality criteria for the final products,
    - unclear legislative framework for SRC production.
  - This complex - beside technical problems faced by WP1-WP3 - leads to low efficiency of SRC value chains and high production costs and
  - it ends in a unfavourable profitability level compared to competing agricultural products.
- (2) Test one potential approach to overcome the constraints. Hypothesis is:
  - Regional co-operations between producers & consumers can lead to optimised business concepts and more efficient supply- and value-chains.

4. Material and methods (1)

- Initiate 3 "**pilot co-operations"** and implement case studies of **co-operations** between

  Producer (Farmers) <=> Consumer (Bioenergy -, Pellet plants, Particle board - or Pulp industry)

- Initiate, moderate and guide an implementation-process, where partners name, define and discuss
  - SRC products (quality, quantity) ►link to WP3 Conditioning
  - Costs and price-restrictions ► link to WP4 Economic evaluation
  - Implementation problems for farmers (politicial-, market-, economical-)
  - Procurement problems for consumers ► link to WP 2 Harvest & Logistics.

4. Material and methods (2)

- The "pilot co-operations" will serve as a **communication forum** for the
  - detection & eradication of production-related, institutional, social, and environmental constraints,
  - development of locally adapted **business concepts** and SRC value chains,
  - knowledge transfer.
- Methods:
  - Workshops and interviews to analyse the situation and to conceptualize and define solutions.
  - Economic model calculations **(link to WP4 Economy)** to evaluate, which constraints and barriers are relevant to restrict successful implementation.
  - Examination of the operational decisive behaviour of the farmers and the wood-fuel industry.

Results

	Deliverables
WP1 Plantation management	- Guidelines for a better adaptation of plant material to the site to reduce irrigation and fertilization needs
WP2 Harvest and Logistics	- Guidelines with the most profitable harvesting method related to the specific site conditions - Advises for SRC-harvest machine constructers - Efficient logistic models for the transport of products
WP3 Conditioning of raw material	- Compilation of a decision support model for conditioning measures - Quality Management System design with cost efficient assessment methods - Compilation of a decision model for different storage techniques of raw material
WP4 Economic evaluation	- Economic model for SRC-value chains especially considering unfavorable conditions - Estimation of social and socio-economic benefits and drawbacks
WP5 Business concepts	- Compiled report on the implementation "experiences" in the pilot-co-operation - Guidelines for implementation strategies considering SRC producer–consumer co-operations

Results

- Strategies to overcome the problem of unfavorable conditions
  = small field sizes at scattered locations on unfavorable sites

by

- Improvement of efficiency via a straight consumer-oriented quality production (WP3)
- Definition of an optimal, locally adopted production system for farmers (WP1)
- Co-operation for better information and opzimized business models between producers and consumers (WP5)

leading to

- consumer-oriented production systems among producers,
- improved harvesting techniques and establishment of efficient logistic systems between partners (WP2).

➔ **Overall cost reduction for the SRC-production** (WP4)

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on small field sizes and under unfavorable site conditions by focusing on high product quality and a product-oriented cooperative value chain

Thank you for your attention!

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