Agroforestry and decentralised food and energy production

The role of coppicing and pollarding

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Aerial view of Wakelyns Agroforestry hazel system

The tree problem

From the emergence of Homo sapiens until the last 200-300 years, trees have been the major source of energy (and other materials and food). Even 20,000 years ago, the ratio of trees to humans was about 1.5 million to one, but it has now fallen drastically to about 400 to one (and is still falling). To save the planet, and humanity, we need food and energy systems that are efficient in terms of supplying both of those outputs while improving the quality and sustainability of the biosphere. This could best be done by reversing this declining ratio of trees to humans.

Ideally, to minimise transmission losses, renewable energy needed to replace all fossil fuels should be produced close to where the energy will be used. The system should also deliver other benefits and be fully sustainable. All agroforestry systems are potentially able to do this, but systems that integrate food and energy production will be the most effective and sustainable.

Willow coppice harvested with circular saw

Fuel production: coppicing and pollarding

The systems being developed at Wakelyns Agroforestry, a 23 ha holding in East Suffolk, England were planned during the early 1990's. The first timber trees were planted in early 1994, the hazel coppice system was planted in 1995 and the willow in 1998. The cropping areas in both the coppice and timber tree systems are occupied by the same crops in a single organic crop rotation, including cereals and vegetables.

The hazel and willow trees were planted as double rows and coppiced with a circular saw, the hazel every 5 years, and the willow every two years. The cut stems are air-dried in the field during the summer and then chipped on demand. Into the winter, the willow stems are best covered to protect them against rain and early decomposition; the hazel stems are much more resilient.

Hazel coppice: there is a high rate of regrowth six months after coppicing

AGFORWARD Agroforestry for Europe

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Advantages

The main advantage of both systems, coppice and pollard, is that, in addition to the renewable energy being generated, commercial crops are being produced, carbon is being sequestered, climate extremes are being reduced, the trees provide a number of different habitats to encourage wildlife, and chemical interventions are eliminated.

In this way, an environment is produced which is agreeable to humans, from the points-of-view of aesthetics, physical and economic health, and the sustainability of the planetary biosphere.

Original sycamore with pollarded neighbour (3.5 yrs growth)

Prof. Martin WOLFE
wolfe@wakelyns.co.uk
Organic Research Centre, Elm Farm, Hamstead Marshall, Newbury, Berkshire UK RG20 0HR
www.agforward.eu

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For the next phase of development, Wakelyns are establishing a 5-yr rotational pollarding management system with 2.5 ha of timber trees (ash, hornbeam, Italian alder, oak, small-leaved lime, sycamore), which have been growing since 1994 also in a 12 m alley-cropping arrangement. The 5-yr rotation should maintain all of the trees in the active growth phase when they are at their most productive. This is starting to generate a large increase in available dried timber, which it is planned to use in a small-scale combined heat and power (CHP) unit to generate electricity as well as heat. The main option to be explored for the electricity produced is to store it in electrical vehicle batteries.

Energy yields

Although willow and hazel yields are variable, both species generate 4-5 t dry matter per ha of agroforestry (i.e. trees and crops) per year. The hedges and their understories occupy about 20% of the land area. The total mass is sufficient to provide ample central heating and hot water via a 20 kw boiler for the farmhouse for the year. These yield figures are higher than the expected short rotation coppice yields (of the order of 40 – 50% increase for both species). This is, probably, largely due to the reduced competition on the trees, with no shading and reduced water competition on the east and west sides of the tree rows, plus the fertility-building phase of the organic crop rotation contributing to increasing short rotation coppice biomass.

Disadvantages

The main disadvantages of both systems are first, the timing and integration of field operations for the trees and crops, and second, availability of space and access to the annuals and perennials for those operations. There is also a need for a wider range of combined heat and power units particularly suited to small-scale, on-farm energy production. These difficulties are not insuperable and an increase in experience and scale should lead to specialised management and machinery.

Further information

Short-rotation willow for bioenergy, bioproducts, agroforestry and phytoremediation in the northeastern United States. IEA Bioenergy Task 43 Report 2012 http://ieabioenergytask43.org/wp-content/uploads/2013/09/IEA_BioenergyTask43_PR2012_01.pdf

Short rotation roppice (SRC): Forest Research https://www.forestry.gov.uk/fr/beeh-9uqplc