Costs and Returns of SRC Production

Claire Coote, Natural Resources Institute

Introduction

This section explores how production of a short rotation coppice (SRC) crop compares with the financial returns from alternative agricultural land uses. In Sri Lanka much of the land is intensively farmed to produce a range of annual agricultural crops. It is therefore important to compare the anticipated net returns of competing crops, both annual crops and SRC (normally *Gliricida sepium*) with its longer production cycle, as well as to see how these can both be affected by variations in yield and crop prices.

Such comparisons need considerable amounts of data and Sri Lanka is fortunate in having detailed information for a few field and vegetable crops, the "Cost of Cultivation of Agricultural Crops"[1], obtained from bi-annual surveys of agricultural production produced by the Department of Agriculture. In this example we compare the production of three rain-fed crops - maize and ground nut in the Maha season and bush bean in the Yala season[2] – with *Gliricidia sepium* SRC. The reason for using these crops for comparison is that we assume that SCR would most likely replace rain fed, lower-value crops.

Yield and production costs data for SRC crops is mainly from trial plots and pilot production schemes. The few cost and revenue estimates available show significant variation. The variation in costs and yields may reflect varying planting conditions – establishing SRC on degraded land is likely to be more costly and lower yielding than planting on coconut lands.

The paper also looks at different ways in which an SRC crop can be grown, such as a support for pepper vines with the pruned branches available for woodfuel; as a monocrop and interplanted with coconut. Cost and returns for monocrop cultivation of coconut was obtained (Gunathilake, 2005) to provide a comparison but as this did not produce a positive net present value it has not been included. Lastly we look at the net returns from the production of *Calliandra calothyrus*, an alternative to *Gliricidia* at higher altitudes.

Methodology

To compare the relative financial performance of annual crops their gross margins - the value of their production minus variable costs per given area (normally an acre or hectare) - are calculated. To compare the contribution of crops that have a life cycle longer than a year the calculation must also take account of the fact that money is tied up in them for longer and that money received in the future is valued less than the same sum now (in the present). In financial appraisal this principle is accommodated by discounting to produce a net present value (NPV). Its application allows future income receipts from the investment to be expressed in terms of (lower) 'present

[1] Socio-economics & Planning Centre, Peradeniya

[2] Maha covers the period October – March and Yala is April - September

values'. The choice of discount rate is important because the main costs generally occur early on with the main benefits flowing several years later. The higher the discount rate the lower the present value of benefits compared to the discounted costs and the more likely that the benefit-cost comparison will be unfavourable (ODA, 1988). The discount rate (= opportunity cost of capital) used here is taken as 12% (Government Treasury Bond rate). It is also the rate charged by a local finance company (Seneviratne, pers.com.) Sri Lanka is considered to have higher cost agricultural finance than in other Asian countries; access to finance is costly and limited. This rate may, therefore, be on the low side. However, private companies may be able to access finance at lower rates and for this reason we also consider the impact of using an 8% discount rate in the sensitivity analysis.

Comparing the annual net return of annual crops with longer-term crops requires that the NPV is converted to an equivalent annual value (EAV)[3] which can then be compared to a gross margin (for similar areas and climatic zones). The EAV is an annuity or annual set payment that would have the same net present value as the actual income streams, which could be positive one year and negative the next (Godsey, 2003).

This paper considers only the financial aspects of crop and SRC production. It does not consider investment and credit aspects, environmental costs and benefits and social and cultural aspects mentioned elsewhere in the toolbox.

Analysis, conclusions and recommendations are hampered by lack of reliable, replicated trial and pilot data for SRC and limited data for other crops. A number of assumptions have had to be made which will strike readers familiar with the country as incorrect. Any investor considering establishing SRC for a biomass energy plant would need to obtain up-to-date and data appropriate to the area under consideration. The methodology given here could still be followed.

The difference in which the yields of crops and wood are measured should be noted. Crop yields are given by weight, usually as kilograms per acre or hectare. Harvested wood yields are normally given as a volumetric measure, i.e. cubic metres per acre or hectare to take account of the water contained in freshly harvested wood. Here we have used weights for SRC output but confusion can arise over different rates paid according to its moisture content. It should also be noted that in Sri Lanka, the unit of field area still tends to be the acre (1 ha = 2.47 acres) and costs and yields discussed below are presented in reference to both hectares and acres, care should be taken when making comparisons that the basic units are the same.

Findings

1. Returns from annual crop production:

In most areas farmers are able to plant two crops per year, in the main *Maha* season (October to March) and in the second, *Yala*, season from April to September. The net

[3] For an explanation of the methodology used please see Jacobson, Michael (1998) Comparing values of timber production to agricultural crop production. University of Florida Cooperative Extension Service www.sfrc.ufl.edu/Extension/comp.pdf

income from the two crops should be added together to compare with the income of SRC, which is calculated on an annual basis although a plot may be continuously harvested. The total, or imputed, cost of production has been used in order to make comparison more realistic. This attributes a cost to inputs used such as own labour and already-owned equipment.

Table 1.

Groundnut production: net returns per acre (estimated 2003/04)
Maha crop - rainfed (Moneragala district)

Costs:	Imputed	17,404
Revenues:	Av Yld kg	528
	Price/kg	35
	Income	18,665
Net Revenue:	Rs.	**1,261**

Price and yield sensitivity

			Price (Rs/kg)	
Yield (kg)	**32**	**35.35**	**38**	**41**
430	-3,644	-2,204	-1,064	226
480	-2,044	-436	836	2,276
528	-508	**1,261**	2,660	4,244
580	1,156	3,099	4,636	6,376
630	2,756	4,867	6,536	8,426

Source: Cost of cultivation of agricultural crops Maha 2003/04

Table 2.

Bushbean: net returns per acre (estimated 2004)
Yala crop - rainfed (Matale district)

Costs:	Imputed	39,782
Revenue:	Av Yld kg	1,932
	Price/kg	30
	Income	57,747
Net Revenue:	Rs.	**17,965**

Price and yield sensitivity

Yield (kg)			Price (Rs/kg)	
	27	**29.89**	**33**	**36**
1,500	718	5,053	9,718	14,218
1,700	6,118	11,031	16,318	21,418
1,932	12,382	**17,965**	23,974	29,770
2,100	16,918	22,987	29,518	35,818
2,300	22,318	28,965	36,118	43,018

Source: Cost of cultivation of agricultural crops Maha 2003/04

Supposing that the information in tables 1 and 2 came from the same area, we could then add the two net revenues of Rs. 1,261 + Rs. 17,965 to obtain the annual return of Rs. 19,226. This means that a farmer would need to earn more than this from other crops to make it worthwhile switching. In some situations the net returns are much lower. The price and yield sensitivity matrix shows how a slight change in yield and price can affect net income.

In Andradhapura, for example, where maize is more widely grown, another crop, such as an SRC, might give better returns if there was a market available for the produce.

Table 3.

Maize production: net returns per acre (estimated 2003/04)
Maha crop - rainfed (Anuradhapura district)

Costs:	Imputed	15,710
Revenues:	Av Yld kg	1,031
	Price/kg	15
	Income	15,774
Net Revenue:		**65**

Price and yield sensitivity

Yield (kg)	**Price (Rs/kg)**			
800	**14**	**15.3**	**16**	**17**
900	-4,510	-3,470	-2,910	-2,110
1,031	-3,110	-1,940	-1,310	-410
1,100	-1,276	**65**	786	1,817
1,200	-310	1,120	1,890	2,990
	1,090	2,650	3,490	4,690

Source: Cost of cultivation of agricultural crops Maha 2003/04

2. Returns from SRC production

In the first comparison we consider the returns from selling the sticks (stems) from *Gliricidia sepium,* coppiced regularly as part of the pepper management system. The data provided in table 4 below does not impute a value for the green manure produced by the *Gliricidia.* Pepper is said to require a considerable amount of nourishment, and the use urea plus other fertilisers are advised (Agricola, 1978). Gliricidia foliage is well-known for its nitrogen content and it is one of several species farmers are recommended to plant along paddy field boundaries to provide green manure (Agricola, op.cit.) .

In addition to the income gained from selling SRC a farmer would also receive the income from pepper sales. Yields are in the region of 140 to 200 kg/acre with prices fluctuating between Rs. 130 – 280/kg, giving a gross income between Rs. 18,200 – 56,000. Production costs, including planting of *Gliricidia sepium* cuttings, are not known. The price and sensitivity matrix shows that at very low wood yields farmers would appear to incur a loss from harvesting the *Gliricidia.* However, pruning *Gliricidia* shoots is an important part of pepper cultivation and would have to be done anyway, whether or not there was a market for the prunings. Pepper farmers sometimes give away the prunings to village committees to build temporary structures in the village during religious festivals (Perera, pers.com). It is interesting to note in the study of the Walapane power plant that little wood was supplied during April and no wood in May – the main months for festivals.

Table 4.

Net returns to *Gliricidia sepium* /acre: support for pepper and sale of prunings

Trees per acre: 700

Costs:	Imputed	2,700	(harvesting, not establishment)	
Revenues:	Av Yld kg	2,500	4,904	8,500
	Price/kg	1	1	1
	Income	2,500	4,904	8,500
Net Revenue:	Rs.	-200	2,204	5,800

Price and yield sensitivity

	Price (Rs/kg)			
Yield (kg)	**1**	**1.5**	**2**	**2.5**
2,500	**-200**	1,050	2,300	3,550
3,500	**800**	2,550	5,100	6,050
4,500	1,800	4,050	8,100	8,550
6,500	3,800	7,050	14,100	13,550
7,500	4,800	8,550	17,100	16,050
8,500	**5,800**	10,050	20,100	18,550

Source: computed from information provided by E. Kumarage, H. Ranasinghe

Table 5 overleaf gives an estimate of the returns from a dedicated *Gliricidia sepium* plantation. The data, provided in a CRI paper (Gunathileke, 2004), were only available for five years. The NPV is low and the EAV is Rs.885, which is much lower than being obtained for several rain-fed annual crops. The yield data was extended for another five years, which is probably a more realistic length of planting, and this gives a much more encouraging NPV of Rs, 24,435 with an EAV of Rs. 4,115. This is still considerably lower than the annual return of some field crop combinations but it could provide useful income on land that had few alternative uses. The yield, at maturity, is given as 25 tonnes per acre. This equates to 60 tonnes per hectare which is much higher than current yield expectations. The price per stem, at Rs.1 is low. Sensitivity analysis shows the impact of higher prices.

Table 5.

Net returns to *Gliricidia sepium* /acre (mononcrop on coconut land)

5 - 10 years; 12% discount rate

Trees per acre: 3,300 Income @ Rs./stem: 1

Basic model

Year	**1**	**2**	**3**	**4**	**5 - 10**
Yld/acre (t)	3	15	20	20	25
Income (Rs.):					
Foliage	760	1,520	3,100	3,600	4,300
Stems (Rs)		3,300	15,000	20,000	25,000
Total	760	4,820	18,100	23,600	29,300

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Costs	12,850	5,700	12,200	15,200	20,200	20,200	20,200	20,200	20,200	20,200	20,200
Revenue*	760	4,820	18,100	23,600	29,300	29,300	29,300	29,300	29,300	29,300	29,300
Net Rev	-12,090	-880	5,900	8,400	9,100	9,100	9,100	9,100	9,100	9,100	9,100
					NPV	3,205				NPV	24,435
					EAI	889				EAV	4,115

* sale of stems plus value of foliage

Source: Gunathilake (2004) Planting gliricidia in coconut lands, CRI

Price and yield sensitivity

	NPV 8%	**EAV 8%**	**NPV 12%**	**EAV 12%**
Basic model	33,733	5,681	24,435	4,115
Income Rs2/st	158,841	26,750	122,961	20,708
Income Rs3/st	283,950	47,819	221,488	37,300
Yield ↑by 25%	65,010	10,948	49,067	8,263
Yield ↑by 50%	96,287	16,215	73,698	12,411

Table 6.

Net returns to Gliricidia sepium/ha (intercropped with coconuts)

Trees per acre: 900

5 - 10 years; 12% discount rate Income @ Rs./stem: 2.6

Year	**1**	**2**	**3**	**4**	**5**
Income (Rs.):					
Foliage	2064	2,576	3,278	5,200	6,208
Stems		32,989	49,213	54,621	65,707
Total	2,064	35,565	52,491	59,821	71,915

Source: Gunathilake at al (2005)

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Costs	20,700	19,000	26,500	29,000	34,000	34,000	34,000	34,000	34,000	34,000	34,000
Revenue	2,064	35,565	52,491	59,821	71,915	71,915	71,915	71,915	71,915	71,915	71,915
Net Rev	-18,636	16,565	25,991	30,821	37,915	37,915	37,915	37,915	37,915	37,915	37,915
				5 years	NPV	56,167			10 years	NPV	144,620
					EAI	15,580				NPV/ac	58,551
										EAV	24,355
Discount rate sensitivity (returns per acre)										EAV/ac	9,860

		NPV 8%	**EAV 8%**	**NPV 12%**	**EAV 12%**
Basic model		75,032	12,636	58,551	9,860
Rs/kg:	1.5	13,549	2,282	9,458	1,593
	2	41,495	6,988	31,773	5,351
	3	97,389	16,401	76,403	12,867

Table 6 provides more recent data, including higher prices for the stems. The EAV is lower for intercropping than for a monocrop SRC when similar wood prices are used i.e. EAV at Rs.1.5/stem is Rs.1,593 compared to an EAV of Rs.4,115 for an SRC monocrop at Rs.1/stem.

Calliandra calothryus is a possible SRC for higher areas. It is currently grown on some tea estates.

Table 7a.

Caliandra calothrysus: Returns per ha (Rs.)

Basic model

Year	**1**	**2**	**3**	**4**	**5 - 10**
Plants/ha	6,000	6,000	6,000	6,000	6,000
kg/plant	4	6	8	8	8
Yld/ha (t)	24	36	48	48	48
Income/t	2,000	2,000	2,000	2,000	2,000
Revenue	48,000	72,000	96,000	96,000	96,000

Source: Growth and Development of SRC

From the data given in table 7a, above, the net present value and annual equivalent value per hectare were then calculated. According to the figures given by a tea estate currently growing the crop, the NPV is quite reasonable if the trees are able to yield continuously for 10 years (At five years the NPV is negative). Yield increases could significantly improve profitability (see table 7b).

Table 7b Calliandra NPV (per hectare) and EAV (per hectare and per acre)

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Revenue			48,000	72,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000
Costs	96,700	23,400	24,000	36,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000
Net Rev	-96,700	-23,400	24,000	36,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000
					NPV 12%		-13,477		NPV 12%		74,185
					IRR		8%		IRR		24%
					EAV		-3,739		EAV		13,130
									EAV/acre		5,316

Table 7c Calliandra price and yield sensitivity

	NPV 8%	**EAV 8%**	**EAV/acre**	**NPV 12%**	**EAV 12%**	**EAV/acre**
Basic model	119,602	21,168	8,570	74,185	13,130	5,316
Income 3,000/t	348,804	61,735	24,994	141,382	25,023	10,131
Income 4,000/t	578,005	102,301	41,417	432,541	76,551	30,992
Yield ↑by 25%	229,611	40,639	16,453	160,293	28,370	11,486
Yield ↑by 50%	348,804	61,735	24,994	253,363	44,843	18,155

Table 8 indicates that the estimated net annual returns per acre from SRC production are not currently competitive compared to net returns from field crop production, based on the information available. This is a very similar situation to that in the UK

Table 8. Comparing average annual returns: (gu)estimate of possible returns per acre

	Field crops	**Pepper and Gliricidia**	**Gliricidia monocrop**	**Gliricidia intercropped with coconut**	**Calliandra monocrop**
Average annual net return/acre	Rs. 17,965	Up to Rs. 5,800 + pepper net income	Rs. 4,115	Rs.1,593+ coconut net income	Rs.5,316

Conclusions and recommendations

The paper has shown how investing in SRC can be analysed, comparing it to other agricultural land uses from a farmer or plantation owner's perspective.

The figures must be regarded as tentative for, as explained in the introduction, the data available on SRC is particularly sparse and sometimes inconsistent. However, the findings are broadly indicative of some of the issues facing SRC producers, both in developed as well as in developing countries. The price being offered per kilogram is

very low and this in combination with the type of yields that can currently be achieved means that returns are very low. Market conditions may change in future and provide much greater returns from investing in SRC production.
Developing country SRC production may well attract CDM payments in future which could, perhaps, allow higher unit rates. Sensitivity analyses show that that increases in unit prices have the greatest impact on improving profitability. However, it is important that research attention is focused on improving yields and that the best provenances are selected and promoted in order to maximise financial potential.

In addition, it should be noted that the growing of SRC does not necessarily have to mean competition with other agricultural crops, but could be an additional activity that can provide another source of income, using labour at a time of the year when demand for labour inputs for agricultural crops may be lower. The growing of SRC in a country like Sri Lanka is one alternative land use strategy for the poorer-quality land currently under-used for agricultural production. It has been suggested (Seneviratne, pers.com.) that on the plains, in the east and north of the country people have small areas of non-prime land which could be planted to an SRC crop. SRC may offer opportunities for poorer, dryer areas where rainfall and moisture levels are more predictable.

As pressures grow to reduce global carbon emissions the government may obtain resources which could be used to support the growing of SRC and this could be area specific i.e. government policy support to SRC in poorer areas with fewer employment options. The UK government has recognised that energy from crops, trees and waste can play a key role in meeting targets on renewable power and cutting carbon dioxide emissions. It also realises that with present costs and prices farmers needed financial support and has provided a series of measures to support the development of biomass energy production, including the creation and management of SRC (DEFRA, 2006).

Continued research is necessary to gain an increased understanding of the implications of promoting SRC. The next paper in this section identifies a number of issues that were identified at a particular site in the country, such as labour availability at certain times of the year and the fact that younger people tended to be less interested in supplying wood. A number of parameters relating not only to land use but also to other factors of production need to be better understood.

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