Session 3 Future Strategies and Development Activities

The Economics of Forest Plantations and On-farm Planting as a Rural Income-generating Activity in the UK and Sri Lanka

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Introduction

This paper explores the issues related to the production of biomass as a fuel for the generation of electricity. It draws on experiences in the UK and also examines some of the lessons in the light of experiences in Sri Lanka. The reason for looking to the United Kingdom, rather than to other European countries more advanced in the production and use of biomass energy is that there are greater similarities between the UK and Sri Lanka, so that what is currently occurring in the UK may be of interest to Sri Lanka. Both countries are islands, with some densely populated areas and some remote, under populated areas; both are net energy importers; the forestry sector in both countries is a small contributor to the national economy. The United Kingdom has slowly woken up to the need for it to diversify its electricity generation base away from fossil fuels and into renewable energies. This interest is primarily driven by its commitment to reduce carbon dioxide emissions rather than because it is worried about the size of its oil import bill. Perhaps a second driver is the need to increase rural incomes and increase skilled employment opportunities. Although many areas of the world are well ahead in their use of biomass as an energy crop the UK is catching up. The policy environment and concomitant assistance is becoming much more supportive to energy crop growers. Interestingly, considering the resistance to growing energy crops, in the 1930s one-third of UK farms were growing energy crops – oats and hay! The UK now has around 1,500 ha of SRC coppice under cultivation. Sri Lanka has a long history of producing fuelwood as an energy crop and this expertise is recognised. However, in much of the country the use of biomass energy is characterised by low efficiency and drudgery and while the country has high potential in biomass production (Sugathapala, 2002) there may be some resistance to its use as a modern fuel.

Many of the commercial crops grown in Sri Lanka (such as tea, tobacco, sugar, rubber, coconut and coffee) involve processing requiring a source of heat. For crops like tea the most efficient way to provide this heat source has been to grow wood, usually on adjacent, sometimes marginal, land. Key drivers include the diminishing availability of indigenous timber, transport costs and logistics and the need for a constant fuel supply. When wood is grown as an energy source a number of factors are vital, including biomass growth rate, calorific value of the wood, suitability of the species to the local climate and whether it is better to use crop land or marginal land. There are many synergies with the production of short rotation coppice, the focus of this paper. The expertise of smallholder farmers in the production of trees for a variety of purposes should also not be overlooked. It is fortuitous that one of the best tree species suitable for bio-energy production in the tropics is already widely known and planted and used by rural people.

Aim of Paper

The objective is to examine the economics of planting short rotation coppice (SRC) species on both large-scale plantations and as “on-farm” smallholder-type planting. Current thinking both in the UK and in Sri Lanka tends to the view that SRC coppice species is economically viable and can play a role in crop diversification and increasing rural incomes. In this paper we look at the financial and economic costs of planting as well as social, cultural and other factors that entrepreneurs, extension advisers and policy makers need to consider when promoting SRC. In the UK as in Sri Lanka it has been assumed that harvesting the wood after a relatively short period is the best energy source for biomass-fuelled power generation. In Finland where there is a much longer history of power generation using wood it is recognised that it better to have several types of wood feedstock to diminish the chance of likelihood of running short of one particular type and to improve the economics of generation. One power station runs on five different types of wood biomass. For this reason we allude to different types of fuelwood production in Sri Lanka as more than one type of wood source may need to be considered. Indeed, in the UK co-generation using wood in coal-fired power stations is now part of the government's carbon reduction strategy[1].

The findings of this paper are based on a review of available literature. It appears from this exercise that there is relatively limited literature available on the economics of SRC because it is a comparatively new crop and production factors are evolving all the time. Much of the material is published in the form of guides for farmers considering planting SRC. A lot of this information is based on the 49 SRC research trials undertaken by the UK's Forestry Commission, Department of Trade and Industry and the Department for the Environment, Regions and Rural Affairs (DEFRA). Literature on uptake of agroforestry in developing countries, published in the 1990s, is still pertinent on some of the socio-economic aspects relating to tree planting.

A central premise of the paper is that there is still a need to convince farmers that crops can be grown for energy as well as for food. In the UK falling farm incomes are putting farmers under pressure to diversify into new areas of activity, including forestry. Other pressures are likely to be affecting Sri Lankan farmers. In both countries finding a market is likely to be an issue until enough customers can be found for the SRC woodchips. There is, in both countries, the need to overcome farmers' production inertia and their willingness to change. Demonstration projects may help bring about this change and allow farmers to see for themselves. It is also important that all those involved in the development of biomass energy (growers, users, public bodies, government departments etc.) play their part in making the supply chain work (Valentine, undated).

Production issues

When considering the growing of wood as energy source in Europe there are generally a number of limitations to overcome. In the UK, slow growth rates and low timber prices have not made timber a financially-rewarding enterprise for most farmers. Some wood is grown commercially but for higher-value uses such as transmission poles and timber. Fuel wood is a by-product from thinning branches. Trees are often planted on land at the margin, including on steep slopes, rocky outcrops and shallow soils making managing management riskier (Hyde, 1991). However, with growing interest in the bio-energy sector and led by the necessity to reduce carbon emissions there is at long-last recognition of the potential importance

[1] It has been suggested recently that the economics of a pure bio-power plant are not supported in the market (Boyle, 1995)

that wood has as an industrial energy option. It is also increasingly understood that financial incentives are necessary to convince farmers of the viability of growing trees as a fuel crop as well as the need to assure farmers that growing SRC has greater similarity with other cropping enterprises than with traditional forestry production.

Currently, as part of its carbon reduction strategy, the UK government has a scheme to underwrite the establishment of short rotation coppice. Under the Energy Crops Scheme, grants are given for establishment of short coppice rotation species and to aid the establishment of producer groups for short rotation coppice. Farmers and land managers with at least 3 hectares and whose land falls within a reasonable radius from the end user are eligible (generally 10 miles for small installations, 25 miles for large installations). Applicants have to demonstrate that they have or will have an energy end-use for the crops. This can be a biomass power station or a community energy scheme using heat or combined heat and power (CHP) technology. Energy crops can also be grown for own use, e.g. to heat a home or business. In spite of this grant, which covers approximately 50% of the establishment costs, there was a slow start to uptake under the scheme. Disadvantages of SRC include the high cost of establishment and the three to five year development time. Despite the grant these factors have deterred farmers from making the necessary up-front investment. Apparently applications to the scheme are now increasing as energy end-users are beginning to be established (Bach, 2005).

Long experience of cost-efficient fuelwood production has shown the attention to detail required from before planting right through until use. This includes selection of the best seed, either through knowledge of seed selection from own trees or purchase of certified seed; land preparation; good planting technique including infilling, weeding and pest control. Fuelwood species are selected for trunk straightness to minimise air gaps in the furnace ensuring a better burn. After planting, harvesting is generally the next most expensive task and is often organised on a task basis of a certain quantity of felled and stacked wood (often on a cubic metre basis). Trailer design to take a particular quantity of wood can maximise transport efficiency. Although perhaps the less glamorous enterprise compared to crop production, fuelwood production, nevertheless requires considerable management. Sri Lanka has a number of knowledgeable people in this area. Much of this knowledge could be transferred to growing wood as a bio-energy power feedstock.

In addition to private investment in fuelwood production enterprises, in Sri Lanka as in a number of other countries in the region, there have been significant amounts of public support in forestry R&D, into tree seed selection and breeding programmes as well as wood burning research and determination of species’ calorific values.

With short rotation coppice species – willow (*Salix* spp.) and poplar (*Populus* spp.) in the UK and *Gliricidia sepium* in Sri Lanka – considerable research is required to ensure that the best varieties are selected to ensure maximum productivity per unit area in response to different soil types and climatic areas. In the UK work has shown the importance of having varieties that are able to compete with weeds and that are resistant to rust. Pest management – exclusion of rabbits for the first two years and ideally up to the first harvest - is vital (Tubby and Armstrong, 2002). Optimising yields per hectare is vital in improving financial returns from planting. Considerable work is being done in Europe to select and breed *Salix* varieties that are high yielding.

Current economic estimates are based on a yield of 8 odt (oven dried tonnes) per hectare per year, sometimes increased to 10odt/ha/year. In some places yields have reached 12 odt/hectare/year and high-yielding varieties are achieving 15 odt/hectare per year. It is predicted that in future yields might reach 25 odt/hectare per year (Heaton et al., 2000). Planting density also affects yields. Farmers are advised to plant between 10,00o and 15,000 stems per hectare. With the older SRC willow varieties it was important to plant at the higher density. New willow clones achieve ‘site capture’ and canopy closure at lower planting densities (Tubby, pers com).

Marketing
The UK’s Energy Crops Scheme supports the formation of SRC producer groups. These are legally established groups of short rotation coppice growers who work together to harvest their crops and supply wood chips, after processing and storage if necessary, to one or more energy end-users. Box 1 below outlines the type of assistance they offer to farmers.

Box 1. Establishment of Producer Groups: basis of the TV Bioenergy Coppice deal

TV Bioenergy Coppice sets outs its arrangements for growers, in the Thames Valley, wishing to supply wood for the fuel market derived from short rotation coppice production. The arrangements, below, are for new growers or existing growers wishing to increase their allocation:

“You (the grower) decide how many hectares you wish to establish (minimum 3 hectares)
You control the crop husbandry and management.
With our help you receive and keep all related grants.
We guarantee a market for the crop based on our portfolio of existing and developing end users with a guaranteed index linked minimum price of £36 per tonne of dry matter as delivered to the end-user, with an additional premium paid per tonne, dependant on the prices achieved in the market.
You can become a shareholder in the producer group with one share being allocated per hectare.
We assist you to organise planting, harvesting and transport and will co-ordinate these activities regionally to help reduce costs.
We contract for 10 years (3 harvests) with options to renew for a further period.
We provide technical advice and support services.
You can be located anywhere in the vicinity of Oxfordshire, Buckinghamshire, Berkshire, North Hampshire or Surrey
All of the above are available for a small annual membership fee.”

TV Bioenergy Coppice has developed a working model which will produce a budget and cash flow for the lifetime of the crop. As each site and situation is unique, their advisors will go through the individual figures for a particular farm.
Source: tvbioenergy.co.uk

It is important to develop end uses for SRC; initially this may be for heating rather industrial application rather than for electricity generation, until a large enough production base has been established. Box 2 below explains how this occurred in an area of the UK.

Box 2. Establishment of Producer Groups - RET

RET has played a catalytic role in kick starting the supply and use of woodfuel in the East Midlands. During its first two years of operation, it handled about 500 enquiries and made over 60 feasibility studies which have led already to the installation of 15 woodfuel boilers to supply 3 MW of heat. This has provided employment in farming, forestry and heating installation. Wood chipping and wood pelleting enterprises have also started. There are significant environmental benefits. The use of sustainably-harvested wood reduces greenhouse gas emissions, particularly when replacing coal, which is the most carbon-intensive of the fossil fuels. The systems installed to date will use about 840 tonnes of wood per year, and avoid the emission of about 1,400 tonnes of carbon dioxide. There are also local benefits to air quality as a result of replacing old coal boilers with wood burners which meet the current strict emissions requirements.

Costs of production and returns from SRC

As production of SRC woodfuel is a relatively new farming enterprise in the UK and end users are scattered across the country, it is difficult to obtain accurate figures of the costs and returns. There are few journal articles and up-to-date reports (Tubby, pers com). The figures presented here are based on research or information provided by SRC producer groups.

To compare the relative contribution of different crops and farm enterprises the gross margin of each is calculated, based on their variable inputs costs and revenues. Gross margins are usually calculated on an annual basis as most crops are harvested annually. To compare an enterprise that has large investment costs at the beginning and revenues occurring in subsequent years the net revenue stream needs to be converted to an 'equivalent annual value' (EAV). In the UK the EAV for SRC is in the region of £203 to £287 per hectare, including establishment grants and farming subsidies such as 'Set Aside' (DEFRA, 2002). Research in the Welsh uplands showed that over a period of 25 years (the total growing period for SRC) the predicted returns from SRC would be similar to sheep production at 8 odt/ha/year, if there were a guaranteed wood chip market in the form of a local electricity plant. If such a market did exist it is possible that returns from SRC could be better particularly as subsidies for sheep production will decline and the demand for raw materials to produce renewable energy is likely to increase as it has done, apparently, in Germany and Sweden with a positive impact on price (Heaton et al., 2000).

In 2003 one author calculated the gross margin for SRC to be around £150 per hectare less than for arable crops but this amount was higher than for leaving the land unused and claiming the 'Set Aside' subsidy (Valentine, undated). It has now been verified that farmers can claim 'Set Aside' when planting SRC and that this improves the returns. Table 1 below gives an idea of the cost of planting one hectare of SRC in the UK.

Table 1. SRC willow establishment costs in the UK

Tasks	*£ per hectare*	*Notes*
Preplanting cultivation and weed control	500	1 or 2 applications of herbicide
Cuttings for planting	1,000	
Weed control in early years	150	
Other labour and machinery costs	100	
Total	1,750	
Establishment grant	1,000 1,600	Arable land Non area aid payment land that is forage area/permanent grass

Source: REFA website

Similar costs are provided by a second producer group. See table two below. After each harvest there would be additional costs such as assition of fertiliser, often in the form of sewage sludge.

Table 2. SRC establishment and first harvest costs - UK

Tasks	*£ per hectare*	*Notes*
Site preparation	119	
Cuttings and planting	1,025	
Cutback after 1 year	62	
Weed control	30	
Rabbit fencing	550	Required if rabbits/deer are present
Total	**1,786**	
Harvesting costs	462	1st harvest in 3rd year

Source: TV Bioenergy Coppice website

Thames Valley Bioenergy Coppice quotes margins of around £100 per hectare (before the Single Farm Payment – the new form of farm support in the EU) and a guaranteed minimum payment of £36 per tonne of oven dry wood chips. Farmers have to pay for drying of the chips as well as chip haulage, which costs between £10 and £12 per tonne.

The current UK market value (early 2005) is around £30/tonne at 30% moisture. The cost of harvesting, chipping and drying needs to be deducted, reducing the return to £20 per tonne, around $205 per hectare, based on a price of £32.50 per tonne of oven dried chips.

Farmers would obviously need to discuss the likely costs and returns with an advisor before committing themselves to investing in SRC. An important factor to consider it that the coppice will grow for 20 – 25 years with very few further inputs. However, many cost models are based over the shorter period of 10 years as growers may consider pulling up the shrubs at this point and replanting with higher-yielding varieties.

The price paid per tonne of chips is obviously a matter of concern to growers and users. With current technology in the UK, biomass energy power production is only considered economic at £25 to £35 per tonne of oven dried chips, or where fuel is given away as a secondary or waste product. However, for SRC chip production to be really worthwhile for farmers (and without a subsidy) chip prices would need to be in the region of £30 to £60 per tonne (Boyle, 2005).

A key factor is the large difference in price between fossil fuels and biofuels. This difference remains, according to the FAO (2005) “even when recent volatility in oil prices makes bioenergy (and raw materials produced from biomass) more attractive”.

In Sri Lanka the rate being paid to smallholder farmers to harvest gliricidia branches from pepper bearing trees, is Rs. 1,250 to Rs. 1,500 per tonne of sun-dried chips (Rs. 1.25 to Rs. 1.50/kg) with a further Rs. 1,000/tonne paid to an agent for purchasing, collection and delivery to the power plant. Based on a tree producing six branches a year and each branch weighing an average of 1kg (dry weight), this works out at a revenue of Rs. 9 per tree per year. From this the cost of paid labour would need to be deducted. This does not include the opportunity cost of family labour, initial planting costs and possibly the opportunity cost of land. However, in addition to the cash revenue received there may be additional benefits, such as the soil nutrient value of the leaves; the use of the leaves as animal feed and reduction of soil erosion when planted on hillsides.

Where gliricidia has been planted intentionally as a second crop on coconut plantations the benefit of the green foliage as a nutrient source is well recognised. The annual saving in costs of urea, rock phosphate, muriate of potash and dolomite has been calculated at Rs. 30/palm (Gunathilake, 2004). Research undertaken on gliricidia interplanting found optimal spacing to be 8,000 stems per hectare with a harvest interval of 8 months. Some form of protection is needed from goats and cattle - a live gliricidia fence is effective in keeping animals out. Under current legislation an advantage of using gliricidia as a fuel source over other fuelwood species, such as acacia, is that it does not require a transport permit when being moved on public roads.

Economic benefits and costs

In addition to the direct costs and returns of producing SRC from an individual grower’s financial perspective, it is also important to consider what is efficient from a society’s point of view. In this paper brief consideration is given to the following aspects: employment creation, carbon sequestration, impact on land use and water, particularly from a developing country perspective.

Several authors have investigated the impact of SRC in developing countries on employment (FAO, 2005; Dormac and Richards, 2004). The International Atomic energy Authority estimates that biomass fuels create up to 20 times more employment

Table 3. Bioenergy employment from selected studies (Latin America, SE Asia, particularly Thailand

Person years/PJ*	Intensive production, farmers	Intensive inter-cropping	Large scale "energy forestry"
Establishment	112	71	34
Weeding	338	196	59
Harvesting	248	251	85
Transport	70	71	51
Chipping	13	13	13
Administration	19	19	11
Total	799	620	252

* employment per unit of energy in person years
Source: Remedio, E. Socio-economics of bioenergy. A focus on employment, FAO quoted in Dormac and Richards, 2004.

What other factors can be put into the economic equation in favour of biomass fuels? Carbon sequestration and sales of carbon may benefit SRC economics in developing countries. The Clean Development Mechanism of the Kyoto protocol (covered in-depth in other papers) may offer additional incentives for establishing energy plantations. Having land more or less permanently under trees may help to reduce or prevent soil erosion and play a part in rehabilitation of degraded and marginal land (FAO, 2005) and in mine restoration (Brierley et al, 2005).

Low input tree crops may be used as a way of keeping land in productive use. Tree growing may also be adopted where lack of access to capital prevents farmers from adopting more capital intensive crops. Trees may also be grown to diversity farm production, to provide products and income in the period between the main harvests and to help even out demand for labour (Arnold, 1991). In some countries in the past the expansion of the growing of trees as field cash crops has caused concern, particularly in India, because it was felt that land was being diverted from production of essential food. This tends to overlook factors which cause farmers to withdraw land from low value crop production and to find less labour intensive forms of land use (Saxena, 1990 quoted in Arnold, 1991).

A number of social issues identified from research in support of the introduction of agroforestry may be pertinent in considering what social impact the introduction of wide scale land allocation to tree production may have on rural societies.

The decision to grow trees can depend on land tenure and security of tenure. Lack of secure tenure or ability to lease land for long periods, sharecropping and other forms of tenancy have been assumed to inhibit tree growing though in some countries and situations the tenure status per se is thought to be less critical to tree planting than related factors such as access to credit and access to local, assured markets (Arnold, op.cit). In Sri Lanka it has been mooted, however, that the lack of lease agreements with the Forestry Department led to limited interest by farmers in establishing woodlots; farmers were expected to plant trees without any legal assurance of tenure in a tree-planting scheme (Carter et al, 1994).

Existing alternative uses of so-called scrub or waste land does need to be investigated, such as its use for livestock grazing. Loss of land formerly used for grazing and its planting with unwanted trees can be resented and provoke people into setting fire to the plantations (Carter, op.cit).

Conclusions and recommendations

The paper has considered two island nations, both expressing tentative interest in biomass for power generation though with very different drivers. The UK is being forced to consider electricity from biomass as a way to reduce its carbon dioxide emissions. SRC offers one such route, with the added advantage of helping farm incomes. Considerable research is needed to increase wood productivity and improve yields. Sri Lanka needs to find cheaper, more sustainable ways to increase its power production, both on and off-grid, particularly in rural areas where many people live without electricity. A major advantage of SRC in the tropics is the short production period, of less than one year, compared to three or more years in the UK.

There is a lot of expertise in Sri Lanka in commercial fuelwood production as a fuel source for the heat required for crop drying and processing, in terms of species selection, breeding and woodfuel management. There are a number of synergies with SRC and these need to be made use of.

In the UK although farmers receive a grant to establish SRC initial uptake was low as farmers were reluctant to tie up their land and make considerable investment for an uncertain market. Lessons from the UK and elsewhere should be considered in developing a biomass fuel system in Sri Lanka.

Grant support for group formation to assist establishment of producer groups appears to have been more successful. A number of groups – 'one-stop shops' for SRC growers have set themselves up in the UK, guaranteeing technical support, a minimum price and help to find markets. A similar system, appropriate to the Sri Lankan context, could be explored.

Finally, information on employment creation from the establishment of SRC supply chains in developing countries is encouraging and policy makers and stakeholders are urged to consider this in the promotion of SRC in Sri Lanka.

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Useful UK web sites

PRASEG – www.praseg.org.uk
(The UK Associate Parliamentary Renewable and Sustainable Energy Group, a cross party group for politicians and senior industry stakeholders that exists to promote sustainable energy issues - renewables, energy efficiency and combined heat and power in Parliament and the wider political community).

Renewable Energy From Agriculture – www.refa.org.uk
(a farmer controlled business growing and promoting energy crops in the UK. REFA have been appointed the on-farm contractor for Greenenergy who have signed an exclusive 10 year contract to supply the 30,000 oven dried tonne of SRC per year for

the SembCorp Utilities 30Mw £60m biomass power station being built on Teeside, known as Wilton 10, in the UK).

Renewable Energy Growers Ltd - www.energycrop.co.uk/
(a not-for-profit organisation representing farmers growing energy crops, particularly farmers growing Short Rotation Coppice(SRC) in the UK; a large and experienced producer of SRC woodfuel).

Thames Valley Energy - www.tvenergy.org
(a one stop shop for all matters relating to the understanding, promotion and delivery of renewable energy projects. A not-for-profit independent regional renewable energy agency, established in 2001).