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PROPOSALS FOR THE DIVERSIFICATION OF AGRICULTURE ON TEA PLANTATIONS

2 - FUEL AND TIMBER RESOURCES

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The present position on the use of timber/fuel/energy on tea plantations is reviewed. The sources are discussed and a programme for the establishment of timber/fuel resources within tea plantations is presented, together with a list of priorities for the establishment of these resources.

1. INTRODUCTION

It was explained in the first article in this series (de Silva, 1978; 1979) that the prospects for the success of diversification of the agriculture on tea plantations are dependent on the availability of land suitable for the new species we may introduce. This approach was preferred to that of attempting to grow large numbers of crops on land often unsuited to them. It was pointed out that crops growing on unsuitable land turned out to be unprofitable. This is the position with much land presently planted in tea where tea has failed because the land used for planting tea was totally unsuited to tea.

The tea industry needs a large quantity of timber/fuelwood for consumption within tea plantations. It is envisaged that ultimately these needs can largely be satisfied from within tea plantations themselves. The problem has become serious and urgent in the context of the high cost of petroleum products and the severe demands on national timber/fuel/energy resources. It is the purpose of this preliminary article to suggest an immediate course of action so that tea plantations can consolidate and develop their own timber/fuelwood resources in order to achieve self-sufficiency at least within a couple of decades.

An aerial survey of the land under forest vegetation in Sri Lanka was conducted in 1956. This revealed that about 2,900,000 ha of land were devoted to forest vegetation. A subsequent estimate carried out in 1970 revealed that this area had diminished to 2,475,000 ha. At present it is estimated that this area has diminished even further. In 1956, the wet zone, including the montane zone, had 250,000 ha under forest which diminished to 225,500 ha in 1970(Forestry Development Plan, 1970). This area is even less at present. It is quite apparent that Sri Lanka's forest resources are dwindling and that immediate action is necessary on a substantial scale to preserve, consolidate and develop further, our national forest resources.

The Tea Research Institute of Sri Lanka wished to draw the attention of the Tea Industry to this situation and requested the then Head of the Forest Department, who was also the Chairman of the State Timber Corporation, to discuss this subject with the members of the tea industry (Perera, 1977 a;b). Our attention has been drawn to the fact that except for two or three forest reserves in the wet zone and also those in a few inaccessible areas, forests in both the wet and dry zones have

been repeatedly harvested during the last 40 years to meet the country's timber requirements. The tea industry is a major consumer of timber for constructional work, for tea chest panels, tea chest battens and for factory and domestic fuel. It is necessary to examine the contribution of the tea industry not only towards the provision of foreign exchange earnings towards the country's exchequer by the export of tea but also to determine to what extent the tea industry can be self-sufficient or better, in terms of enhancing the country's energy resources. It would appear that very little attention has been paid to this aspect of the tea industry in the past. The reason for this is that attention was paid merely to tea production and the generating of foreign exchange, but not to the inputs required by the industry. Today, as everybody is aware, fuel is one of the world's most expensive commodities not only because the price of petroleum products is so high but also because consumption of fuel and fuelwood is taking place on a massive scale particularly in countries which do not have their own resources of petroleum. Sri Lanka need not necessarily be in a hurry to exploit whatever petroleum resources she may have. These resources are, after all, finite. There is plenty of potential however for developing the fuel resources available from trees if sufficient attention is paid to it. These resources, unlike petroleum resources, are renewable. The purpose of this article is to review the position as far as tea plantations are concerned and to discuss to what extent the tea industry can benefit from a programme of fuelwood/timber production to achieve self-sufficiency within the industry, and if possible to supplement national resources.

2. SOURCES OF TIMBER/FUEL/ENERGY

There are three sources of timber/fuel/energy available for tea plantations. These can be conveniently grouped into:

2.1 Natural resources
2.2 National resources
2.3 Plantation resources

2.1 Natural Resources

The primordial source of all energy including petroleum and fossil fuels like coal, is the sun. Solar energy is being used directly in certain countries quite successfully for domestic purposes. This is of course expensive from the point of view of capital outlay, and this subject and that of energy derived from nuclear sources are excluded from the scope of this article. Biogas is another natural resource which is available but which is under exploited. Perhaps the economics of biogas production needs more scrutiny. This subject will also not be considered in this article.

2.2 National resources

2.2.1 *Natural jungles*

Natural jungles whether they be primary, like the virgin montane forests of the high country and the virgin tropical rain forests (*eg* Sinharaja) of the low country, or whether they be secondary like the dry zone forests, have been built up over several centuries and constitute a climax vegetation over fairly extensive areas. These jungles have a multiplicity of species many of which are sub-optimal as sources of timber (Perera 1977, a;b) but they are being continuously exploited.

It is a common sight to witness the degradation of these natural jungles. They are, however, not able to supply as much good timber as planted forests. The importance of natural jungles apart from their ability to yield fuel/timber, is that they contain a lot of genetic material which may possibly be extremely useful in the future as a gene pool in breeding programmes designed for specific purposes.

2.2.2 *Forest plantations*

The major sources of timber/fuel/energy for Sri Lanka in the future will be forest plantations. They are also the most productive sources of timber. In the high country they consist of *Eucalyptus* spp., *Pinus* spp., *Cupressus* spp. *etc.* At low elevations the major forest plantations consist of *Tectopia grandis* (Teak), *Swietenia macrophylla* (Mahogany), *Alstonia macrophylla* (Havari Nuga) *etc.* These are the most efficient sources we have for the supply of timber and fuelwood. It is envisaged (Perera, 1977 b) that in about 10-20 years the major sources of structural and furniture timber in Sri Lanka will be the teak plantations in the 'dry' zone.

2.2.3 *Crop plantations other than tea*

Rubber plantations provide a large quantity of timber/fuel. When old rubber is replaced by budded rubber. Much of the wood from the uprooted rubber finds its way into tea plantations for use in tea factories.

2.2.4 *Industrial Waste*

Industrial wastes from the fibre industry and other industries produce small quantities of fuel which at present may be under-exploited. This subject is excluded from the scope of the present article.

2.2.5 *Petroleum products*

Petroleum products are imported and expensive.

2.2.6 *Fossil fuels*

The price of fossil fuels can be expected to rise sharply in the future, as petroleum prices rise.

2.2.7 *Electrical power from the national grid*

Electricity is generated from hydro-power schemes and is relatively inexpensive, although capital costs are extremely high.

2.3 Plantation resources

It is perhaps not generally realized that tea plantations already have substantial timber/fuel/energy resources. The potential for the development of these resources appears to be promising. Sufficient emphasis was not placed on the development of these resources over the years as petroleum products were available for several decades at very low cost. With the increase in the cost of petroleum products the industry was caught unawares and had very little time to consider developing their own resources. This has now become an absolute necessity. Some degree of complacency still prevails at present because the high cost not only of petroleum products but also of timber/fuel is absorbed in the industry's present state of profitability. This has resulted in the development of timber/fuelwood resources being postponed or neglected, but it is not a situation which is likely to last long.

Many tea plantations obtain their fuelwood through contractors at competitive rates. As supplies of fuelwood always seem to be forthcoming, the source of fuelwood to estates is not often considered seriously, partly because the estates can perhaps afford to pay the price that a contractor would demand. When oil prices first rose steeply most estates converted their oil-fired tea drying machines to work on fuelwood. This conversion was encouraged by the availability of fuelwood from 'coups' from natural jungles particularly at high elevations. Under the fuel coup scheme virgin jungles or secondary jungles were made available to tea plantations which completely denuded the forest vegetation to obtain their supplies of fuelwood from these coups. It was agreed that estates would be responsible for replanting the fuel coups with forest species when the exploitation of the natural timber/fuelwood was complete. Occasionally such agreements were not honoured, possibly because insufficient emphasis was paid to the importance of timber/fuel/energy resources.

When contractors were employed to provide timber/fuelwood to plantations, the estates hardly concerned themselves as to the origin of the contracted wood. The question is, where did this timber come from? It would be correct to say that much of it came from rubber plantations, natural jungles and forest plantations; some of it, perhaps, illegally. If this situation still prevails, it cannot be allowed to continue any longer. It is therefore vitally necessary that fuel, which is an essential raw material for tea production not only for withering and drying tea but also for the domestic needs of workers in tea plantations, be generated *within* tea plantations or regions wherever possible. The question of how this can be achieved is discussed below. The seriousness of the situation is such that we must do all we can to avoid finding ourselves in the ludicrous position of having tea plantations which cannot produce tea because we are unable to wither and dry the produce. Action must, therefore, be taken now.

Plantations have the following resources available to them.

2.3.1 *Fuel tree plantations on land not devoted to tea*

2.3.2 *Tea and shade trees uprooted for replanting tea land under the Tea Replanting Subsidy Scheme*

2.3.3 *Tea prunings*

2.3.4 *Fuelwood from windbelt trees*

2.3.5 *Fuelwood from shade trees in tea fields*

2.3.6 *Hydropower from small schemes.*

Hydropower was a common feature on several estates a few decades ago but with electricity being supplied from the national grid a few of these schemes were not used or were abandoned.

In the mid 1960's unfortunately large-scale shade tree removal took place on tea plantations which decimated their resources of timber/fuelwood. As a result of the fuel deficiency, uprooted tea and tea prunings were expeditiously swallowed up for the domestic needs of workers on tea plantations. This led to a further depletion not only of the timber/fuel resources but also of the organic matter resources of some tea soils. With the increase in the cost of petroleum

products, the whole question of the timber/fuel/energy resources within tea plantations needs immediate rescrutiny in order to build up these resources to achieve self-sufficiency at some future date. In doing this it is absolutely essential that a programme of priorities be worked out on each and every plantation and by each and every region, if an honest attempt is to be made by the tea industry to be self-sufficient in timber/fuel within a decade.

3. PLANNING ON A REGIONAL BASIS

The advantages of planning the development of fuel resources on a regional basis rather than on a more parochial plantation basis will be readily evident. If each estate is taken as an individual entity for purposes of timber/fuelwood self-sufficiency, then some estates, for example, may devote land good enough for tea, to timber production merely to be self-sufficient. This approach is to be discouraged. On the other hand, another estate may have very much more land available for, and more suited to, fuelwood production in excess of its own needs. If the two estates were taken as one entity then fuel from one estate could supply the other estate which can concentrate on tea production because its land happens to be suitable for tea. This principle can be applied extremely well on a regional basis so that tea production would not be adversely affected, merely because an estate wishes to be self-sufficient in its timber/fuelwood requirements. Flexibility is desirable provided the entire region ultimately achieves self-sufficiency.

Another reason for encouraging the self-sufficiency of regions in their timber/fuelwood requirements is that the cost of handling and transportation of timber/fuelwood over long distances is extremely high. It would be very much cheaper if the wood was available close by, relieving the need for transportation over great distances.

4. PRIORITIES IN THE DEVELOPMENT OF PLANTATION FUEL RESOURCES

In devising a programme for the establishment of fuel resources for tea plantations it is firstly necessary for each individual plantation and each region to work out its annual fuel requirements for tea drying as well as for domestic needs. These requirements must also be forecast for the future. It is convenient to assume that one tree ten years old, can yield 1/2 m^3 of fuelwood. This estimate may be somewhat conservative but out of this quantity can come some domestic fuel from the small branches in addition to stacked fuelwood. The productive estates where the tea is high yielding will naturally require more fuelwood for tea drying than low-yielding estates. Already, tea estates should have a good estimate of their requirements and they could therefore easily calculate how many trees they would need to plant each year if they are to be felled after ten years. Land must be found within each region to plant the required number of trees each year and a rotational scheme of felling must be correctly developed.

It would take at least ten years after planting before the fuelwood becomes available. The longer planting is postponed, the worse the situation would be. The problem would be compounded if the cost of petroleum products continues to increase sharply. At present, however, the tea industry may run at a sufficiently high level of profitability to absorb such an increase, and because of this it is suggested that petroleum products be used until our own fuelwood resources are properly established. We should preserve our trees for a time when we can no longer afford to import petroleum products, or until we have planted enough

trees. A target of ten years should be set, within which we should aim to be self-sufficient. Estate profitability may be adversely affected if we switch to oil at present, but the importance of profitability figures written on a balance sheet is trivial compared with the situation that may develop if we lose what little fuelwood resources we have prematurely without developing fresh resources.

It would be unfortunate if we were to fell trees less than ten years old merely because we are starved of fuelwood particularly on estates which are only marginally profitable at present levels of taxation. It is not in the national interest to allow these estates to keep on consuming valuable fuel resources from elsewhere within Sri Lanka. If the foreign exchange earned by these estates is so important then oil can well be supplied to these estates during the ten-year development period. If the 'profitability' of tea is so low then we may even have to think in terms of macrodiversification (de Silva, 1977) to timber to supply other estates which are able to produce tea on most of their land at a highly productive level.

The use of petroleum products and the postponement of felling trees until they are at least ten years old are placed high in the suggested order of priority in order to preserve what little timber/fuel trees we already have on tea plantations. The use of petroleum products is purely a temporary palliative and it is not to be construed that this is a highly desirable course of action. It is simply inevitable because we have delayed so long in developing our own timber/fuelwood resources. It is perhaps the price we have to pay for complacency in the past and it is certainly not desirable that we continue this practice indefinitely. We can stop using petroleum products only after we have our own timber/fuel plantations. This means that we have to begin a planting programme straight away.

5. TREE-PLANTING PROGRAMME

In planning a planting programme it is firstly necessary to know how many trees each estate requires each year for tea withering and drying as well as for domestic needs. Having determined this number, the extent of land required can be worked out. The land area from which timber/fuelwood can be extracted may be classified into three groups for convenience as follows :

5.1 Land presently unutilized.

5.2 Land earmarked for diversification (largely microdiversification).

5.3 Land on which tea will be retained, additional to which timber/fuelwood trees will be planted.

5.1 Land presently unutilized

In the land classification given in the first paper in this series (Table 1. de Silva, 1979) land classified under 2.1 as steep ill-drained land should be taken up for tree planting first. Next should come, in order of priority, land classified under 2.3.2.2 as flat ill-drained land with seasonal surface water availability and far from houses. Thirdly, land classified under 2.3.1.2 as flat ill-drained land, with, perennial water availability but located far from houses, can be planted. Almost all this land would presently be wasted unless it has timber/fuel trees already planted there.

5.2 Land earmarked for diversification

Land classified under 1.1 as steep and well-drained may or may not be presently planted in tea. If it is earmarked for diversification because of its steepness, this land should be taken up for planting timber/fuel as the fourth in the order of priority.

The fifth in the order of priority is the microdiversification of land classified under 1.2.2 as poor soil on undulating well-drained land. In all probability if tea was planted on this land it would be extremely poor and would justify microdiversification into timber (de Silva, 1979).

5.3 Land earmarked for interplanting tea and trees

Such land can be classified under 1.2.1 as good tea land with good soil on undulating well-drained land. The introduction of trees on to such good tea land purely for the purpose of generating fuel is only to be considered if these lands are windswept and require the planting of belts of trees as windbreaks, or if trees need to be introduced to provide shade and/or other advantages. It is not within the scope of this article to examine the complex topic of interplanting trees for the purpose of shade. According to the scheme of priorities suggested in this article, the planting of wind belts as a source of trees is accorded higher priority than the planting of trees for shade on the grounds that minimizing wind damage is considered more important than the provision of shade *per se*. It will also be noted from this order of priorities that the planting of shade trees in good tea fields merely for the purpose of providing timber is the last of the suggested priorities.

6. SPECIES

Several species of timber/fuel/pulp plants can be accommodated on tea plantations but as the purpose of this article is to draw attention to fuelwood, those yielding pulp, match wood, furniture timber or constructional timber are excluded. It is emphasized that a crash programme for the development of timber/fuel is presently needed and the species to be selected should, therefore, be fast growing. Slower-growing, but perhaps more valuable timbers, can be tried out in a later phase of the programme when tea plantations are well on the way to self-sufficiency in timber/fuelwood requirements. This article, therefore, concentrates on the genus, *Eucalyptus* which is a fast-growing species and which, therefore, serves our purpose.

The Genus *Eucalyptus*

There are about 600 species and varieties of the genus *Eucalyptus*. Most of these species come from Australia but a few have been recorded from south-east Asia. Many species produce extremely good hardwood satisfactory for building construction, railway sleepers, furniture manufacture, newsprint, fibre board and rayon. An essential oil can be extracted from some species for the perfumery industry and tannin can be extracted from the bark of other species. Some species are important as a source of nectar and pollen for bees and others are attractive ornamentals. It has been found that the best species for introduction to tea plantations are *E. grandis* (earlier known as *E. saligna*), also known as the blue gum (but not to be confused with *E. globulus* which is also bluish) and *E. robusta* also known as the red gum. These two species grow on all elevations but do particularly well above 800 m. It is suggested that tea plantations use these two species for planting in appropriate land types, as far as possible, as sources of fuelwood.

E. grandis originates from Australia and can be grown on a short rotation of ten years for use as fuelwood on tea plantations. The timber often splits on felling and is, therefore, not ideally suited for constructional purposes but it is excellent for pulp or as fuel. On a 10 to 15 year rotation it should provide 150–200 m^3 of fuelwood per acre. On long rotation of 35 to 50 years about 150–170 m^3 of timber can be obtained per acre in the log form. The plants could be initially spaced at 3 × 3 metres and later thinned out periodically.

E. robusta also originates from Australia and in addition to its uses as fuelwood and pulp it is suitable for transmission poles, and if grown on long rotation, as a general-purpose timber. Yields are similar to that obtained from *E. grandis*. In addition, there are other species of *Eucalyptus* which grow well but which are not so productive in timber/fuel as *E. grandis* and *E. robusta*. From the point of view of fuelwood production these other species are, therefore, not so highly recommended. However, *E. camaldulensis* has shown some promise on elevations below 1000 m and could be tried out on estates in the mid-and low-country for purposes of comparison with *E. grandis* and *E. robusta*.

The seeds of both *E. grandis* and *E. robusta* are available locally from the Forest Department and may be planted at a spacing of 3 x 3 m. Half a kilogram of seed of E. *grandis* of approximately 33% viability is sufficient for 30 ha (75 acres). At the same spacing and viability 500 g of seed of *E. robusta* is sufficient for about 14 ha (35 acres). For germination the seeds of both species need loamy soil. As the seeds are very small, a heavy soil may form a crust through which the seedlings cannot emerge. The seeds can be sown in seed beds which should be raised 15–20 cm to provide adequate drainage. In order to disperse the seeds evenly on the nursery beds they could be broadcast with an equal quantity of fine clean sand to increase the bulk. The seed bed should be covered with a fine dust of sand or loam to just cover the seeds. Shade is necessary and germination commences 3 to 4 days after sowing. The shade should be gradually reduced as the seedlings start growing. When the seedlings have 2 to 3 pairs of leaves they could be uprooted carefully using a stick and planted in polythene sleeves which contain a suitable loamy soil. Seedlings should be handled by the top leaves and not by the stem. The polythene bag plants should also be shaded. In 4 to 6 months the plants will be 20-30 cm tall and can be planted in the field. Field planting is suggested at a spacing of 3 m x 3 m. Planting holes should be 25 cm in diameter and not less than 50 cm deep with holes half filled with soil at planting.

Within the first year at least two circular weedings would perhaps be necessary depending on the extent of weed growth and at least one weeding and slashing in the next two years till the plants are established. Growth of both species varies greatly with field conditions. Loosening up the soil, for example, greatly enhances the growth rate. *Acacia decurrens* is a suitable second canopy species as it provides fuelwood with a high calorific value.

7. SUMMARY OF PRIORITIES

7.1. Work out the annual fuel requirements of the estate on the basis that one tree provides $\frac{1}{2}$ m^3 of fuelwood on short rotation on a ten year cycle.

7.2 If supplies of fuelwood from the estate are less than the annual requirements do not fell any trees less than 10 years old but use petroleum products for the present.

7.3 Order of priority in planting :

(a) Plant steep ill-drained land.

(b) Plant flat ill-drained land where water availability is seasonal but which is far from houses.

(c) Plant flat ill-drained land where water availability is perennial but which is far from houses.

(d) Microdiversify very steep well-drained land presently planted in tea.

(e) Microdiversify undulating well-drained land where the soil conditions are poor.

(f) Establish wind breaks where appropriate.

(g) Plant shade trees where they are needed most (See TRI Advisory Circular No. O – 1).

The urgency of the need to implement this programme cannot be over-emphasized.

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