

## Sri Lanka Tea Plantations Industry – To diversify or not?

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**ABSTRACT:** Introducing and growing the species *Camellia sinensis*, notably by James Taylor, planting along the margins of the divisional roads on his coffee estate, finally 'saved the day' for the colonial economy and the Planter's Association in Ceylon when the coffee plantations, the foundation of the economy, were wiped out due to the coffee blight. Despite the deforestation caused, the Tea plantations prospered introducing 'Ceylon Tea', now well known around the world. The Tea Plantations Industry is now reported to be nonviable. Considering its importance to the economy of Sri Lanka, an implementable solution is needed to make it viable and vibrant once again to achieve high productivity from agricultural land under Tea. Analysing the available published data and information describing the problem indicates the answer lies in any form of diversification of uneconomical Tea. Diversifying with the species, *Pentadesma butyracea* has potential to increase exports and reduce imports ensuring benefits to all stakeholders and especially to the environment. *Pentadesma* oil extracted from the seeds of the species will be of interest at a time when it is necessary to avoid partial hydrogenation of vegetable oils which produces undesirable trans-fatty acids.

**KEYWORDS:** Sri Lanka tea plantations industry; Productivity; Cost of production; Net sales average; Diversification; *Pentadesma butyracea*

### Introduction

The almost 150-year-old Tea Plantations Industry (TPI) in Sri Lanka is considered very important to the economy and for providing employment in the country. "Ceylon Tea" is well known all over the world. To quote the Chairperson, SL Tea Board, "... the Colombo auction still gets the highest tea prices in the world. We are doing something right, we just need to protect it and sustain it".<sup>1</sup> In 2012, the TPI was based on 222,000 ha of agricultural land, with a total production of 326 m kg of made tea from 184,000 ha in bearing, averaging a yield of 1,771 kg ha<sup>-1</sup> with a cost of production (COP) of LKR. 391.39 per kg and received a net sale average (NSA) of LKR. 392.40 per kg.<sup>2</sup> Total 38,000 ha or 17% of the total extent of land under Tea was immature but will be in bearing in the near future. With the immature extent reaching maturity, the total annual production may increase even if the average yield continues to decrease in the extent in bearing at present.

The TPI is reported to be non-viable.<sup>3,4</sup> The main reasons given for the non-viability are as follows:

1. Increasing wages to and low productivity of workers.
2. Declining productivity due to the senility of the tea stock in the corporate tea sector and to

a lesser extent of the small holder growers who produce ~75% of the annual crop.

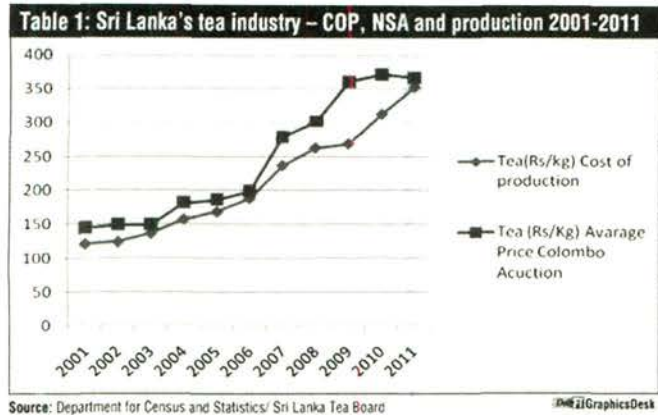
To overcome this situation, the Tea Research Institute of Sri Lanka (TRI) has recommended a scheme for a replanting programme, the main recommendation to be implemented, but the high cost of carrying it out, LKR. 3 m kg ha<sup>-1</sup> is reported to be not justifiable, given the escalating COP and the corresponding NSA value, which has been pointed out as the reason for the low replanting rate. The objective of this study was to analyse the published data and information in order to propose an



**Pentadesma butyracea - Planted in 1897  
National Botanical Garden - Peradeniya  
Sri Lanka**

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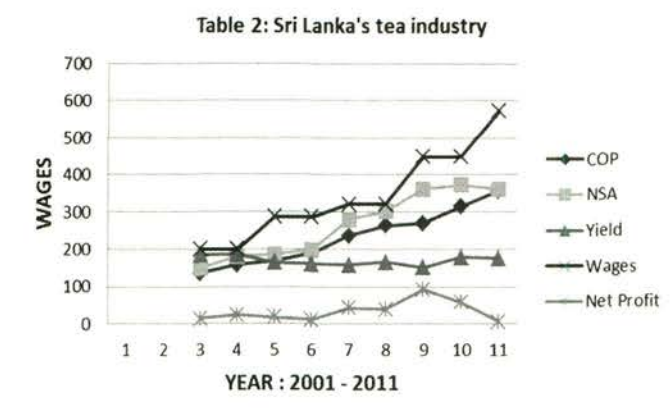


implementable solution, using available resources to an identified problem in order to make this important Sri Lankan agricultural industry viable and vibrant once again to discontinue or reduce further deterioration.

**Methodology**

The study was undertaken by analysing information and data available in published reports, articles in local publications and when necessary seeking information from sources outside the country. The reports and publications reviewed are listed at the end of this report.

“Ceylon Tea in catch-22?” describes in detail the non-viability of the TPI, explaining the reasons for the situation that is expected to worsen later on.<sup>3</sup> To quote, “Whilst some can say that the workers in a tea plantation must be remunerated as per the increasing quality of life just like other parts of the country, a point that needs to be noted is that if the Cost of Production (COP) becomes greater than the Net Sales Average (NSA), the industry becomes non-viable like what has happened today” (Table 1).



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One year later in ‘SL’s tea industry needs market-driven policies’ quote, “From the weekend reports we saw in the media, it’s very clear that the industry is in a catch 22 situation with the recent wage increase. The wage rate has catapulted from LKR 290 five years back to LKR 620 as at 2013, which is an increase of 114%, but the net sales prices from the auctions reveal that in 2008 the average was at LKR 310 per kg and today the prices are at around LKR 400, which reflects only a 29% increase. This indicates the supply chain and demand generation tipping point that the industry has come to. It also reflects the poor quality policy-making that is totally outside the grain of competitiveness of an industry.

(Repeating) Whilst some can say that the workers in a tea plantation must be remunerated as per the increasing quality of life just like other parts of the country, a point that needs to be noted is that if the Cost of Produc-



China  
Tree in bearing, app. 50 years old  
Courtesy - Dr. Z. Cai



App. 20 years old - 2nd flowering in 2013  
National Botanical Garden, Peradeniya  
Sri Lanka



**Table 3: Comparison of Annual Results of Well and Poor Performed Estates**

Year	Daily wage (LKR)	Well-performed Estate (233 ha)		Poor-performed Estate (231 ha)	
		Yield (kg ha <sup>-1</sup> )	Profit (LKR)	Yield (kg ha <sup>-1</sup> )	Profit (LKR)
		2000	136.00	2254	12,820,711
2001	165.15	2261	15,189,714	1255	3,230,724
2002	165.15	2010	7,323,306	1288	1,243,120
2003	200.45	2145	106,606	1181	1,141,023
2004	200.25	1581	62,860	1242	3,529,976
2005	285.50	1868	1,899,307	1351	912,237
2006	285.50	2036	2,783,476	998	3,816,323
2007	320.00	2117	1,003,521	1151	3,938,233
2008	320.00	2228	34,684,211	1107	10,009,919
2009	447.75	2287	14,459,992	1189	7,127,679
2010	447.75	2386	58,562,461	1264	140,953
2011	572.00	2281	47,529,014	1311	40,612,354
Avg. yield		2121		1217	
Avg. profit yr <sup>-1</sup>		16,368,764		3,622,410	
Avg. profit yr <sup>-1</sup> ha <sup>-1</sup>		70,026		15,681	

tion (COP) becomes greater than the Net Sales Average (NSA), the industry becomes nonviable and this can lead to the collapse of the total industry”.

With regard to productivity, to quote, “One of the key issues was to manage the supply chain issue of the increasing COP, to increase productivity. However, a point to note is that productivity in the corporate sector of the Sri Lankan tea industry is mainly dependent on the yields it could generate. The yields of this segment of business have dropped from the year 2000 from 1502 kg ha<sup>-1</sup> to 1323 kg ha<sup>-1</sup> in 2007. Research revealed that one of the reasons for the declining productivity is due to the senility of the tea stock in the corporate tea sector”.<sup>3</sup> “The Tea Research Institute (TRI) stated that the current volume of approximately 126 m kg output from the RPCs

will decline to 98 m kg of tea within the next five years as the tea in the RPCs are at senile stage and yield is declining rapidly. The loss to the country in volume terms will be 28 m kg of tea per annum and in value it will be 92 million dollars while in rupees it will be a colossal Rs. 9.9 billion”.<sup>3</sup>

With regard to the small-holder growers to quote, “In the recent past we have seen the small-holder sector also reporting the same trend. From a volume of 240 million kilograms of tea that the small holder sector had produced around three years back, it dropped to 210 million kilograms and last year it has reported only 188 million kilograms of tea, with the core reason once again being the ageing tea stock”.<sup>3</sup>

**Table 4: Elpitiya Plantations Plc – Comparison of Extents**

Crop	2007/08 (%)	2012/13 (%)	Inc./Dec.	% Increase	% Decrease
Tea	2,669 (30)	2,590 (29)	79	–	2.96
Rubber	1,449 (16)	1,410 (16)	39	–	2.69
Oil Palm	793 (9)	1,209 (14)	416	52.46	–
Others	920 (11)	969 (11)	49	5.32	–
Uncultivated	3,014 (34)	2,660 (30)	354	–	11.74
Total	8,845 (100)	8,838 (1000)	7	–	0.08





**Unopened, opened and pollinated flowers.**  
**October, 2013**  
**National Botanical Garden, Peradeniya,**  
**Sri Lanka**



**Pentadesma butyracea - Small plantation**  
**established in November, 2009.**  
**Wet zone - Sri Lanka**

In his keynote address at the 225th Experiment and Extension Forum – Corporate Sector, the Director of the TRI has identified the major issues in the Tea Industry and given priority to the high COP which cannot negate the existing NSA and high cost component on workers due to wage hikes and other social costs.<sup>5</sup>

“Strategic Cost Management for Profitability of Tea Plantations” in identifying strategies required for improving profitability of tea estates states that the COP in Sri Lanka tea sector has increased dramatically over its competitors, making the tea industry less profitable, the producer margins continuing to shrink due to escalating costs, Estates facing a threat of the fast declining labour force and stagnate or declining productivity and land labour ratio decreasing mainly due to the decline of the labour force.<sup>6</sup>

“Wage hike dampens Ceylon Tea cup”<sup>7</sup> states that the Planters’ Association of Ceylon (PA) deliberating on the issue has noted that the 18% hike from April 2013 to March 2015 in the estate workers’ basic daily wage would negatively impact the tea industry if industry

stakeholders do not rally and brainstorm for possible solutions. The key challenge confronted by those in the industry is the increase in COP of which 68% is recorded as labour cost. If the Tea industry is adversely affected, close to two million dependents are also due to be adversely affected. The PA has suggested the increase of productivity of workers with an increase of around 2–3 kg on intake (average green leaf plucked) which according to a general consensus could help offset the Rs. 40/- increase in COP as with the increase in wages the COP is expected to increase from Rs. 390/- to Rs. 430/.

The fact that the TPI is non-viable is accepted by experts in the industry. Though many reasons are responsible for this situation, the “Once in two year” wage increase is put forward as the main contributory factor. To overcome this obstacle, the industry wants the productivity of labour involved in plucking the green leaf increased to quote, “An increase of around two to three kilos on intake of green leaf” to reduce the cost of production to the original level.

**Table 5: Elpitiya Plantations Plc – Annual Results**

Year ending	2011/12	2012/13	Increase	% Increase
Revenue	2,512,971,592	2,833,456,187	320,484,595	12.75
Other income	131,926,851	226,835,580	94,908,729	71.94
Pbt	148,200,740	495,593,577	347,392,837	234.40
Pat	150,083,550	451,411,291	301,327,741	200.77





**Pentadesma butyracea - Small plantation established in November, 2009  
Wet zone - Sri Lanka**



**Pentadesma butyracea - Small plantation established in November, 2009.  
Wet zone Sri Lanka**

**Results**

The annual production of “Ceylon Tea” (CT) is mostly for the export market. The demand for either Tea or CT is known to be finite. World production can be increased by growing Tea a perennial crop, in new lands for the improvement of livelihoods of small-holder growers (SHG) just as they in SL have benefited and now produce ~75% of the annual production. New areas are planned to be planted with Tea, e.g. 18,000 ha in Rwanda.<sup>8</sup> Increasing the tea production in the world will not be beneficial to the TPI and Kenya, which depend on the export of most of its annual production. With increasing costs and decreasing yields, the situation may be worse for the TPI in the future. If the demand for CT is finite, what is the annual production and average yields the TPI should aim for? Is it an annual production of 350 m kg? In the past it has been noticed that unfavourable climatic conditions and or labour unrest in the main tea-producing countries resulted in high prices for the produce and *vice versa*. Unless it is possible to increase the demand for CT,

increasing the supply to more than 350 m kg may depress prices without a substantial decrease in the cost of production. An annual production of 350 m kg on a yield of 2,250 kg ha<sup>-1</sup>, compared to a yield of ~2,500 kg ha<sup>-1</sup> in Kenya, the extent of land required to produce it will be ~155,000 ha. This indicates an excess of ~67,000 ha of land that is not needed to produce the supply to meet the demand for CT if the TPI becomes a viable industry.

While it is agreed that if the COP is greater than the NSA, the industry will become non-viable, it is also very important to consider the reasons for the increase in the COP. The graph (Table 2) gives a better understanding of the non-viability with additional data of yield, wages and net profit taken from the same sources as for Table 1.<sup>3</sup>

No doubt, higher wages will increase the COP but, is it the most important reason for the increasing COP in the TPI and/or the decrease in net profits leading to non-viability? The wages have increased once in two years. When during two consecutive years the wages have remained the same, increased yields (except in

**Table 6: Elpitiya Plantations Plc – Comparison of Revenue from Individual Sectors**

Crop	20011/12 (%)	2012/13 (%)	Increase	Decrease	%
Tea	1,737,471,929 (65)	2,174,098,272 (71)	436,626,343	–	25.12
Rubber	473,239,267 (18)	333,557,032 (12)	–	139,682,235	29.51
Oil Palm	263,868,658 (10)	322,161,486 (10)	58,292,828	–	22.09
Other produce	38,391,738 (2)	3,639,398 (1)	–	34,752,340	90.52
Other income	131,926,851 (5)	226,835,580 (7)	94,908,729	–	71.94
Total	2,644,898,443 (100)	3,060,291,767 (100)	415,393,324	–	15.70



**Table 7: Comparison of Revenue and Profit from Individual Crops**

Crop	20011/12		2012/13	
	Revenue (%)	P/L (%)	Revenue (%)	P/L (%)
Tea	1,737,471,929 (69)	88,214,025 (27)	2,174,098,272 (76)	345,926,398 (54)
Rubber	473,239,267 (19)	221,605,433 (68)	333,557,032 (12)	98,187,140 (15)
Oil Palm	263,868,658 (10)	155,639,529 (48)	322,161,486 (11)	192,535,535 (30)
Other	38,391,738 (2)	37,902,353 (11)	3,639,398 (1)	1,362,784 (2)
Total	2,512,971,592 (100)	326,933,290 (100)	2,833,456,188 (99.1)	638,011,857 (99.2)

2005/2006), NSA and COP, the net profit has decreased except in 2003/2004. The “once in two year” increase in wages does not appear to be the main reason for the non-viability of the TPI? What then is the main reason for its non-viability? The clue to the answer of this vital question is given in “Plantation sector statistical pocket book, MPI”;<sup>6</sup> “there is a strong negative correlation between productivity and cost of production in tea sector”.

### Wages, Cost of Production and Productivity

Comparison of data published by the TRI of a well performed (WPE) and Poor performed estate (PPE) adapted to indicate the importance of yield or the productivity of land and the COP in the viability or non-viability of a Tea plantation are shown in Table 3.<sup>6</sup>

Over a period of 12 years, the WPE and PPE have averaged a yield of 2,121 and 1,217 kg ha<sup>-1</sup>, respectively. During this same period, the wages have increased from LKR 136.00 to LKR 572.00 an increase of 320%. The net profits/losses of the two plantations indicate that despite the increase in wages, higher profits in WPE have

been due to the high yield and selling price. The losses in PPE have been due to the low yield or the low productivity of the land, despite possibly receiving similar prices. The prices received by the two plantations were, however, not provided in the report. A pertinent question is why were scarce resources wasted on the management of PPE for producing an export-oriented product at a loss?

Even if it is possible to reduce the COP by increasing the intake of green leaf by 2–3 kg, what will the situation be when the wage increases are granted in 2015, 2017 and so on? Can only the workers employed in harvesting the Tea leaves, the majority being women including those who are pregnant, continue to increase their productivity to reduce the COP to overcome increases in wages?

Does the data in Table 3 indicate where the Catch 22 is? It is mainly in the yield or productivity of land and not wholly in the increase in wages. If it is accepted that the non-viability is due to the low yields per ha or the low productivity of land, how can this be overcome? Productivity of land is the output per unit area. This can be increased in two ways. (a) By increasing the output



**Pentadesma butyracea - small plantation established in November, 2009.**  
Wet zone - Sri Lanka



Pentadesma butyracea - The fruit

Peeled fruit



Fresh fruit, steamed, blended and frozen

Pieces of sun-dried fruit





**Seychelles**  
Seedling from  
decaying fruit  
Courtesy Mr. Simmane



**Sri Lanka**  
Regeneration from lateral  
root



**Togo**  
Regeneration from felled  
mature tree  
Courtesy Dr. Atsu Guelly

per unit area or (b) By producing the same or increased output from a reduced area. Fortunately, both these practices can be adopted on a Tea plantation.

As stated and recommended by the TRI and others, the increase of the productivity of land under Tea can be achieved by:

1. Foremost, replanting with high yielding cultivars, improved management with the required inputs such as fertilizer, moisture and soil conservation, pest and disease control, mechanization, improvement of post-harvest and processing technology, etc.<sup>5</sup>
2. Application of biochar,<sup>9</sup> irrigation<sup>10</sup> and diversification<sup>6</sup>
3. Diversification can be carried out with species to produce fuelwood, timber, fruits, spices, oil palm, etc. taking into account the limiting factors, especially the availability of financial resources and labour and the market for the produce.

The TRI is able to produce high yielding cultivars and provides advice on the required improvements as a result of extensive on-going research or what has already been carried out.<sup>5</sup> The main benefits of the application of biochar and irrigation can be achieved by further increase of yields of existing high yielding Tea. They have to be considered taking into account the costs and practical implications of doing so. The benefit of increasing yields is subject to the supply and demand for CT. This leaves the diversification to improve productivity and here too, the cost of diversification, availability of labour, market for the produce, benefits to the environment and all stakeholders have to be taken into account.

There is an extent of land presently under Tea that is not needed for the production of the expected supply for CT. This may be ~67,000 ha. The larger extent is in the corporate sector and to a lesser extent in small holdings and lands owned by other private individuals. This extent can be termed the Uneconomical Tea (UT). The major concern is in the plantations managed by Regional Plantation Companies (RPCs) and those under the management of the State Plantations Corporation (SPC). It is known that the RPCs and the SPC either do not have adequate funds to initiate the required replanting programme or do not wish to embark on it taking into account the return on investment. The present condition of UT will deteriorate further from degradation. The availability of workers will also get reduced in the years ahead. Innovative ways of reducing the COP by handing over the maintenance of lands under Tea to workers on a contract basis will be beneficial, but will not be a solution to the large extent of UT, the main problem of the TPI.

What then is the solution to overcome the non-viability of the TPI?

It is known that Tea was established for the deforestation of natural forests, and the adverse effects of which are well known and need not be repeated here. One very good solution therefore is to “reforest” the UT. At a time when funds are in short supply for long-term investments the necessity to obtain returns as quickly as possible is also essential. Is diversifying with forestry species to supply fuelwood and timber the best option? The diversification with fruit, spices, oil palm and rubber will need far more financial resources and labour than fuelwood and timber species, but will give faster returns. Will any



of these species be a permanent or a long-term “Reforestation” activity to counter-act the adverse effects of climate change and reducing the continued degradation of the large extent of UT?

### Results from Diversification –Elpitiyaplantations Plc

Elpitiya Plantations PLC (EP), one of the SL Regional Plantation Companies has achieved the highest ever PAT of LKR 451 m in 2012/13.<sup>11</sup> The previous highest PAT of LKR 363 m was in 2010/11 and the average PAT during the previous 9 years was LKR 82 m. An analysis was carried out to find out the reasons for the highest ever PAT in 2012/13 and they are based on the data available in the annual reports.

#### Extent

Table 4 gives a comparison of extents under the different crops in 2007/08 and 2012/13. During the 6 years under review, the extents under Tea, Rubber and uncultivated land have decreased, and the extent under Oil Palm and other crops have increased, indicating the diversification of ~5.25% of the total extent. In 2012/13, Tea occupies the highest or 29% of cultivated land.

#### Results of Company

Table 5 compares the revenue, other income, PBT and PAT in the two consecutive years of 2011/12 and 2012/13. While the increase in revenue from crops has been 12.75% in 2012/13, an increase of 200.77% in the PAT in 2012/13 has been achieved by the increase of

71.94% from other sources of income such as the profits from diversifications, joint ventures and other gains.

#### Revenue from Individual Crops

Table 6 indicates that EP is dependent on Tea to contribute 65–71% of the annual revenue income.

#### Comparison of Revenue and Profit from Crops

Table 7 compares the revenue and profit or loss from the different crops in the two consecutive years, 2011/12 and 2012/13. Despite the high % of revenue from Tea, its contribution to the end of the year profit is much less significant unless the NSA is high. In 2011/12 Tea sector has been at a loss. Rubber, Oil Palm and other crops have given a higher % of the profits on a lower % of revenue.

To quote from the Chairman’s statement:

1. “The company embarked on a strategy of diversifying its resource base several years ago, and I am pleased to state that this strategy has now started giving us the results that was expected.”
2. “Cost of production particularly of Tea, continues to be the key concern facing the Tea industry. The new wage structure that was negotiated effective from 1st April 2013 has raised the cost of production of Tea far higher than our international competitors, placing the viability of the Tea Estates at risk.”
3. “Investment in future Tea replanting, which is already yielding low returns, is bound to be under further pressure in future financial years as plantations will tend to shy away from investment into tea replanting due to the negative returns.”

**Table 8: Pentadesma Fat – Specifications**

Physical and Chemical Characteristics		Fatty Acid Composition	
Fat content of seed	50.0	Myristic	Nil
Ash content	2.1	Palmitic	3.1
Melting point (complete fusion)	39.0–39.5	Palmitoleic	0.2
Slip point (0C)	37.5–38.2	Stearic	45.5
Iodine number	47.3	Oleic	50.5
Iodine number	8.3	Linoleic	0.4
Free fatty acids (oleic)	4.2	Linolenic	Nil
Saponification number	188.0–194.0	Degree of unsaturation	0.51
Unsaponifiable matter (%)	1.5–1.8		0.51
Solidification point (0C)	27.0–28.6		
Adomako	–	Ghana	1976



If the COP of Tea is the main concern, replanting is expected to yield low returns, and diversification of any form has paid good dividends, the logical next step is to seriously consider the best options for diversifying and improving productivity of the UT instead of wasting limited resources on maintaining them at a loss. Though the annual revenue will be reduced, continued diversification of the UT will improve the annual net profits, making the RPC less dependent on Tea and workers who are in any case leaving the plantations for more lucrative employment.

As can be observed, it is not a case of whether to diversify or not, but how best to diversify the UT which is an impediment for the TPI to be a viable industry once again.

### Introduction to *Pentadesma butyracea*

The natural stands of this species exist in the forests in several countries in the tropical West African region. It is an evergreen and perennial tree crop, medium-to-large-sized tree that will grow to a height of ~30 m. This tree will be productive for well over a century and will produce one or more crops of fruits depending on the distribution of the rainfall. It is only in Benin some attention has been given to this species and the fat. The oil extracted from the seeds is a substitute for cocoa butter, and the fruit is edible. Research studies have been carried out by several Lipid Scientists in the EU, and the demand for this vegetable fat will be from the cosmetic, food and confectionery industries if it is produced in a sustainable manner.

This species is best suited in tropical and sub-tropical regions where the rainfall is sufficiently high for good growth. An annual rainfall >3,000 mm may be necessary unless the distribution ensures the availability of adequate moisture and in soils where its retention is high. It should be established in open land for the proper growth as a well spread out tree. In Benin it has been noticed that this species will grow successfully along streams even with an annual rainfall of 1,000 mm. Introduced to Seychelles, Singapore, Sri Lanka and China, the species is growing successfully, even though it has not been established on a scale to properly observe the best conditions for good growth and high yields.

Introduced to Seychelles over a century ago, it is reported to be "invasive". This situation is merely due to the good climatic conditions prevailing in the country for natural establishment and the fact that not a single fruit or seed is picked up or collected for any useful purpose. It has been reported that several thousands of trees in bear-

ing, some >100-years old exist in the two main Islands (Personal communication from a Swiss Biologist).

The small plantation, possibly the only one that can be seen anywhere, was established in Sri Lanka in November 2009 on Hunuwella Estate, Kahawatta. The immature trees have reached a height of 8–12 feet in 3 years and 9 months and expected to reach maturity within the next one year or two. Subject to climatic conditions, pepper may be grown on this tree if the growth of the vine is limited to a height of 8 ft to facilitate harvesting.

### *Pentadesma fat*

The specifications are shown in Table 8.<sup>12</sup> This analysis is probably the first one published and the data has been verified many years later in Benin.

*Pentadesma fat* produces a good yield of solid fat rich in C-18 acids (stearic and oleic). The oil is of interest in that it contains only very low levels of palmitic and linoleic acids. This should make it oxidatively stable (low linolenic) and nutritionally useful (low palmitic, high C-18). It is of interest for confectionery fats. At a time when it is necessary to avoid partial hydrogenation which produces undesirable trans-fatty acids, there is an interest in solid fats for use as hardstock in spreads and the presence of stearic acid rather than palmitic acid could be an advantage (adapted from a personal communication from a UK-based Lipid Scientist).

To quote, "The U.S. Food and Drug Administration just announced its preliminary determination that partially hydrogenated oil is no longer generally recognized as safe for use in food. The move paves the way for a ban, or at the very least, strict limits on the fake fats, which are the primary source of artificial trans fats in the diet. Artificial trans fats are formed when food makers turn liquid oils into solid fats in a process called "hydrogenation". Hydrogenation will increase a food's shelf life, but the science shows it also pumps the body full of artery-clogging fat".<sup>13</sup>

The demand for the fat will be from the cosmetic, food and confectionery industries, initially from major vegetable oils and fats refiners in the EU. This fat is suitable for the production of biodiesel for warm climates. If the stearin is fractionated for the food industries, the olein can be converted to biodiesel for any climate. Though biodiesel has not been produced with this fat, producers in the USA and South Korea, after studying the specifications and other information provided will consider using this fat as a feedstock if adequate volumes are available for the purpose.



### **Fruit**

The mature fruit is self-harvesting and can be collected daily. It is edible, but there is no interest whatsoever on using it for any purpose. In Benin, where the extraction of the oil from the seeds is carried out, the collected fruits are heaped and allowed to decay for the easier removal of the seeds. This is not necessary. If the freshly fallen fruit is peeled, the fruit (Mesocarp) can be steamed, put in a blender and kept un-spoilt if refrigerated. This product is sour but, when sweetened, it has a palatable and distinct flavour. The ripe fruit is reported to be sweet though I am unable to confirm it. The fruit can also be sun-dried and stored at ambient temperature. The weight of the mesocarp and fresh seed are ~45% and 20% of the weight of the fresh fruit, respectively.

### **Species Determined to Survive**

The pictures show (1) Seedling from decaying fruit; (2) Regeneration from root; (3) Tree cut down for timber showing signs of re-growth indicate its determination to survive. No one is aware how long this species has survived in the forests in tropical West African Region. Introduced to Seychelles, Singapore, Sri Lanka and China, it is growing successfully though still obscure where the natural stands are. One year ago, it was planted in Colombia (SA) with seeds taken from SL and showing signs of successful growth. It is necessary to undertake further investigations to realize its inherent potential with a similar determination as the species itself is showing in order to survive.

### **Discussion**

The TPI is non-viable and the main reason is due to the low productivity of a substantial extent of land under Tea. Diversification appears to be the only solution to overcome this serious problem, and it has to be a low-cost operation, beneficial to the environment and all stakeholders, not be labour-intensive and produce an export-oriented commodity with a good demand. Success of any form of diversification are supported by the successful results already obtained by Elpitiya Plantation PLC in 2012/13.

UT can be diversified with *Pentadesma* without uprooting the existing Tea. The density of planting will be a maximum of 400 per ha with seedlings that can be very conveniently raised at a low cost. Mature fresh seeds will germinate almost 100%. After this species has been established in the UT, the harvesting of the green leaf can be continued for at least 10 years, keeping the expendi-

ture low on its maintenance. *Pentadesma* is expected to reach maturity in 4–5 years, subject to climatic conditions and growth. The fruits should be collected fresh for maximum utilization. The thinning out of the excess or interfering trees can be started in 12–15 years after planting.

While *Pentadesma* has not been grown on a commercial scale and therefore several important agronomic practices have never been studied or observed, the successful and easy establishment, high productivity, the demand for the oil/ fat, its potential to improve the livelihoods of the small-holder grower can be seen where the natural and introduced stands exist and have been for well over a century. Accurate information of yield is not available. However, based on the observations in Sri Lanka, in about 8 years after planting, a yield of ~50–60 fruits, with an average of 3 seeds per fruit can be obtained from a single crop and tree. Depending on the distribution of the rainfall, the trees will give more than one crop annually. An approximate forecast of yield and revenue are given in Table 9.

In Benin, women extract 30% of the oil using traditional methods. In a local laboratory, 43–45% was extracted with solvents. The extraction can vary between 47–67%, depending on the efficiency of extraction. This is unpublished information from Professor Vijai Shukla ([www.ifsc.dk](http://www.ifsc.dk)) whom I understand has carried out extensive research on the species and the fat. The extraction was also carried out using locally available fairly simple technology. In Benin where ~70 mt of *Pentadesma* butter is produced annually, using primitive methods of extraction, studies to improve the efficiency of extraction have been started.

*Pentadesma* being a perennial tree crop that needs little attention, the cost of production will be low after it has been initially established. The annual expenditure on management will be less than for Coconut, considered the “Lazy man’s crop”. The cost of replanting one ha of Tea has been reported to be at least LKR 3 m.<sup>4</sup> With a similar amount it should be possible to diversify 10–12 ha of UT with *Pentadesma* up to maturity. The opportunity cost of diversifying with *Pentadesma*, rather than foregoing a profitable alternative will ensure the reduction of waste of limited resources on maintaining the UT at a loss, to produce an export-oriented commodity.

### **Pentadesma up to Maturity**

The opportunity cost of diversifying with *Pentadesma*, rather than foregoing a profitable alternative will ensure the reduction of waste of limited resources on maintain-



**Table 9: Revenue per Hectare**

	Unit	Comment – 8 years after planting
Trees in bearing	325	Out of 400 trees per ha.
Fruits per tree per crop	50	Subject to rainfall two crops are possible.
Seeds per tree per crop	150 kg	Fresh weight – 3 kg
Dry wt. of seeds	1.5 kg	50% of fresh weight.
Production of oil per tree	0.6 kg	40% of dry weight.
Total production of oil	195 kg	$325 \times 1.5 \times 40\%$
Revenue	US \$ 487	$195 \times 2.5$ ₹ 63,310
Fruits per ha	₹ 16,250	$325 \times 50$
App. weight of fruits	4,062 kg	$250 \text{ g} \times ₹ 16,250$
App. weight of mesocarp	1,828 kg	45% of fresh fruit.
Revenue – nominal	₹ 35,560	@ LKR 20/ per kg ₹ 36,560
Total revenue per ha	LKR	₹ 99,870
Total revenue per ha	US \$ 768	

ing the UT at a loss, to produce an export oriented commodity.

In Sri Lanka, diversifying the UT will provide opportunities to “Increase Exports and Reduce Imports” with the following commodities and value-added products.

1. Exports – Vegetable fat, cocoa butter equivalent, value-added cosmetics, vs. fat for production of biodiesel and possibly processed fruit.
2. Import substitutes – Vegetable fat spread and biodiesel for warm or any climate.
3. Local use – Nutritious vegetable oil/ fat, fresh or dehydrated fruit and compost from the refuse after the extraction of the oil.
4. Ultimately this tree will provide large volumes of good quality timber having reduced CO<sub>2</sub> in the environment for well over a century.

Diversifying with this species offers an implementable solution to the TPI to overcome its present non-viability. The reclusive James Taylor “Saved the day” for the colonial economy and to the then Planter’s Association in Ceylon almost 150 years ago by growing *Camellia sinensis* on the margins of divisional roads. Compared to the information Taylor possessed on the growing of *C. sinensis* and producing the end-product, then much more research and investigations have been carried out with the species, *Pentadesma butyracea*, and the vegetable oil/ fat that need not clog the arteries of the consumers of food produced with this oil. The TPI was once known as the “Goose that laid the golden egg” and now called the “Lame or dying duck” by two reputed former directors of TRI.<sup>14-16</sup> EP has proved that with any form of diversi-

fication improved results can be achieved. I am confident that the common sense solution for the TPI to once again be a viable and a vibrant industry is to discontinue “Putting all the eggs in the same basket” to avoid the doomsday prophecy of, to quote, “.... leading to the collapse of the total industry”.<sup>4</sup>

Additional comments and suggestions by experts closely involved with the industry on the non-viability and ways of overcoming it can be referred to from references given below.

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