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Cost benefit analysis to introduce bamboo plantations as an alternative fuel wood for industrial bio mass power plants in Sri Lanka

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Abstract: The bio mass energy demand in Sri Lanka has increased significantly with its developing industrial sector and especially with the tea industry. Timber plantation for fuel wood and timber is not enough meeting energy demand in Sri Lanka. While long term uncertan dependency on fossil fuels has resulted in an increasing demand for renewable energy. However, within this crucial problem in biomass energy production in Sri Lanka, selection of alternative bio Mass timber which could provide a sustainable supply of feedstock without having an impact on food security and the environment is a necessity. In this context, promote using bamboo, a perennial grass, as a potential alternative for biomass energy in Sri Lanka. Since bamboo is already growing along the riverine areas in Sri Lanka, In this research highly focused on economical characteristics of bamboo along with the *Gliriceedia* and multi cropping with ginger and turmeric as a economical support crop for bio mass energy issue in Sri Lanka. Further bamboo has many ecological and socioeconomic benefits; there can be several challenges in bamboo cultivation and management for bioenergy production. Bamboo plantations managed properly since the some plant species can pose a threat as an invasive species, as it can displace the surrounding native vegetation. Bamboo monocultures/intercrops with selected crops can increase the forest cover and the bio diversity to increase the carbon sequestration.
Keywords: biomass; cost benefit analysis; energy; alternative crop; Sri Lanka; cultivation

Introduction

World bio mass crisis is a broad development context, in terms of the implications of bio mass energy, scarcity and environmental damage for private and public choice. In Sri Lanka too the bio mass energy crisis is widening with the shortage of fuel wood. Tea industry, ceramic industry, tyre manufacturing industry, cement industry, hospitality and tourism, national hospitals, bakery industry are main victims facing for this issue.

Bamboo plantations are common in riverine areas in all-over the country and most common and widely planted species is *Dendrocalumus vulgaris*. Depending on calorific value of bamboo species it is very much important to plant bamboo with other economically important crops. Therefore select *Gliriceedia*,g inger, and turmeric intercrop with bamboo to gain economic value to the plantation.

Methodology

Data collection were done by using qualitative and quantitative methods. Research was conducted in 2020 within a period of 3 months.

The data collection includes with the interview of main *Gliriceedia* planting companies in Sri Lanka .Site visits were done to collect the details of bamboo plantations along Ging ganga (River Gin) area in Southern Sri Lanka. The interviews contents with the village people, government officials, department of irrigation and professionals Etc, sample size of 100.

Nursery management data were collected from the government farm in Sri Lanka and personally attend for the planting and nursery management practice in the fieldsat Kurunagala and suburbs.

Results and Discussion

Based on research findings,

1) Approximate Cost and Selling price at Colombo market using exsisting bamboo reasourese as follows (for 350 units),

Vehicular transportation of bamboo	Unit	Rate	No of unit	Amount	
Royalty or payment for owners	Calms	25.00	350	8,750.00	
Extraction labour	Rate	25.00	350	8,750.00	
Sizing labour	Rate	5.00	350	1,750.00	
Manual transportation and loading labour	Labour day	1,250.00	3	3750.00	
Transportation cost 160 km at Rs.75/km	Rate (Both way)	75.00	160	12,000.00	
Unloading cost	Sum	1,000.00	1	1,000.00	
Other cost	Sum	1,000.00	1	1,000.00	
Total cost				37,000.00	
Cost to the supplier at Colombo market					106.00
Profit	Rate	60.00	350	21,000.00	
Delivered price including profit				58,000.00	
Delivered price per calm at Colombo					166.00

Table 01– 2019 analysed data

Chipping cost using existing bamboo resources as follows (for 1000 Bamboos),

Item	Unit	Rate	No of unit	Amount(Rs)	Amount (US$)
Obtaining permits including royalty or payment for owners	Calms	75	1000	75,000.00	581.395
Extraction labour	Rate	25	1000	25,000.00	193.798
Sizing labour	Rate	5	1000	5,000.00	38.760
Manual transportation loading and unloading labour	Labour day	800	9	7,200.00	55.814
Total cost up to processing plant				112,200.00	869.767
Wet weight of bamboo	Kgs	25	1000	25,000.00	193.798
Dry weight (20%) of bamboo Assuming 60 % at fresh	Kgs	12.5	1000	12,500.00	96.899
Cost before chipping per Kg @ dry basis@ 20% M.C.				8.976	0.070
Chipping cost Rs. 1.00 for one Kg of chips(Assumption)				1	0.008
Other handling cost after chipping including drying(Assumption)				0.5	0.004
Total cost 1 kg of dried chips at processing plant				10.476	0.081
Volume of dry chips of 1000 bamboo (Bulk density 233 kg/m3)	Kgs	233	12500		53.65 m^3

Table 02: 2019 analyzed data

Chipped bamboo verses bamboo calm transportation

Bamboo large scale market requires different type of raw materials. However, using bamboo as a dedicated energy crop for large scale biomass production will have some drawbacks compare to other energy crop such as:

- It is difficult to mechanize harvesting because only mature shoots should be harvested selectively.
- Non-energy applications in most cases have a more extractive market
- Bamboo has to be established vegetative rather from seeds, making large Plantings relatively expensive
- It takes several years to get steady production.
- Quality for thermal conversion is lower than other wood.

Bamboo biomass has both advantages and disadvantages in comparison to other type of energy source. It is hard to evaluate the suitability of bamboo biomass in energy sector in general. Instead, growers should put it in context to assess whether to choose bamboo to be planted and use as a sustainable energy source.

The following table shows the production forecast of the 100 Ha bamboo plantations

Bamboo plantation production forecast (100Ha)	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Total yield in air dry weight (24% Moisture)	Mt					93	747	1,493	1,867
Bamboo bio mass (24% Moisture)	Mt					93	747	747	933
Bamboo poles (8 Mid culms segments)	Pcs							53,402	66,752

Table3: Production forecast

Market research

1. High demand for activated carbon (1300-2800/t USD) Due to high demand on coconut charcoal, activated carbon users are deviating to alternative solutions. Proposed bamboo project - Asset Holdings, can be addressed this trend.
2. Price escalation of coco shell (price 80-130 USD/t) Due to high demand of coco shell activated carbon, price fluctuations cannot be controlled.
3. Implement green business concept -Bio based economy has long term sustainable returns to society.
4. Produced bio char for affordable prices - Prices of bio mass raw materials relatively low comparative to the coco shell. Prices of alternative bio char gets down.

Managing market risks

1. Scarcity of bio mass raw material bamboo/ *Glidiceria* framing project with KPL, Plant relocating according to biomass availability, diversified raw materials
2. Lack of thermal application Set up a coconut coir dust / crop drying facility
3. Decline of charcoal demand - convert business to bio char compost, marketing bio charcoal as barbecue applications
4. Plant availability - smart monitoring mechanisms to secure high plant availability

Economic Analysis of Briquetting

Cost analysis of a briquetting plant is highly profitable.

The potential types of biomass under this category are **rice husk, coffee husk and groundnut shells**.

Capacity Basis:	
Two machines each	750 kg/hr
Production capacity	1.5 T/hr (20 hrs/day operation)
Operating days per year	300
Operating hours per year	6000
Capacity utilization	85%
Raw material	8000 TYP
Moisture losses	350 TYP
Briquettes produced	7650 TYP
Briquettes consumed (Dryer)	600TYP
Saleable production	7050 TYP

Table 4: saleable production of briquettes

Infrastructural facilities	
Power 150 KW	
Land area 3000m2	
Operational shed area 240 m2	
Briquetting storage (covered area) 250 m2	
Cost of production	
Power	136.70
Manpower	67.50
Water	8.00
Maintenance (including consumables)	76.70
Administrative overheads	43.00
Depreciation (Plant 10% Building 5%)	74.10
Subtotal	406.00
Financial cost per tonne	91.50
Cost of production	497.50 = Rs. 500/
Overall cost of production per year	38.25 lac

Table 5: Overall cost of production per year

Profitability Basis:	
Cost of raw material per tonne	500/
Net sale price of briquettes per tonne	Rs. 1450/
Total sales	(1450 x 7050) 102.22
Production cost	(500 x 7650) 38.25
Raw material	(500 x 8000) 40.00
Gross profit before taxes Pay	23.97
2.5 years	

Table 6: Profitability chart

The above analysis is based on a screw press costing Rs.9.0 lat. Plants with less than two machines are not recommended. However, plants with more machines will definitely have better profitability and advantages of scale of operation can be derived.

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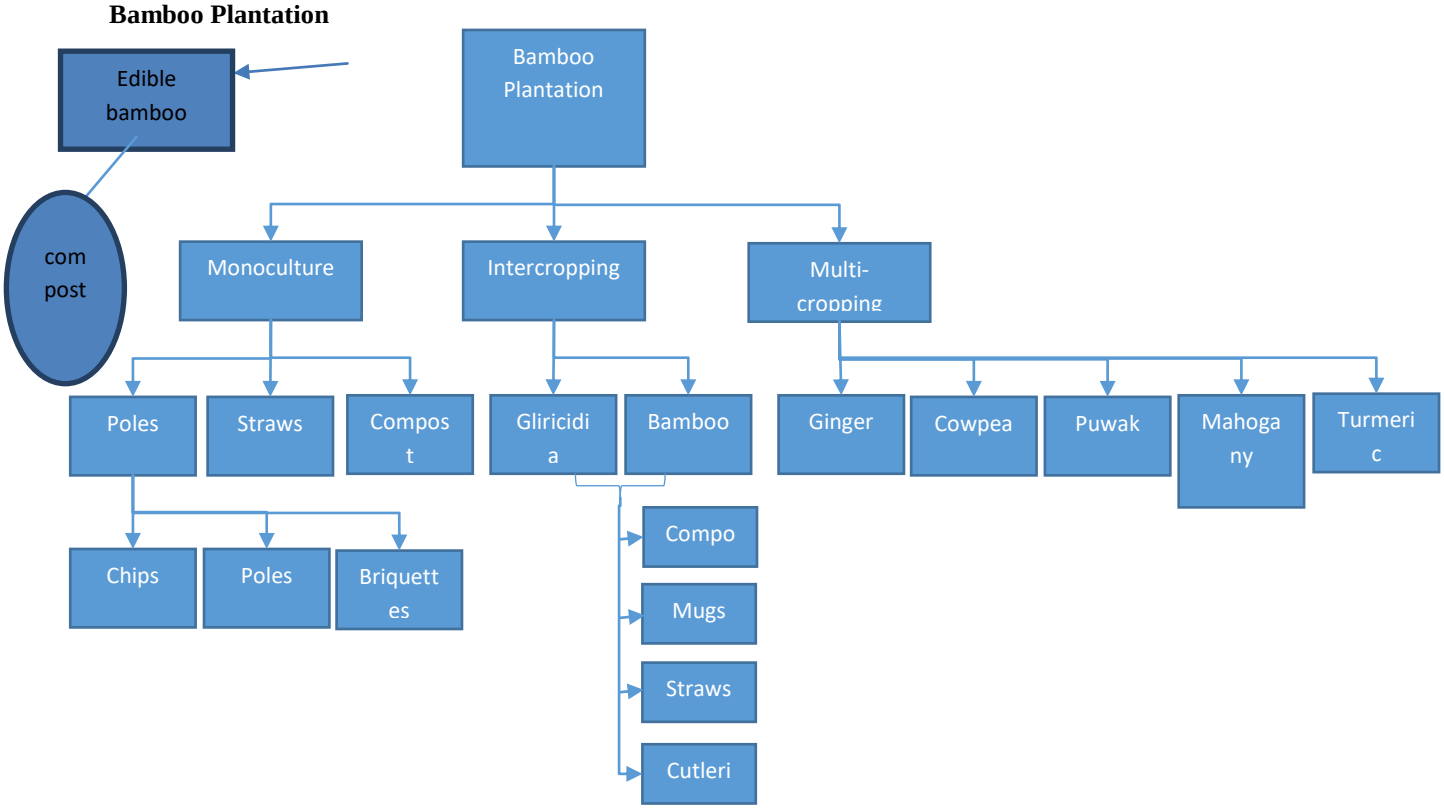
Bamboo Plantation



Financial analysis of Bamboo plantations (100 Ha)
Mono culture bamboo Plantation

The advantage of bamboo is manifold compared to monoculture tree plantations. After planting, bamboo clumps start yielding after 3 -7 years. It can become part of agro forestry practice in small land holdings. New bamboo plantations may curb the pressure from deforestation by serving as wood substitutes. From 1st year on words bamboo leaves could be used as composting and bamboo straw production from the smaller branches.

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Total Investment Cost

Total Investment	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Total Fixed Investment Cost	8,615	947	63	63	1,093	1,299	475	475	475	475	475	475	475	475	475
Increase/ (Decrease) in Net W/C	1,625	30	(65)	3	1,639	144	587	110	28	(37)	(49)	-	-	-	-
Total Investment Cost	10,239	977	(1)	66	2,732	1,443	1,062	586	503	438	426	475	475	475	475

Business Results

Income Statement	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Sales revenue	-	-	-	-	706	5,511	35,513	47,976	49,445	49,939	49,939	49,939	49,939	49,939	49,939
Less- Variable cost	3,060	3,198	2,862	2,862	2,852	3,116	4,850	5,190	5,207	5,207	5,207	5,207	5,207	5,207	5,207
Material	60	246	30	30	6	6	6	6	6	6	6	6	6	6	6
Personnel	2,700	2,700	2,700	2,700	2,700	2,700	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600
Marketing	-	-	-	-	15	125	781	1,032	1,049	1,049	1,049	1,049	1,049	1,049	1,049
Contingencies	300	252	132	132	130	286	463	552	552	552	552	552	552	552	552
Variable margin	(3,060)	(3,198)	(2,862)	(2,862)	(2,146)	2,395	30,663	42,787	44,237	44,732	44,732	44,732	44,732	44,732	44,732
Less- Fixed Cost	5,063	5,076	5,089	5,101	5,320	5,516	5,599	5,681	5,763	5,640	5,475	5,475	5,475	5,475	5,475
Land Lease Cost	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Depreciation	63	76	89	101	320	516	599	681	763	640	475	475	475	475	475
Operational Margin	(8,123)	(8,274)	(7,951)	(7,963)	(7,466)	(3,121)	25,064	37,106	38,474	39,092	39,257	39,257	39,257	39,257	39,257
Financial cost	-	-	-	-	35	276	1,776	2,399	2,472	2,497	2,497	2,497	2,497	2,497	2,497

Gross profit	(8,123)	(8,274)	(7,951)	(7,963)	(7,501)	(3,397)	23,289	34,707	36,002	36,595	36,760	36,760	36,760	36,760	36,760
Less- Income tax	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Profit	(8,123)	(8,274)	(7,951)	(7,963)	(7,501)	(3,397)	23,289	34,707	36,002	36,595	36,760	36,760	36,760	36,760	36,760

Figure 9 - Only Gliricidia for 100 Ha (LKR 000')

Revenue Description	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**
Income – Wood	-	13,608	27,216	45,359	45,359	45,359	45,359	45,359	45,359	45,359	45,359	45,359	45,359	45,359	45,359
Income - Leaf	452	7,502	11,068	12,626	15,179	15,179	15,179	15,179	15,179	15,179	15,179	15,179	15,179	15,179	15,179
TOTAL REVENUE	**452**	**21,110**	**38,284**	**57,986**	**60,538**	**60,538**	**60,538**	**60,538**	**60,538**	**60,538**	**60,538**	**60,538**	**60,538**	**60,538**	**60,538**
REVENUE PER PLANT	**0.00**	**0.21**	**0.38**	**0.58**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**	**0.61**

Costing Description	**Year1**	**Year2**	**Year3**	**Year4**	**Year5**	**Year6**	**Year7**	**Year8**	**Year9**	**Year10**	**Year11**	**Year12**	**Year13**	**Year14**	**Year15**
Land Clearing & Preparation	750	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting - Sticks and Transport (Rs.6/= & Rs.2/= Each)	8,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting – Workers	750	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fencing - Materials (Barb Wires, Fencing Poles and Other)	2,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fencing – Workers	1,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fencing - Maintenance workers	-	750	750	750	750	750	750	750	750	750	750	750	750	750	750
Weeding	1,500	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Harvesting - Workers	-	3,750	7,500	12,375	12,375	12,375	12,375	12,375	12,375	12,375	12,375	12,375	12,375	12,375	12,375

Harvesting - Transportation(Vehicle Hire, etc.)	-	600	1,200	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Re Planting of Diebacks (20% - 2,000 plants / Ha)															
Planting - Sticks and Transport (Rs.6/= & Rs.2/= Each)	1,600	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting – Workers	1,050	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL DIRECT COST	**17,650**	**8,100**	**12,450**	**18,125**	**18,125**	**18,125**	**18,125**	**18,125**	**18,125**	**18,125**	**18,125**	**18,125**	**18,125**	**18,125**	**18,125**
DIRECT COST PER PLANT	**1.77**	**0.81**	**1.25**	**1.81**	**1.81**	**1.81**	**1.81**	**1.81**	**1.81**	**1.81**	**1.81**	**1.81**	**1.81**	**1.81**	**1.81**
TOTAL CONTRIBUTION - FROM BOTH WOOD & LEAF	**(17,199)**	**13,010**	**25,834**	**39,861**	**42,413**	**42,413**	**42,413**	**42,413**	**42,413**	**42,413**	**42,413**	**42,413**	**42,413**	**42,413**	**42,413**
CONTRIBUTION PER PLANT	**(1.72)**	**1.30**	**2.58**	**3.99**	**4.24**	**4.24**	**4.24**	**4.24**	**4.24**	**4.24**	**4.24**	**4.24**	**4.24**	**4.24**	**4.24**
TOTAL CONTRIBUTION - FROM WOOD ONLY	**(17,650)**	**5,508**	**14,766**	**27,234**	**27,234**	**27,234**	**27,234**	**27,234**	**27,234**	**27,234**	**27,234**	**27,234**	**27,234**	**27,234**	**27,234**
CONTRIBUTION	**(1.77)**	**0.55**	**1.48**	**2.72**	**2.72**	**2.72**	**2.72**	**2.72**	**2.72**	**2.72**	**2.72**	**2.72**	**2.72**	**2.72**	**2.72**

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PER PLANT															

Admin Costing Description	Year1	Year2	Year3	Year4	Year5	Year6	Year7	Year8	Year9	Year10	Year11	Year12	Year13	Year14	Year15
Land Lease Cost	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Contingencies (10% from Direct cost)	(1,765)	551	1,477	2,723	2,723	2,723	2,723	2,723	2,723	2,723	2,723	2,723	2,723	2,723	2,723
Depreciation	-	-	-	-	8	62	390	516	525	525	525	525	525	525	525
Direct Marketing Cost															
TOTAL ADMIN COST	**3,235**	**5,551**	**6,477**	**7,723**	**7,731**	**7,786**	**8,114**	**8,239**	**8,248**	**8,248**	**8,248**	**8,248**	**8,248**	**8,248**	**8,248**

PBT- FROM BOTH WOOD & LEAF	**(20,434)**	**7,459**	**19,357**	**32,137**	**34,682**	**34,627**	**34,299**	**34,174**	**34,165**	**34,165**	**34,165**	**34,165**	**34,165**	**34,165**	**34,165**

PBT- FROM WOOD ONLY	**(20,885)**	**(43)**	**8,289**	**19,511**	**19,503**	**19,449**	**19,121**	**18,995**	**18,986**	**18,986**	**18,986**	**18,986**	**18,986**	**18,986**	**18,986**

Figure 10 : Gliricidia and Bamboo for 100 Ha (LKR 000')

RevenueDescription	Year1	Year2	Year3	Year4	Year5	Year6	Year7	Year8	Year9	Year10	Year11	Year12	Year13	Year14	Year15
Income-Bamboo	-	-	-	-	353	2,756	17,756	23,988	24,722	24,969	24,969	24,969	24,969	24,969	24,969
Income-*Gliricidia* Wood	-	13,608	27,216	45,359	45,359	45,359	45,359	45,359	45,359	45,359	45,359	45,359	45,359	45,359	45,359
Income-*Gliricidia* Leaf	23	375	553	631	759	759	759	759	759	759	759	759	759	759	759
TOTAL REVENUE	**23**	**13,983**	**27,769**	**45,991**	**46,471**	**48,874**	**63,875**	**70,106**	**70,840**	**71,088**	**71,088**	**71,088**	**71,088**	**71,088**	**71,088**

Costing Description	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Land Clearing & Preparation	750	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Plant purchasing - Bamboo (Rs.85/= per plant)	1,063	213	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant purchasing - Gliricidia Sticks and Transport (Rs.6/= & Rs.2/= Each)	4,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting - Workers for Bamboo &*Gliricidia*	750	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planting - Farm Tools for Bamboo & *Gliricidia*	144	29	29	29	497	590	216	216	216	216	216	216	216	216	216
Planting - Fertilizer & other supplies for Bamboo & *Gliricidia*	40	40	40	40	40	40	40	40	40	40	40	40	40	40	4
Contingencies - Farm Tools for Bamboo &*Gliricidia*	29	6	6	6	99	118	43	43	43	43	43	43	43	43	2
Contingencies - Plantation Development for Bamboo& *Gliricidia*	573	34	-	-	-	-	-	-	-	-	-	-	-	-	-
Fencing - Materials (Barb Wires, Fencing Poles and Other)	2,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fencing – Workers	1,500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fencing - Maintenance workers	-	750	750	750	750	750	750	750	750	750	750	750	750	750	750
Weeding	1,500	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Harvesting – Workers	-	3,750	7,500	12,375	12,375	12,375	12,375	12,375	12,375	12,375	12,375	12,375	12,375	12,375	12,375
Harvesting - *Grilicidia* Bamboo Transportation(Vehicle Hire, etc.)	-	200	400	667	667	667	667	667	667	667	667	667	667	667	667
Re Planting of Diebacks (20% - 2,000 plants / Ha)															
Re-Planting - Sticks and Transport (Rs.6/= & Rs.2/=	800	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Each)															
Re-Planting – Workers	525	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL DIRECT COST	**14,173**	**8,021**	**11,725**	**16,866**	**17,428**	**17,540**	**17,091**	**17,091**	**17,091**	**17,091**	**17,091**	**17,091**	**17,091**	**17,091**	**17,014**
TOTAL CONTRIBUTION - FROM BOTH BAMBOO & GRILICIDIA	**(14,151)**	**5,962**	**16,044**	**29,124**	**29,043**	**31,334**	**46,784**	**53,016**	**53,750**	**53,997**	**53,997**	**53,997**	**53,997**	**53,997**	**54,074**

Admin Costing Description	**Year1**	**Year2**	**Year3**	**Year4**	**Year5**	**Year6**	**Year7**	**Year8**	**Year9**	**Year10**	**Year11**	**Year12**	**Year13**	**Year14**	**Year15**
Land Lease Cost	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Contingencies (10% from Direct cost)	1,417	802	1,172	1,687	1,743	1,754	1,709	1,709	1,709	1,709	1,709	1,709	1,709	1,709	1,701
Depreciation	32	38	44	51	160	258	299	341	382	320	238	238	238	238	238
Direct Marketing Cost	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL ADMIN COST	**6,449**	**5,840**	**6,217**	**6,737**	**6,903**	**7,012**	**7,008**	**7,050**	**7,091**	**7,029**	**6,947**	**6,947**	**6,947**	**6,947**	**6,939**
PBT- FROM BOTH BAMBOO & GRILICIDIA	**(20,600)**	**122**	**9,828**	**22,387**	**22,140**	**24,322**	**39,775**	**45,966**	**46,659**	**46,968**	**47,050**	**47,050**	**47,050**	**47,050**	**47,135**

Table7: - Bio mass - Monoculture (Bamboo) for 100 Ha (LKR 000')

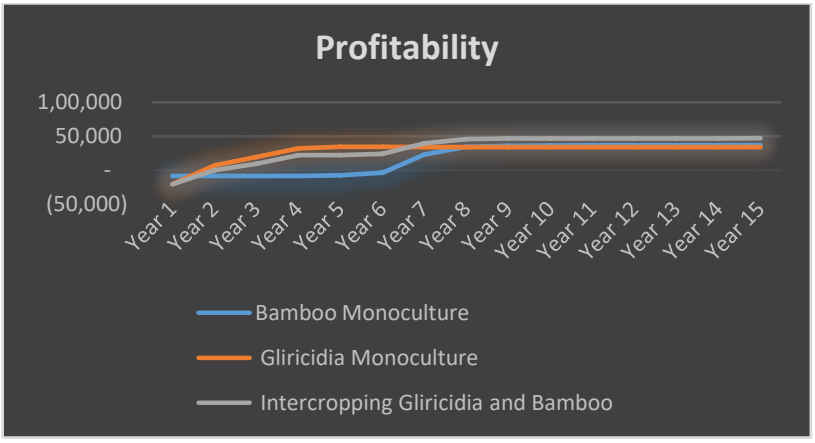
Further following financial benefit also can be achievable through the same planation and through these alternatives we can secure loss income or negative income impact in very beginning of the main project.

Multi-cropping (Bamboo & Gliricidia & Ginger or turmeric)

Under this method we can plant Bamboo & Gliricidia with Ginger or Turmeric.

Plant layout details for 100 Ha
Bamboo Trees – 10,000
Gliricidia Tress – 500,000
Turmeric or Ginger (yield) – 2,200 Tons per year
Farm gate prices
Turmeric - LKR 6,650 per Quintal
Ginger – LKR 145 per Kg

Through the multiplying option we can incur more profitability as Turmeric & Ginger gives better prices as well as better yield throughout the year.



Graph 1: profitability analysis

As per the above profitability analysis it's clear that Intercropping (*Gliricidia* and bamboo) option gives more benefit to the company while achieving highest level of profitability. Further we can improve this profitability level through introducing Turmeric or Ginger to the same model (Multi-cropping)

Cost Comparison to identify the most feasible way of bamboo industry through Bamboo plantation
Edible bamboo Shoots

There are various bamboo species that are considered as multipurpose species, since mature culms from plantations raised for shoot production, can be used for other purposes like construction, furniture, handicrafts, agriculture implements etc. as well. The profitability of D.asper cultivation for shoot production and culm production was assessed through a Benefit – Cost Analysis(BCA) following Friday et al. (2000) and Purushothaman (2005).The financial returns from plantations raised for shoots production were estimated three years after planting. It becomes imperative to judge the viability of bamboo plantations through appropriate financial analysis, taking the time value of money into account. D.asper has a life span of around 40 years and is expected to keep producing shoots at least for 40 years, hence the time period taken for analysis was kept at 40 years.

As Bamboo plantation not giving considerable income generation in first 3 years, we can go for composting which can be sell LKR 80/- per Kg and Edible bamboos can be sell at LKR 1,800 per Kg

Importing seeds
initially we are planning to import 2Kg's bamboo seeds from China.
Approximately 80,000 bamboo plants can be predicted from 2 Kg's of seeds.

Cost for 2 Kg's	Amount
CIF price (US $)	1,628
CIF Price LKR	304,436
Duty & Clearing (LKR)	50,000
Total cost (LKR)	354,436

Nursery
Cost of establishing a Nursery will be as follows,

Description	Units	Amount
Poly Shelter 30m X 10m	1	1,200,000
Shade Net Role	10	120,000
Water Pump	1	50,000
PVC Pipe	200	220,000
2000L Water Tank	1	28,000
Poly bags	30,000	45,000
Cowdom cub	10	90,000
Coir Dust cube	10	55,000
Sand cube	3	45,000
Fuel	200L	21,200
Top soil cube	10	30,000
3/4" rubber horse	4	13,000
1" ball valve	10	4,000
Black Polythene	300 Kg	93,000
Fertilizer (NPK)	300 Kg	15,000
Captan	20	12,000
Wheel barrow	5	3,000
Mam maty	5	6,000
Saval	5	3,750
Water basket	10	6,500
1' GI Pipe	30	90,000
Labour 90 days (Rs. 1,100 Per day)	5 Labour	495,000
Total Cost of Nursery		**2,645,450**

Conclusion

This paper discusses the potential of bamboo intercropping with *Gliriceedia* as a bio mass energy production along with ginger and turmeric as intercropping to deliver other socio-economic and environmental benefits in Sri Lanka. However proper planning, management, and harvesting of bamboo has a great potential in bioenergy production. Bamboo is freely available, fast-growing, crop with multiple uses, can rapidly store and sequester carbon, grows in degraded lands, and has good fuel characteristics for modern bioenergy production.

According to the Cost benefit analysis to introduce bamboo plantations as an alternative fuel wood for industrial bio mass power plants in Sri Lanka, it proves a planter can have their profit after three years of continues planting and have profit with intercropping.