Short Rotation Forestry: The Potential of a Low Input Approach

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Short Rotation Forestry (SRF), using fast growing species such as poplars and willows, has a promising potential in the development of an energy industry based on the utilization of biomass resources. Moreover, the environmental benefits of SRF as a renewable energy source have already been well documented. Hence, one might ask the question: why is this technology not being used commercially? The answer lies in the economics and risks of biomass production and conversion.

Whether woody biomass is used for direct combustion or for ethanol production (the two major alternatives), it has to compete in one way or another with fossil fuels. Some studies have suggested that SRF could compete with electricity generated by oil, and even with coal, if all pollution abatement costs were considered.

In the case of ethanol production, improvements are needed at the production and conversion stages in order to reduce the retail price of ethanol, which could be possible within ten years. At the production level, this can be achieved by higher biomass yield per hectare and/or by reducing the amount of inputs required to obtain the same yields.

Energy balance

The latter option highlights another interesting and important issue: the energy balance. When using biomass as an energy source, there is an expectation of reducing (or, in the most optimistic scenario, eliminating) the negative environmental impacts associated with the use of fossil fuels, the most important of these being the release of carbon dioxide (CO_2) into the atmosphere, which is responsible for nearly half of the greenhouse effect.

Because of this expectation, the development of new production schemes for SRF must minimize the utilization of fossil fuels in the production process. Another way of addressing the problem would be to say that the

output-input ratio of SRF should be maximized, which will require a de-emphasis of energy intensive farming practices by scientists and economists researching SRF alternatives.

In this spirit, REAP-CANADA initiated a 3-year project on SRF in May 1992 with support from Forestry Canada, Energy Mines and Resources Canada (EMR), and Agriculture Canada. A comprehensive on-farm development program for SRF is being conducted in Ontario and Quebec using different species of willows as well as poplars and black locust. Approximately 25,000 trees were planted in the spring of 1992. These trees were provided by Sylvia Strobl of the Fast Growing Forest Group in Brockville, Michel Labreque of the Institut de Recherche en Biologie VŽgŽtale in Montreal, and Sandy Robertson of Forestry Canada in St. John's, Newfoundland.

The project includes field scale plantations, on-farm cultural management trials and environmental studies of SRF. Two graduate students are involved in the project: one, studying at the Agricultural Economics Department of McGill University, will focus on measures to lower pre-harvest costs and another, at the University of Waterloo, will study nutrient cycling. The impact of energy forests and the establishment of commercial plantations will also be assessed; in the former case, the assessment will include changes in soil properties, nitrate studies, CO2 storage capacity and effect on tile drains. In the latter, two options will be investigated: wind break applications and field plantations.

Windbreaks

Wind break plantations deserve attention because they could help to improve farmers' acceptance of SRF as well as provide a way to minimize land costs. When planted on medium and high quality soils, yields of 15 mg/ha/yr ????

Does this actually mean milligrams?

with minimal input use can be obtained. Better sunlight interception, reducing the risk of creating a moisture deficit and combining with good soil fertility should enable a high growth rate.

The main problem with high quality land is rental costs. For field plantations, the high cost is a serious problem whereas with wind break plantations, the problem could be minimized as the benefits of the wind break (reduced soil erosion, higher crop yield, etc.) could offset part of the high land cost. With a high growth rate, a very short rotation is possible; hence, farmers could get a first return from the plantations earlier (after 2-3 years), helping to improve acceptance of SRF by farmers.

Thus, a higher growth rate, shorter rotations, minimum use of inputs and environmental benefits are the main advantages that wind break plantations could offer. Whether or not these advantages can be translated into economic profitability compared to conventional SRF intensive systems is still yet to be determined.

Energy from grass

REAP-CANADA is also looking at the potential of warm season grasses, such as switchgrass (Panicum virgatum) and elephant grass (Miscanthis Sinensis Giganteum), as complementary bio-energy feedstocks. Farms in the future could potentially produce both woody and herbaceous biomass crops, as well as food crops.

Photo 1. Harry Wilhelm of Tavistock, Ontario stands behind a recently sprouted Salix eriocephala cutting. Wilhelm is one of four cash crop farmers which established energy windbreaks in 1992.

Figure 1. One of 10 windbreak systems established at the Wilhelm farm included two row treatment of 1) poplar and 2) shrubby willow (Salix eriocephala).

Photo 2. REAP-Canada research assistant Ying Chen stands in a 4 row strip of Salix viminalis with agricultural economics graduate student Patrick Girouard and executive director Roger Samson.

Photo 3. REAP-Canada president John Van Dorp of Woodstock, Ontario planted 600 "Austree" willows on his farm in 1990. In 1992, a study evaluating 8 different tree type willows was initiated on his farm.

Table 1. Summary of Strategies to Improve SRF Profitability

1. Lowering of Pre-harvest Costs through use of:

- farm generated cuttings

- mechanical weeding including rotary hoeing and precision cultivation.

- modified vegetable transplanters for tree planting

- improved nutrient cycling and judicious use of fertilizer

2. Reducing Land Costs through:

- wind break plantations

3. Improving Productivity and Harvest Frequency through:

- increased sunlight interception and reduced moisture deficit potential through strip cropping with willow windbreaks