Realistic expectations on biomass potential in conventional forestry and agriculture - Swedish experiences

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Introduction

Both in the scientific literature and in national and regional reports and statements there are tendencies to be overoptimistic concerning the biomass potential for bioenergy in forestry and agriculture. Experiences from Sweden, a country characterized by large areas of slow growing boreal and temperate forest with long rotation periods, limited area of agricultural land, and a large number of smallholders owing relatively small lots of forests and agricultural land, are given here. The aim is to suggest more moderate expectations on biomass deliveries from these sectors.

Stump potential in Sweden

In the boreal and temperate forest, with long rotation periods, it takes time to substantially increase forest growth. Thus, the short-term feedstock supply is restricted to the growing stock. In Sweden residues from the forest industry is fully used and logging residues, i.e. branches and tops, are already on the market. Another potential major “logging residue” are the stumps. With the restriction that only confer stumps should be harvested an estimate based on data from the Swedish National Forest Inventory showed the annually physically available amount of stump biomass amounted to 12 million dry tonnes. However, due to techno-economical and environmental constraints the market available potential was estimated to be considerably less and not larger than 2 million dry tonnes per year, corresponding to roughly 15 % of the physical potential.

Constraints used to estimate the market available stump biomass included:

- Stumps will not be harvested in thinnings
- With current technology stumps will not be harvested on sites with steep slopes; on sites with a lot of boulders; on sites with fine textured moist to wet soils
- Stumps with a diameter less than 20 cm will not be harvested
- Stumps will not be harvested on clear-cuts: that are small; far from the market; with long terrain transport distances; within the raindeer herding area; in areas with high conservation values; in areas with a high density of ancient monuments

Some of the techno-economical constraints is likely to be overcome as technology and logistics develops and the operators improve their skills over time. But forest biomass for energy purposes will remain a low priced commodity that is bulky and expensive to procure and locked up by a number of environmental constraints. Expectations therefore have to be realistic and not blinded by the physical amount in the forest.

Figure 1. Due to techno-economical and environmental constrains the market available amount of stump biomass from conventional forestry in Sweden should be expected to be far less than the physically available stump biomass following logging operations.

Figure 2. Previous assessments of the bioenergy potential in Salix in Sweden overestimated the potential by far and has not resulted in any large areas of Salix cultivation in Sweden despite the fact that the bioenergy market in Sweden has been growing steadily during the last decades.

Salix potential in Sweden

Bioenergy assessments during the early 1990s presented a considerable Salix potential based on (i) large amount of agriculture land available for Salix plantations, and (ii) high Salix yields. The anticipated future cultivation area amounted up to 800,000 ha, which is equivalent to almost 30 % of the total arable land, and the average biomass yield was estimated to roughly 12 dry tonnes per hectare and year. Thus, in energy terms, the corresponding physical Salix biomass potential amounted to some 150 PJ per year. The Salix potential has been revised in several assessments during the years and a typical estimation in the late 1990s was that some 60 PJ biomass could be produced per year from 400,000 ha Salix cultivation with an yield of, on average, 10 dry tonnes per hectare and year.

Salix cultivation expanded up to 15,000 ha during the early 1990s, but have been constant or even decreasing since then. The average biomass yield is significantly lower than previous expectations, often between 6-8 dry tonne per hectare and year today. Thus, the practical biomass harvest from current Salix production in Sweden amount to approximately 2 PJ per year. Compared with the estimated physical potentials in the early and late 1990s, this correspond to 1-3%.

This huge difference between the previous estimated Salix potential and the actual Salix market include a wide variety of factors which have been identified in various research projects during the last years. These factors includes:

- Biophysical
  - a large part of the cultivations is not fertilized
  - the introduction of new, high-yielding Salix clones are slow
  - problems with weed control
- Agriculture policy
  - Common agricultural policy has been focused on traditional food crops
  - long-term economical incentives for perennial energy crops have been missing
  - environmental related subsidies could not be used in multifunctional Salix cultivations
- Energy market structures
  - a well functioning sales organization for Salix producers towards bioenergy users has been missing
  - some district heating plants has had technical limitations to use wood chips from Salix
  - long term contracts between Salix suppliers and end users, mainly district heating plants, has not been developed
  - limited Salix plantation areas gives high harvest, transport and administrative costs and slow technology development
- Farmers acceptance
  - high economical risk
  - less flexibility in land use
  - landscape perspective
  - less optimal farm business structure